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The Global Innovation Index 2017

Innovation Feeding the World

TENTH EDITION

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The Global Innovation Index 2017

Innovation Feeding the World

TENTH EDITION

Soumitra Dutta, Bruno Lanvin, and **Sacha Wunsch-Vincent**
Editors

The Global Innovation Index 2017: Innovation Feeding the World is the result of a collaboration between Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO) as co-publishers, and their Knowledge Partners.

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Suggested citation: Cornell University, INSEAD, and WIPO (2017): *The Global Innovation Index 2017: Innovation Feeding the World,* Ithaca, Fontainebleau, and Geneva.

ISSN 2263-3693
ISBN 979-10-95870-04-3

Printed and bound in Geneva, Switzerland, by the World Intellectual Property Organization (WIPO), and in New Delhi, India, by the Confederation of Indian Industry (CII).

Cover photo courtesy of iStock.com/RomoloTavani.

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Releasing the Global Innovation Index 2017: Innovation Feeding the World

We are pleased to present the Global Innovation Index (GII) 2017 on the theme 'Innovation Feeding the World'.

This year is a particularly noteworthy one for the GII, as it marks the release of the 10th edition of the report. The first edition was produced in 2007 by Soumitra Dutta at INSEAD with the goal of producing a comprehensive broad-based model of innovation that captured its complex nature in both developed and emerging economies. Over the last decade, the GII has gained international recognition, establishing itself as both a leading reference on innovation and a 'tool for action' for decision makers.

Numerous countries have incorporated the GII into their innovation agendas and metrics. Remarkably, in view of the GII, a large number of countries have increased their collection of innovation metrics that conform to international standards; these countries also use the metrics more. These changes are taking place with the cooperation of WIPO and other responsible international organizations—most notably the UNESCO Institute for Statistics—which assist the country in question to resolve issues and increase its data coverage.

Innovation is not limited to the most advanced economies. Innovation is also not limited to the high-technology sectors. Innovation has today become a global phenomenon, affecting all sectors of the economy, including food and agriculture—which are among the most ancient and basic sectors of activity. Feeding the world, while contributing to protecting the environment and providing quality and balanced nutrition to growing populations with different lifestyles and consumption patterns, remains a complex challenge. Innovation has a key role to play in addressing this challenge.

The 2017 edition of the GII is dedicated to the theme of innovation in agriculture and food systems. Agricultural and food-processing sectors continue to face an enormous rise in global demand and increased competition for limited natural resources. Innovation can be key to maintaining the productivity growth required to meet this rising demand in a sustainable fashion, and it can help enhance the networks that integrate food systems. This year's report analyses these demands and the opportunities they present from different angles, including those of data-driven strategies, the impact of biotechnological and digital technologies, effective policies, and strengthened networks, while at the same time suggesting new approaches for both developed and developing countries.

Finally, the GII 2017 includes another innovation this year. The GII has long recognized that innovative activity tends to be concentrated in geographic clusters. However, no metrics have existed to measure innovation performance at the cluster level on an internationally comparable basis. This year's GII seeks to take a first step in remedying this measurement gap. It presents a novel approach towards identifying and ranking the world's largest clusters of inventive activity, drawing on international patent filings. We hope that the cluster perspective offers a useful complement to the long-standing country-based rankings that will continue to form the core of the GII.

We thank our Knowledge Partners, the Confederation of Indian Industry (CII), PricewaterhouseCoopers (PwC) and Strategy&, and the National Confederation of Industry (CNI) and Serviço Brasileiro de Apoio às Micro e Pequenas Empresas (Sebrae) for their support of this year's report.

Likewise, we thank our prominent Advisory Board, which has been enriched by a new member this year: Chuan Poh Lim, Chairman, Agency for Science, Technology and Research (A*STAR) of Singapore.

We hope that the collective efforts of innovation actors and decision makers who use the GII will continue to pave the way for better innovation policies around the world.

Soumitra Dutta
Dean, Cornell SC Johnson College of Business, Cornell University

Francis Gurry
Director General, World Intellectual Property Organization (WIPO)

Bruno Lanvin
Executive Director for Global Indices, INSEAD

Innovation as the Key Driver of Sustainable Agriculture and Future Food Security in the Developing World

The primary obligation of a nation is to protect its citizens from hunger and malnutrition by enabling sustainable and equitable food production and distribution channels. The developing world, characterized by gross economic and social inequalities coupled with inequitable access to safe, nutritional food and quality healthcare, requires innovation to meet the ever-rising demand for food and to sustain its agricultural growth.

Despite the fact that India is one of the world's largest producers of food grain, the largest producer of milk, and its second largest producer of sugar, low-quality inputs such as low-grade seed, saline soil, inadequate irrigation, traditional farming methods (combined with small, scattered landholdings), restrictive access to formal credit, dependence on private moneylenders, and weak market linkages have long plagued its agriculture sector.

To counter these challenges, a gradual infusion of tech-based tools such as digital remote sensing, geographic and price information systems, crop and soil health monitoring, and farm management platforms has taken place. These tools promise to rationalize processes and enhance efficiency, productivity, distribution, and access along the entire continuum of the food system from farm to fork and beyond.

Public policy plays a pivotal role in making an environment conducive to this transition. The adoption of innovation-led farm technologies has spurred public and private investments in R&D, helped technology transfer and uptake, as well as inter-sectoral cooperation. Over the last two decades, this has enabled sustainable agriculture to gradually gain momentum.

The Confederation of Indian Industry (CII) has been a strong proponent of this paradigm shift. The theme of this year's Global Innovation Index (GII), 'Innovation Feeding the World', thus resonates well with the agenda and focus of CII in this sector, and like previous years may prove beneficial for stimulating effective policy dialogue within the government.

For last two years, in collaboration with the GII, CII has been engaged with the Indian government to boost India's ranking. I am delighted to report that this effort has improved India's 2016 GII results. Another outcome of this sustained effort was the launch of the GII 2016 in India at a special event, jointly organized by the Department of Industrial Policy and Promotion (DIPP), the National Institution for Transforming India (NITI Aayog), and CII, in the presence of the Director-General of the World Intellectual Property Organization (WIPO). During the event, India's Minister of State for Commerce and Industry instituted a high-level Task Force on Innovation to suggest ways India can improve its innovation eco-system.

As a follow up to this launch, the first international consultative exercise was organized in January 2017 in New Delhi to address existing data gaps in the GII. International agencies such as UNESCO, among others, participated in the exercise where the first India Innovation Index Portal was launched. These developments have created the desired momentum for states to work on building their innovation ecosystems and improving their innovation indicators.

In line with this year's theme, Chapter 5 covers the current ecosystem of digital technologies in Indian agriculture—the rise of agro-tech start-up ventures and the advocacy initiatives that are the backbone needed to modernize Indian agriculture.

CII has been a longstanding partner of GII. I would like to take this opportunity to congratulate the GII team once again for coming out with this important edition, and for taking up a theme that resonates very well in today's challenging times.

Chandrajit Banerjee
Director General
Confederation of Indian Industry

Innovating to Feed the World

We live in a world of finite resources but infinite passion and creativity. At PwC, we are committed to building trust in society and solving important problems. But as problems become more global and complex, the solutions require a greater focus on innovation. The Global Innovation Index (GII) does just that by creating metrics to evaluate innovation and by identifying new ways to address the challenges that affect business and society.

At Strategy&, PwC's strategy consulting business, we are proud to be part of the 2017 GII. This year's theme of innovation in food systems highlights one of the most complex challenges humanity faces: managing the global food supply. We know that without significantly expanding agricultural production over the next three decades, the world's population will increasingly face hunger, malnutrition, and famine.

Resource scarcity is one of the key megatrends shaping our world today and in the years to come, so meeting the needs of the world's people in a sustainable way will require renewed focus on innovation in a variety of fields and from a variety of stakeholders. In this case, addressing global food insecurity involves technological innovation, including leading-edge advances in data analytics; global distribution and supply chain management; risk assessment; economic flexibility; a deeper understanding of climate and weather conditions; and sustainability practices. It's clear that no company, government, or any other institution can solve the food crisis on its own. To find a lasting solution, we have to work together.

In our research for the GII, we have identified promising agricultural innovations being developed by the private sector. Many of these are a result of more corporate R&D investment in software and services, and new technologies that are improving efficiency and productivity. However, the public sector—which has traditionally represented the majority of agricultural R&D expenditures—continues to play an important role in spurring agricultural innovation. There's a real opportunity for governments and businesses to collaborate to support corporate ventures and to ensure that investments have a greater impact.

In PwC's most recent CEO survey, we asked CEOs how the corporate community can help spread the benefits of globalization more widely. The majority of them said the best way is to collaborate, particularly with government. As a GII Knowledge Partner, we hope to do our part in helping to close the gap between innovation and finding tangible solutions to important problems that affect communities around the world.

Tim Ryan
US Chairman and Senior Partner
PwC

Innovation in Food Production: Learning from the Past with an Open Mind for the Future

The National Confederation of Industry (CNI), the Social Service of Industry (SESI), the National Service of Industrial Training (SENAI), and the Brazilian Micro and Small Business Support Service (Sebrae) are more and more concerned with innovation. We are convinced that the only way to achieve sustainable development is through innovation. Since 2008, CNI business leaders have maintained the Entrepreneurial Mobilization for Innovation (MEI), putting innovation at the centre of corporate strategy and enhancing the effectiveness of innovation policies in Brazil.

'Innovation Feeding the World', this year's theme for the Global Innovation Index, is a central issue for environmental sustainability and for the world's social and economic well-being. Innovations are spread across different economic sectors, sustaining one another with new ideas and state-of-the-art technologies. Innovation in agribusiness and food production now requires the knowledge and technologies produced by other sectors.

Brazil's role in grain production is not just a result of abundant natural resources and good climate conditions. Historically, the country has developed a consistent and comprehensive system of research and development to support innovation and new agriculture technologies. This system benefits from the leadership of Embrapa (Brazilian Agriculture Research Corporation), one of the country's most important public research enterprises, which has provided Brazilian farmers with crucial tools needed for a modern and dynamic agroindustry.

Inspired by Embrapa, in 2013 the government launched the Brazilian Agency for Industrial Research and Innovation (Embrapii), which manages non-refundable grants invested in projects carried out by companies and research institutions and is acknowledged for its excellence, technological focus, and ability to meet companies' needs.

The technology challenges for agro-industry are now more complex than ever. In the past, soil fertilization, mechanization, plant breeding, genetic engineering, and improvements in cultivation techniques were the main drivers for the increase in agriculture productivity; today other challenges demand a new set of technologies and policies.

Agriculture and food production greatly impact the environment. With the growing demand for agriculture products, sustainable productivity growth in agriculture is a vital issue. This includes not only increasing crop productivity but also reducing inefficiencies in transportation and food industrialization. Another significant issue relates to how best to adapt to climate change and the expected increased frequency of extreme weather events. New technologies could contribute a great deal in this domain too.

Fortunately, a vast array of new technologies promises to increase efficiency in food production. New equipment and devices are at the centre of such technologies. Precision agriculture raises the possibility of using knowledge and information technologies to adapt cultivation techniques to each specific location, with its own soil and climate characteristics. Crop sensors could use agriculture inputs much more precisely by using the exact amount needed by a specific site. Drones and robots have already automated several tasks in agriculture production.

All these innovations are blurring the boundaries between industry, services, and agriculture. More and more, industrial and service technologies are offering new possibilities in agriculture. These new possibilities are also becoming more accessible to small innovative businesses in all sectors. To seize the resulting opportunities, a new framework of policies and institutions is needed to take advantage of lessons learned from successful past experiences and envision new possibilities for agriculture and food production. The theme of the Global Innovation Index this year could not be timelier.

Robson Braga de Andrade
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and President, SENAI's National Council

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KNOWLEDGE PARTNERS

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United Nations Commodity Trade Statistics Database, Department of Economic and Social Affairs/ Statistics Division, **http://comtrade.un.org/db/**

PwC Global entertainment and media outlook 2016–2010, www.pwc.com/outlook

Advisory Board to the Global Innovation Index

In 2011, an Advisory Board was set up to provide advice on the research underlying the Global Innovation Index (GII), generate synergies at its stages of development, and assist with the dissemination of its messages and results. The Advisory Board is a select group of leading international practitioners and experts with unique knowledge and skills in the realm of innovation. Its members, while coming from diverse geographical and institutional backgrounds (international organizations, the public sector, non-governmental organizations, business, and academia), participate in their personal capacity. We are grateful for the time and support provided by the Advisory Board members.

In 2017, we welcome a new member to the Advisory Board: Chuan Poh Lim, Chairman, Agency for Science, Technology and Research (A*STAR).

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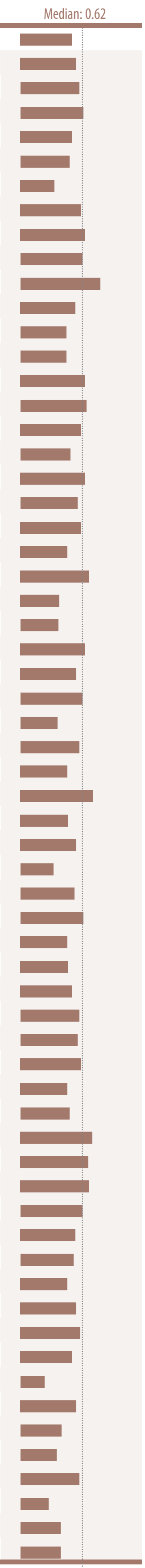
Rankings

Global Innovation Index 2017 rankings

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Efficiency Ratio	Rank	Median: 0.62
Switzerland	67.69	1	HI	1	EUR	1	0.95	2	
Sweden	63.82	2	HI	2	EUR	2	0.83	12	
Netherlands	63.36	3	HI	3	EUR	3	0.93	4	
United States of America	61.40	4	HI	4	NAC	1	0.78	21	
United Kingdom	60.89	5	HI	5	EUR	4	0.78	20	
Denmark	58.70	6	HI	6	EUR	5	0.71	34	
Singapore	58.69	7	HI	7	SEAO	1	0.62	63	
Finland	58.49	8	HI	8	EUR	6	0.70	37	
Germany	58.39	9	HI	9	EUR	7	0.84	7	
Ireland	58.13	10	HI	10	EUR	8	0.85	6	
Korea, Rep.	57.70	11	HI	11	SEAO	2	0.82	14	
Luxembourg	56.40	12	HI	12	EUR	9	0.97	1	
Iceland	55.76	13	HI	13	EUR	10	0.86	5	
Japan	54.72	14	HI	14	SEAO	3	0.67	49	
France	54.18	15	HI	15	EUR	11	0.71	35	
Hong Kong (China)	53.88	16	HI	16	SEAO	4	0.61	73	
Israel	53.88	17	HI	17	NAWA	1	0.77	23	
Canada	53.65	18	HI	18	NAC	2	0.64	59	
Norway	53.14	19	HI	19	EUR	12	0.66	51	
Austria	53.10	20	HI	20	EUR	13	0.69	41	
New Zealand	52.87	21	HI	21	SEAO	5	0.65	56	
China	52.54	22	UM	1	SEAO	6	0.94	3	
Australia	51.83	23	HI	22	SEAO	7	0.60	76	
Czech Republic	50.98	24	HI	23	EUR	14	0.83	13	
Estonia	50.93	25	HI	24	EUR	15	0.79	19	
Malta	50.60	26	HI	25	EUR	16	0.84	8	
Belgium	49.85	27	HI	26	EUR	17	0.67	47	
Spain	48.81	28	HI	27	EUR	18	0.70	36	
Italy	46.96	29	HI	28	EUR	19	0.73	31	
Cyprus	46.84	30	HI	29	NAWA	2	0.74	28	
Portugal	46.05	31	HI	30	EUR	20	0.71	33	
Slovenia	45.80	32	HI	31	EUR	21	0.68	44	
Latvia	44.61	33	HI	32	EUR	22	0.74	26	
Slovakia	43.43	34	HI	33	EUR	23	0.75	25	
United Arab Emirates	43.24	35	HI	34	NAWA	3	0.49	104	
Bulgaria	42.84	36	UM	2	EUR	24	0.80	15	
Malaysia	42.72	37	UM	3	SEAO	8	0.68	46	
Poland	41.99	38	HI	35	EUR	25	0.67	48	
Hungary	41.74	39	HI	36	EUR	26	0.73	30	
Lithuania	41.17	40	HI	37	EUR	27	0.59	84	
Croatia	39.80	41	HI	38	EUR	28	0.66	52	
Romania	39.16	42	UM	4	EUR	29	0.69	39	
Turkey	38.90	43	UM	5	NAWA	4	0.84	9	
Greece	38.85	44	HI	39	EUR	30	0.56	87	
Russian Federation	38.76	45	UM	6	EUR	31	0.61	75	
Chile	38.70	46	HI	40	LCN	1	0.60	77	
Viet Nam	38.34	47	LM	1	SEAO	9	0.84	10	
Montenegro	38.07	48	UM	7	EUR	32	0.63	62	
Qatar	37.90	49	HI	41	NAWA	5	0.61	68	
Ukraine	37.62	50	LM	2	EUR	33	0.83	11	
Thailand	37.57	51	UM	8	SEAO	10	0.75	24	
Mongolia	37.13	52	LM	3	SEAO	11	0.74	27	
Costa Rica	37.09	53	UM	9	LCN	2	0.69	43	
Moldova, Rep.	36.84	54	LM	4	EUR	34	0.78	22	
Saudi Arabia	36.17	55	HI	42	NAWA	6	0.53	96	
Kuwait	36.10	56	HI	43	NAWA	7	0.79	18	
South Africa	35.80	57	UM	10	SSF	1	0.53	97	
Mexico	35.79	58	UM	11	LCN	3	0.61	74	
Armenia	35.65	59	LM	5	NAWA	8	0.80	17	
India	35.47	60	LM	6	CSA	1	0.66	53	
TFYR of Macedonia	35.43	61	UM	12	EUR	35	0.59	80	
Serbia	35.34	62	UM	13	EUR	36	0.61	67	
Panama	34.98	63	UM	14	LCN	4	0.69	38	
Mauritius	34.82	64	UM	15	SSF	2	0.48	109	

Global Innovation Index 2017 rankings *(continued)*

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Efficiency Ratio	Rank
Colombia	34.78	65	UM	16	LCN	5	0.52	100
Bahrain	34.67	66	HI	44	NAWA	9	0.56	88
Uruguay	34.53	67	HI	45	LCN	6	0.59	82
Georgia	34.39	68	UM	17	NAWA	10	0.63	60
Brazil	33.10	69	UM	18	LCN	7	0.52	99
Peru	32.90	70	UM	19	LCN	8	0.49	106
Brunei Darussalam	32.89	71	HI	46	SEAO	12	0.34	124
Morocco	32.72	72	LM	7	NAWA	11	0.61	71
Philippines	32.48	73	LM	8	SEAO	13	0.65	55
Tunisia	32.30	74	LM	9	NAWA	12	0.62	65
Iran, Islamic Rep.	32.09	75	UM	20	CSA	2	0.80	16
Argentina	32.00	76	UM	21	LCN	9	0.55	94
Oman	31.83	77	HI	47	NAWA	13	0.46	115
Kazakhstan	31.50	78	UM	22	CSA	3	0.46	116
Dominican Republic	31.17	79	UM	23	LCN	10	0.65	54
Kenya	30.95	80	LM	10	SSF	3	0.66	50
Lebanon	30.64	81	UM	24	NAWA	14	0.61	69
Azerbaijan	30.58	82	UM	25	NAWA	15	0.50	103
Jordan	30.52	83	UM	26	NAWA	16	0.65	57
Jamaica	30.36	84	UM	27	LCN	11	0.57	86
Paraguay	30.30	85	UM	28	LCN	12	0.61	72
Bosnia and Herzegovina	30.23	86	UM	29	EUR	37	0.47	112
Indonesia	30.10	87	LM	11	SEAO	14	0.69	42
Belarus	29.98	88	UM	30	EUR	38	0.39	120
Botswana	29.97	89	UM	31	SSF	4	0.38	121
Sri Lanka	29.85	90	LM	12	CSA	4	0.65	58
Trinidad and Tobago	29.75	91	HI	48	LCN	13	0.56	90
Ecuador	29.14	92	UM	32	LCN	14	0.62	66
Albania	28.86	93	UM	33	EUR	39	0.37	122
Tajikistan	28.16	94	LM	13	CSA	5	0.59	83
Kyrgyzstan	28.01	95	LM	14	CSA	6	0.47	114
Tanzania, United Rep.	27.97	96	LI	1	SSF	5	0.73	29
Namibia	27.94	97	UM	34	SSF	6	0.48	108
Guatemala	27.90	98	LM	15	LCN	15	0.56	91
Rwanda	27.36	99	LI	2	SSF	7	0.33	125
Senegal	27.11	100	LI	3	SSF	8	0.54	95
Cambodia	27.05	101	LM	16	SEAO	15	0.63	61
Uganda	26.97	102	LI	4	SSF	9	0.47	113
El Salvador	26.68	103	LM	17	LCN	16	0.48	107
Honduras	26.36	104	LM	18	LCN	17	0.52	101
Egypt	26.00	105	LM	19	NAWA	17	0.59	81
Bolivia, Plurinational St.	25.64	106	LM	20	LCN	18	0.57	85
Mozambique	24.55	107	LI	5	SSF	10	0.61	70
Algeria	24.34	108	UM	35	NAWA	18	0.47	111
Nepal	24.20	109	LI	6	CSA	7	0.49	105
Ethiopia	24.16	110	LI	7	SSF	11	0.72	32
Madagascar	24.15	111	LI	8	SSF	12	0.68	45
Côte d'Ivoire	23.96	112	LM	21	SSF	13	0.69	40
Pakistan	23.80	113	LM	22	CSA	8	0.62	64
Bangladesh	23.72	114	LM	23	CSA	9	0.55	93
Malawi	23.45	115	LI	9	SSF	14	0.53	98
Benin	23.04	116	LI	10	SSF	15	0.47	110
Cameroon	22.58	117	LM	24	SSF	16	0.56	92
Mali	22.48	118	LI	11	SSF	17	0.60	78
Nigeria	21.92	119	LM	25	SSF	18	0.52	102
Burkina Faso	21.86	120	LI	12	SSF	19	0.24	127
Zimbabwe	21.80	121	LI	13	SSF	20	0.56	89
Burundi	21.31	122	LI	14	SSF	21	0.41	117
Niger	21.18	123	LI	15	SSF	22	0.36	123
Zambia	20.83	124	LM	26	SSF	23	0.59	79
Togo	18.41	125	LI	16	SSF	24	0.28	126
Guinea	17.41	126	LI	17	SSF	25	0.40	118
Yemen	15.64	127	LM	27	NAWA	19	0.40	119



Note: World Bank Income Group Classification (July 2016): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income. Regions are based on the United Nations Classification: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

Key Findings

Key Findings of the GII 2017

From the Global Innovation Index 2017, devoted to measuring the innovation performance of 127 economies and the theme 'Innovation Feeding the World', six messages emerge. Many of these messages are concerned with innovation as a driver of growth generally. One is concerned specifically with the role of innovation as a way to address the growing need for advances in agriculture and food value chains.

Finding 1: Crafting the foundations for innovation-driven growth while the global economy is at an important turning point

In a turn of events, growth is reaching a novel and more sustained momentum as the GII goes to print this year. Laying the foundation for innovation-driven economic development is ever more paramount. Related policies that will sustain innovation investments can help transform the cyclical economic upswing into longer-term growth. Such proactive innovation policies are also a powerful antidote to uncertainty because they boost the confidence and thus also the investments of economic actors into the future.

In spite of this new growth momentum, investment and productivity growth are still at historic lows. China aside, investment growth in middle-income countries has now fallen to levels similar to that of rich countries (Figure A). Furthermore, the productivity crisis is more topical today than ever. The downturn has amplified the phenomenon of lacklustre productivity gains in rich countries, in conjunction with weakened technological innovation and diffusion. Emerging economies are affected as well, with their catch-up to advanced-country productivity slowing.

Research and development (R&D) investments need to be intensified. Although permanently subdued R&D growth was avoided thanks to countercyclical innovation policies and private innovation expenditures, R&D growth is still lower today than it was in 2011–13, and much lower than in 2005–08 (Figure A). Tighter government R&D budgets in selected high-income countries and slower spending growth in emerging countries explain part of this slowdown. Disconcertingly, and in addition to flattening public R&D, business research expenditures seem to be losing momentum.

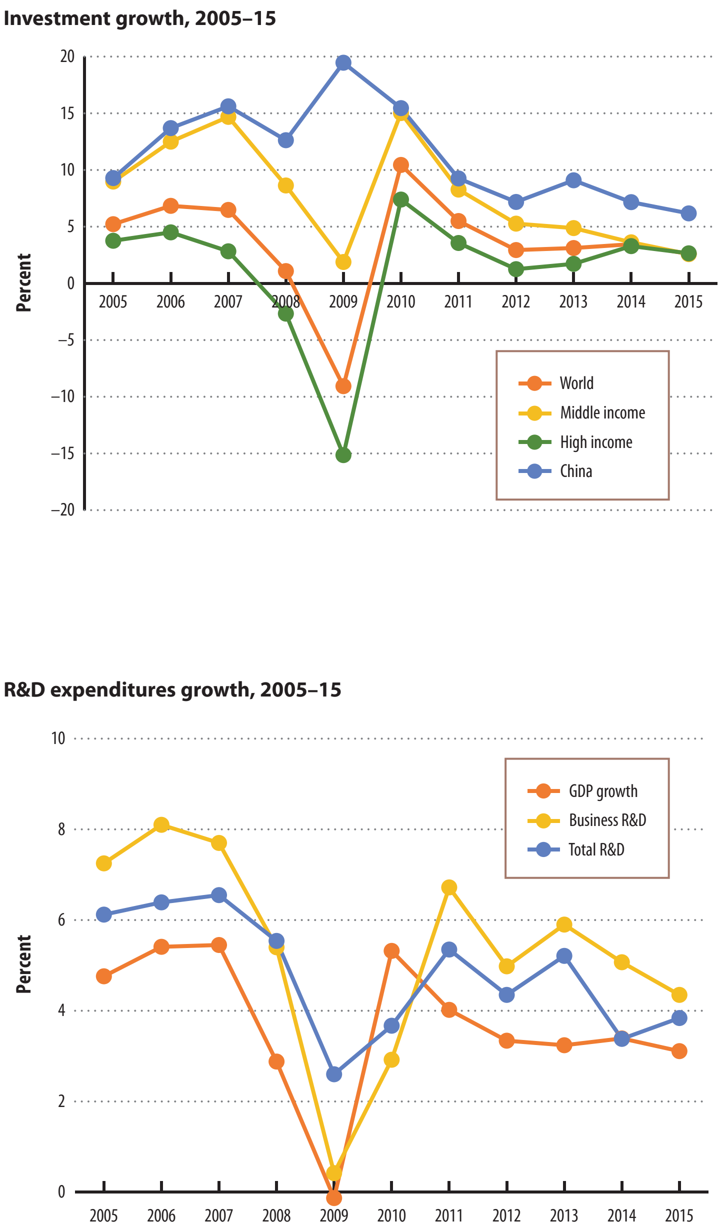
Finding 2: Smart, digital agricultural innovation and a better uptake of innovation in developing countries can help overcome serious food challenges

Today a fresh innovation drive is required to confront slow growth in agricultural productivity and the bottlenecks in today's agricultural innovation systems. First and foremost, lagging agricultural productivity growth in low- and middle-income economies and lagging agricultural R&D spending across all economies both need to be reversed. Second, innovations need to disperse more effectively throughout the agricultural and food sector, especially in developing countries.

Helping to meet this need for innovation in agricultural systems, a wave of new agricultural technologies and innovations is taking place that could help overcome lagging productivity. The pace of agricultural innovation has increased over the last few years, with innovations from other sectors spilling over to agricultural and food systems. Advances in areas such as genetics and nano- and biotechnologies have proven their ability to be a source of higher yields and better nutrient content, even though their full environmental and health impacts have yet to be fully understood. Big data are reshaping the world of agriculture: digital agriculture has started to spread worldwide, helped by the development of innovations in information technology (IT)—for example, sensors, drones and robotics, and virtual and augmented reality—as well as data generation and analytics enabled by remote sensing, and geographic information systems.

Unfortunately, the new wave of technological advances is rolling out rather slowly in many parts of the world, including in rich countries. And developing countries,

Figure A: Global investment and business R&D falling short



Source: See Figure 1 from Chapter 1.

particularly in Sub-Saharan Africa, have yet to benefit from earlier waves of agricultural innovations.

New technologies aside, the brunt of agricultural innovation is found in improved processes and services that occur along the agricultural value chain, be it in high-income or low-income economies, not only in novel technologies. In the case of developing countries, there are many significant bottlenecks along the value chain. These are mostly obstacles concerned with liquidity constraints, agricultural inputs of imperfect quality, insufficient information and awareness, and a lack of post-harvest and distribution infrastructure.

Public authorities have critical roles to play in helping stimulate innovation in food and agricultural value chains. For a start, the agriculture and food sector should be part and parcel of any national innovation strategy. To this day, this is very rarely the case.

To overcome market failures, policy makers have a responsibility to provide funding mechanisms to stimulate innovation in agriculture and food production. Instruments such as agricultural funds and focused research institutes need to work more efficiently. Developing countries also need to engage more in domestic R&D, for example, while setting priorities in research fields appropriate to their specific resources and contexts. Local (sub-national) initiatives are also important: grassroots innovations are happening in farming that can often be scaled up. In such contexts, robust links between public research institutions, firms, and the grassroots level are key.

Efforts to enhance the efficiency of the food and agriculture innovation system should focus on reducing lags between R&D efforts and the widespread adoption of agricultural innovations. Accelerating technology transfers by establishing clear rules of engagement in university-industry interactions, including the commercialization of intellectual property derived from these, is a valuable option. Supporting the demand for innovation from farmers and commercial farming operations is equally important. Five recommendations are:

- First, provide adequate information to farmers, ensure that key workers along the value chain have sufficient relevant skills, and encourage the adoption of new products and processes.
- Second, empower farmers by providing access to digital technologies and the new service platforms that have immense potential to positively impact agriculture.
- Third, recognize and help boost entrepreneurship and venture capital approaches within the agricultural sector.
- Fourth, both the private sector and government can help infuse excellence and innovative attitudes that are evident in other vital sectors—such as the information and communication technologies, or ICT, sector—into the agricultural sector.
- Finally, improve national legal and regulatory frameworks in agriculture, and more generally streamline regulations and reduce bureaucracy around farmers, in particular when striking a balance between traditional and advanced farming technologies.

Table A: Innovation achievers: Income group and years as an innovation achiever

Economy	Income group	Years as an innovation achiever (total)
Viet Nam	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)
Kenya	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)
Moldova, Rep.	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)
India	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)
Armenia	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012 (6)
Ukraine	Lower-middle income	2017, 2016, 2015, 2014, 2012 (5)
Rwanda	Low income	2017, 2016, 2015, 2014, 2012 (5)
Uganda	Low income	2017, 2016, 2015, 2014, 2013 (5)
Mozambique	Low income	2017, 2016, 2015, 2014, 2012 (5)
Malawi	Low income	2017, 2016, 2015, 2014, 2012 (5)
Senegal	Low income	2017, 2015, 2014, 2013, 2012 (5)
Tajikistan	Lower-middle income	2017, 2016, 2013 (3)
Malta	High income	2017, 2016, 2015 (3)
Madagascar	Low income	2017, 2016 (2)
Bulgaria	Upper-middle income	2017, 2015 (2)
Burundi	Low income	2017 (1)
Tanzania, United Rep.	Low income	2017 (1)

Source: See Table 5 from Chapter 1.

Finding 3: More innovation convergence is needed globally, with developing countries perfecting their innovation systems

Innovation is becoming more global but divides remain; innovation leaders are uncontested at the top but new players are emerging.

Switzerland leads the rankings for the seventh consecutive year. In the top 25, some economies—such as the Netherlands, Denmark, Germany, Japan, France, Israel, and China—move up. Yet rich countries take most of the top 25 spots, with middle-income countries growing more distant to the top 25 this year, rather than closing the gap.

The exception is still China. It moves up by three spots in this edition, becoming the 22nd most innovative economy in the world after having entered the top 25 in 2016 as the first middle-income economy. With the exceptions of Bulgaria and Malaysia, the gap between the 11–25 ranked economies and middle-income economies remains large, especially in Institutions, Human capital and research, Infrastructure, and Creative outputs. Outside these countries, only a few upper-middle-income economies—such as Turkey, the Russian Federation, and Viet Nam—are among the top 50 this year. Similarly, the innovation quality ranking is led by the United States of America (USA), Japan, the United Kingdom, and other high-income countries, with China being the only middle-income country closing the gap.

In terms of regions, the same patterns of innovation divides persist: Northern America; Europe; and South East Asia, East Asia, and Oceania lead, followed at a great distance by Northern Africa and Western Asia; Latin America and the Caribbean; Central and Southern Asia; and, finally, Sub-Saharan Africa.

Yet there are many positive developments too. For a start, in 2017 we continue to see a number of countries that perform significantly better on innovation than their current level of development would predict; it is hoped that this will trigger a virtuous cycle of development in the years to come. A total of 17 economies compose the cluster of 'innovation achievers' this year. This group has grown this year relative to 2016.

Most of these economies—nine in total—come from the Sub-Saharan Africa region, followed by three economies in the Eastern region of Europe. Table A shows the list of innovation achievers; particularly notable is the consistent progress in Sub-Sahara Africa, with some new economies, such as Tanzania and Burundi, joining this group. Importantly, Kenya, Rwanda, Senegal, Uganda, Mozambique, and Malawi stand out for being innovation achievers at least five times in the previous six years. Particular results-oriented activities in Viet Nam and India leading to achievements on particular innovation components are also especially notable.

Continuing with the trend identified in earlier editions of the GII, the average performance of the group of low-income economies is getting closer to the average performance of the middle-income cluster. Both in GII scores and also in their catch-up on particular innovation variables, the innovation achievers mentioned in Table A help close the gap.

Finding 4: Opportunities have emerged to leverage the rise of new East Asia Innovation Tigers, fostering deeper regional innovation networks and benefitting from the rise of India

In terms of innovation and economic development more broadly, Asia is definitely a more and more important engine of innovation in the 21st century, complementing existing innovation efforts in high-income economies, mostly in Northern America and Europe.

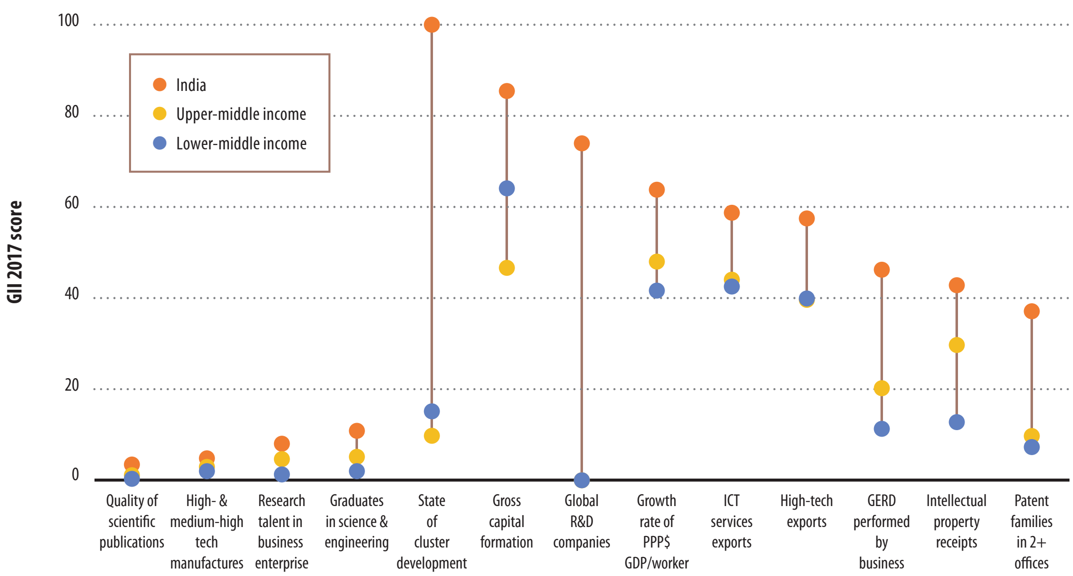
The different elements of a potentially strong networked innovation powerhouse are coming together in Asia. For a start, and despite enduring economic setbacks, Japan has continued to be a driving force of global innovation since the late 1970s. Later, in the 1980s, the so-called Asian Tigers emerged, with Hong Kong (China), Singapore, the Republic of Korea, and to some extent Malaysia developing their innovation agendas quite rapidly. In conjunction with Japan, these economies are the top Asian countries in innovation in the region. In the 1990s, the rise of other South East Asian countries such as Thailand was also forecast by economic and innovation experts—complementing the large established players. The economic spurt of these countries was temporarily stopped short by the Asian financial crisis, but has since continued unabated. In addition, thanks to its steadily persevering innovation agenda, China also vigorously entered the picture while making strides in terms of innovation activities and results.

Moving forward, a novel dynamic of innovation development is in place today, potentially producing a new line-up of up-and-coming Asian countries. New Asian Tigers—such as Indonesia, the Philippines, and Viet Nam—are emerging too, and they increasingly join not only Asian high-tech value chains but also other activities such as ICT offshoring. These and other countries in Asia are also active in improving their innovation performance. Although Singapore is still uncontested as number 1 among the smaller or emerging Asian economies, countries such as Viet Nam, the Philippines, and Thailand are rapidly catching up. Among them, Viet Nam tops education expenditure in the region and does very well in ICT use, gross capital formation, and FDI net inflows. Malaysia has the best cluster development and ICT use, the Philippines leads ICT services exports, Thailand tops the quality of publications and trademarks, and Cambodia only recently engaged on innovation activities but its FDI inflows are already high.

A potentially stronger pan-Asian innovation network is seeing the light of day as China, Japan, and the Republic of Korea increasingly conduct some of their manufacturing activities—including those in technology-intensive sectors—in neighbouring Asian countries, leading to regional production and innovation networks. However, these intra-regional production activities still mostly concern low-skill and low-wage assembly operations with Chinese, Japanese, or Korean firms choosing to manufacture in, for example, Viet Nam, to benefit from excellent framework conditions and lower wages. Few collaborative R&D projects exist between the Asian leading nations, their top innovation clusters, or these smaller newcomers today, at either the firm or the country level. The newly emerging Asian economies, such as Malaysia, the Philippines, and Viet Nam, still experience low R&D and low resident patenting levels. As a result, the potential of intra-regional innovation networks in Asia is far from fully utilized.

There is development in Central and Southern Asia too, with interesting developments in countries such as the Islamic Republic of Iran, Kazakhstan, and Bangladesh. But, first and foremost, India's current and imminent development, and its contribution to the region and the global innovation landscape, is vital these days. As demonstrated in the GII for some years, India has consistently outperformed on innovation relative to its GDP per capita. Recently it made important strides in innovation input and output performance. India is now in the top half of the GII rankings. The continual improvement of India in terms of investment, tertiary education, the quality of its publications and universities, its ICT services exports,

Figure B: India ahead of average lower-middle- and upper-middle-income economies



Source: See Figure 6 in Chapter 1.

and its innovation clusters deserves mention (Figure B). It is to be hoped that India will continue on this trajectory, with innovation investments leading to more and more dynamic R&D-intensive firms that are active in patenting, high-technology production, and exports. If India then increasingly connects its innovation system to the innovative countries in the East mentioned above, as well as to standing innovation powerhouses in the West, it will make a true difference in Asia's regional role in innovation, and to global innovation more generally.

This is a promising prospect. The emergence of innovative new Asian Tigers, an innovative India, and better innovation networks in the region are likely to be among the most encouraging developments for worldwide innovation in the next few decades.

Finding 5: Preserving the innovation momentum in Sub-Saharan Africa and tapping the innovation potential in Latin America are priorities

A recurrent finding of the last editions of the GII has been that the innovation momentum in Sub-Saharan Africa must be preserved, while countries in Latin America and the Caribbean are working to meet their innovation potential.

For several editions, the GII has noted that—relative to its level of economic development—the Sub-Saharan Africa region performs comparatively well on innovation. Since 2012, Sub-Saharan Africa has had more countries among the group of innovation achievers than any other region. Kenya, Rwanda, Senegal, Uganda, Mozambique, and Malawi stand out for being innovation achievers at least five times in the past six years. Kenya is the chief innovation achiever in the region, outperforming every year since 2011—including in the 2017 edition.

Noted improvements in Institutions and Business sophistication have allowed the region as a whole to catch up with Central and Southern Asia in these factors. Boosted by economies such as South Africa, Mauritius, Botswana, Namibia, Rwanda, and Burkina Faso, Sub-Saharan Africa this year has its highest scores in Institutions and Market sophistication. Larger economies such as South Africa, Kenya, Botswana, and Namibia help foster the expansion in Infrastructure; others such as Mauritius, Rwanda, Senegal, and Zimbabwe are helping to do so in Human capital.

This year, however, the drivers of growth that have been active in the region have seen a slowdown. Clearly, in absolute terms the gap between these Sub-Saharan Africa economies and some South East Asian innovation

Table B: Top cluster of countries or cross-border regions, within the top 25

Rank	Cluster name	Territory(ies)
1	Tokyo–Yokohama	Japan
2	Shenzhen–Hong Kong (China)	China/Hong Kong (China)
3	San Jose–San Francisco, CA	United States
4	Seoul	Korea, Rep.
10	Paris	France
12	Frankfurt–Mannheim	Germany
18	Eindhoven	Netherlands/Belgium
21	London	United Kingdom
22	Tel Aviv	Israel
24	Stockholm	Sweden

Source: Derived from Table 1 in Annex 2 in the Special Section on Clusters.

leaders is also still large, in particular when one considers that integration of global value chains and innovation exports, participation in high-tech production and exports, and patenting by Sub-Saharan economies are still low.

Turning to Latin America and the Caribbean, more must be done to reach the region's full innovation potential. Chile, Mexico, and Brazil and some other countries in the region are undoubtedly important innovation actors. Mexico is also an active contributor to global value chains, including in high-tech sectors. It is notable, however, that there is more potential for broad regional improvement on innovation, both in terms of overall innovation performance and also in terms of key innovation variables such as scientific publications, R&D, and patenting. For example, in recent years and also in 2017, no economies from this region are identified as innovation achievers—none outperform in innovation relative to their level of development. The region as such has faced important economic challenges in the last year, with Brazil only slowly emerging from an economic recession according to current forecasts, although the country is still facing a high degree of uncertainty.

To further support this economic upswing and help the region progress in terms of innovation, sustained efforts in improved innovation investments and more coordinated innovation systems are required. Also needed is broader regional R&D and innovation cooperation, which is still largely absent when compared with other regions identified by the GII as being successful in innovation.

Finding 6: The largest sub-national clusters of inventive activity, as measured by patenting, include Tokyo–Yokohama, Shenzhen–Hong Kong (China), and San Jose–San Francisco, CA

This year the GII makes a first attempt at assessing sub-national innovation clusters. The importance of innovation hubs at the sub-national and international levels has been at the forefront of GII discussions for the last 10 years for two main reasons. First, successful innovation clusters are essential for national innovation performance. Second, one of the most frequent questions from countries has been whether the GII model can be applied at the sub-national level to assess innovation clusters more broadly.

However, measuring the territorial dimension of innovation remains challenging. Only a few GII indicators are readily available at the regional or city level for a large set of countries. Besides, clusters often do not stop at national borders. By definition, the search for official and timely innovation data is challenging. In an effort to contribute preliminary solutions, a novel approach is presented in the GII 2017 that identifies the largest inventive clusters as measured by Patent Cooperation Treaty (PCT) patenting. Drawing on advanced mapping techniques and WIPO patenting data, Table B shows some of the leading innovation clusters that result from this analysis. Tokyo–Yokohama, Shenzhen–Hong Kong (China), and San Jose–San Francisco (the Silicon Valley area in California) lead in terms of being the largest inventive clusters, based on this methodology.

In the coming years, attempts to foster data on local innovation clusters should receive increased attention, and may possibly become a more important component of the GII.

Chapters

The Global Innovation Index 2017: Innovation Feeding the World

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Since the release of the Global Innovation Index (GII) last year, the world has seen reason to expect recovery and indeed renewed economic growth. Although uncertainty remains high, the holding pattern of the global economy might well give way to a more sustained upswing. It is still questionable, however, whether the foundations for continued growth are in place; the probability of a 'low-growth' scenario is still high. In this context, firms, institutions, and policy makers can help sustain the recovery and shape the future by creating novel sources of innovation-driven growth.

Key findings in brief

The six key findings of the GII 2017 are:

1. Creating new sources of innovation-driven growth is now vital to transforming the current economic upswing into the possibility of longer-term growth.
2. Smart and digital agricultural innovation and better diffusion to developing countries are required to help overcome serious food challenges.
3. More innovation convergence is needed globally, as low- and middle-income countries put more emphasis on their innovation systems.
4. The prospect of regional Asian innovation networks will also benefit from the rise of new Asian Innovation Tigers and India's high potential.
5. Preserving the momentum of innovation in Sub-Saharan Africa and tapping the innovation potential in Latin America and the Caribbean must be priorities.
6. Regional clusters of inventive activity are essential to national innovation performance; improved innovation metrics on this topic are required.

Nourishing the welcome economic upswing while tackling low investment and productivity

The global economy has been in a holding pattern for several years; it has never fully recovered from the 2007–08 crisis and has never returned to a momentum of sustained growth. In recent years, initial optimism and hopes of recovery were rather quickly replaced with downward revisions to economic growth. The growth rates experienced before the economic crisis remain elusive.

As the new edition of the Global Innovation Index 2017 goes to print, however, a new, if modest, growth momentum is in place. The world's leading economic institutions predict a pick-up of global economic activity in 2017 and 2018, following a strong fourth quarter in 2016.[1] Compared with previous years, these growth forecasts for the world economy have not been revised downwards but upwards in recent months.[2] Business and consumer confidence are high.[3]

Projections also indicate that growth across low-, middle- and high-income economies will be broad-based and positive. Growth in emerging economies continues to be the main driver of the economic upswing. Economic growth is predicted to be relatively strong in middle- and certain low-income economies such as China, India, Indonesia, and Thailand; a few African economies (Kenya, Senegal, and Uganda); and also in a handful of large advanced economies—the Republic of Korea (Korea), the United States of America (USA), and Canada. Brazil and the Russian Federation (Russia) are expected to experience growth again, with the former emerging from a deep recession.[4]

As a region, Latin America and the Caribbean face more positive prospects, following the stabilization of commodity prices benefitting low- and middle-income economies worldwide. Africa will experience a modest pick-up, boosted also by new infrastructure projects.[5]

Figure 1: Global investment and business R&D falling short

Figure 1a: Investment growth, 2005–15

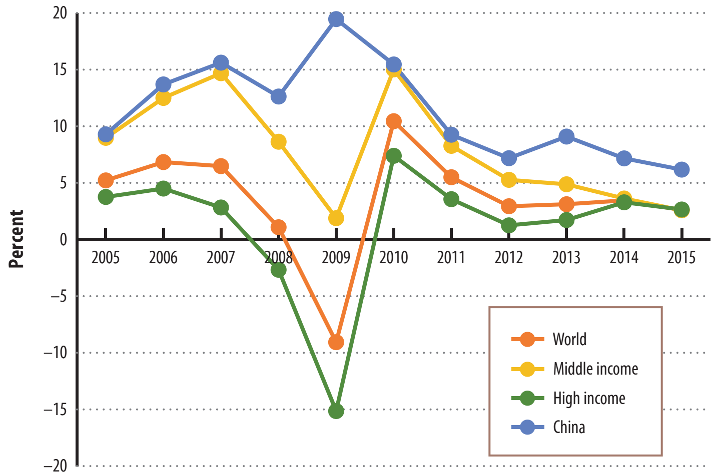
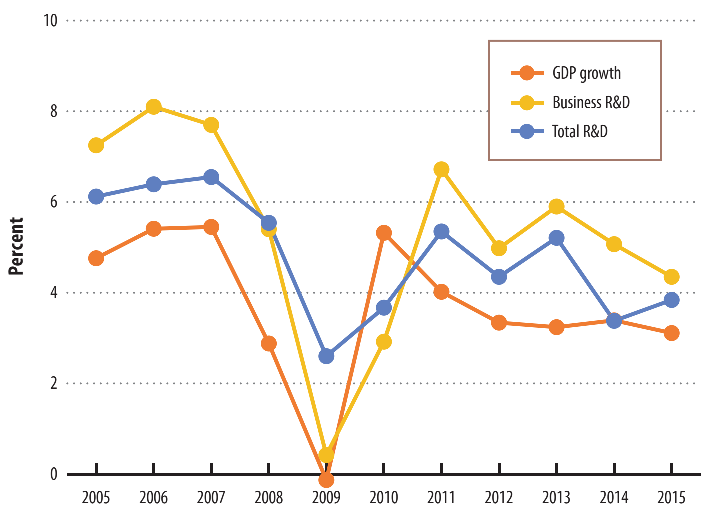


Figure 1b: R&D expenditures growth, 2005–15



Source: 1a. World Bank World Development Indicators database, March 2017; 1b. Authors' estimate based on the UNESCO Institute for Statistics (UIS) database and the IMF World Economic Outlook database, March 2017.

Note: 'Investment' refers to real gross fixed capital formation.

That said, growth rates experienced before the economic crisis remain distant for close to all countries. Some large emerging economies, such as China, are seeing their high growth rates reduced, and other advanced economies, such as Japan, see persistently low growth rates.

Furthermore, a number of factors might derail the scenario of a durable upswing.

Many monetary, fiscal, and other factors are at stake, as well as unprecedented levels of geopolitical and economic uncertainty. The leading economic institutions are wary of a more perpetual low-growth scenario, in which growth cannot be sustained and increased over time. This report is concerned with two related bottlenecks in particular.

First, investment and productivity increases are still at historic lows. And these low levels are at the origin of the lower growth than was enjoyed in pre-crisis years.[6] Despite more positive recent developments, investment—especially in emerging and developing countries—has not yet recovered.[7] In fact, investment growth in middle-income countries has fallen to levels similar to that of rich countries. China aside, the growth of investment in middle-income countries is even lower than it is in high-income ones (see Figure 1a). Furthermore, the productivity crisis is more topical today than ever.[8] Potential measurement issues aside, global labour productivity in 2016 is as low as it was in 2015.[9] The downturn, in conjunction with forces that weakened technological innovation and diffusion, has amplified the phenomenon of lower productivity in rich countries.[10] In the meantime, emerging economies are affected as well, with catch-up to advanced-country productivity levels slowing.

Second, concerns around faltering global economic integration are mounting. Trade growth has been historically weak since 2010—hovering around 2.5% between 2013 and 2015—and was even weaker in 2016, when it fell to 1.3%.[11] Cross-border foreign direct investments (FDI) also fell further in 2016.[12] Trade in particular is traditionally seen as both an important cause and an effect of global growth. A more neglected aspect of economic integration, however, is that both trade and FDI are key channels of the diffusion of technology, know-how, and innovation more broadly.[13] A reversal of globalized economic activity, and

Box 1: Benchmarking R&D expenditures across countries

Global expenditures on R&D (GERD) following the 2008–09 financial crisis have varied considerably (see Tables 1.1 and 1.2 on the following page). Some countries—such as China, India, Mexico, the Russian Federation, and Poland—did not decrease their R&D efforts during the crisis and have intensified them further after the crisis, with business expenditures on R&D (BERD) also following the same trend. Other countries saw declining GERD and BERD during the crisis, but above pre-crisis levels in 2015 (the latest year for which data are available). These include traditionally high R&D spending economies, such as the United States of America, the United Kingdom, Germany, and the Netherlands, as well as relatively newer actors such as Chile and Slovakia.

In yet other countries (e.g., Colombia and Norway), GERD did not fall during the crisis, but BERD did. Governments pushed R&D investments to compensate for lower business R&D during the crisis; their efforts were rewarded with higher GERD and BERD after the crisis. Finally, in a number of countries—such as Spain, Portugal, and Finland—R&D expenditures (both total and business) have not recovered yet, with GERD and BERD still below pre-crisis levels in 2015.

Note

Thanks to Antanina Garanasvili, PhD Candidate in Economics, University of Padova and Queen Mary, University of London, and our colleagues from the UNESCO Institute for Statistics (UIS) Martin Schaaper and Rohan Pathirage for help in producing Box 1.

(Continued on next page)

the associated networks of production and innovation, could have adverse consequences for economic catch-up and technological leapfrogging, which have been historically so critical for successful development cases such as China, Korea, and more recently Viet Nam.[14]

Fortunately, trade, FDI, and productivity growth are also forecast to be recovering in 2017 and further increasing in 2018, in conjunction with output growth and the cyclical recovery currently being experienced.[15]

Policy initiatives to sustain investment, human capital, innovation, and productivity growth could send a strong signal and be an important antidote to uncertainty.

Crafting the foundations for innovation-driven growth as an antidote to uncertainty

Laying the foundations for innovation-driven growth is paramount.

Although not at levels seen after the crisis, some government spending initiatives are underway again in major economies; an uptick in investment will be felt in 2016 and 2017.[16] Still, there is room for even more initiatives aimed at satisfying economists' omnipresent calls for more infrastructure investment in economies across the board.

To lay the foundation for future growth, policy actions that foster human capital, research and development (R&D), and other innovation inputs and outputs, as captured by the GII, are now required. Indeed, available economic evidence shows that an increase in R&D can effectively translate into an increase of GDP in the medium and longer term.[17]

Our study of global R&D data yields the following insights. Global R&D growth fell in the aftermath of the global financial crisis of 2009 (see Figure 1b and Box 1).[18] Governments stepped in to stimulate R&D effectively. Business R&D investments returned to faster growth in 2010. Encouragingly, by 2013 the share of business in total R&D had returned to its pre-crisis levels. Broadly speaking, our analysis indeed indicates that for the last four years, up until 2015 (when the most recent data are available), global R&D intensity—measured as global R&D expenditures relative to global GDP—was at 1.7%, and thus at levels similar to 2000–08.[19] GERD growth has also consistently been higher than GDP growth, also a reflection of low general GDP growth in that period. Still, about eight years after the crisis, the worst-case scenario of permanently reduced R&D growth has to date been avoided, thanks to these anticyclical innovation policies and the role of R&D champions such as China, Germany, and Korea, which have consistently spent large and growing sums on R&D.

Yet, although permanently subdued R&D growth has been avoided, R&D growth is still inferior today than it was in 2011–13 immediately following the crisis, and much lower than in 2005–08 when it averaged around 6%. As governments have phased out some of their stimulus programmes, and as spending cuts are applied, tighter government R&D budgets in selected high-income countries and slower spending growth in key emerging countries explain part of this slowdown.[20]

Disconcertingly, and in addition to flattening public R&D, based on our estimates, business R&D growth seems to be losing momentum, with growth rates decreasing from about 6% in 2013 to 5% in 2014 and about 4.5% in 2015 (see Figure 1b).[21] In

Box 1: Benchmarking R&D expenditures across countries *(continued)*

Table 1.1: Gross domestic expenditure on R&D (GERD): Crisis and recovery compared

Countries with no fall in GERD during the crisis that have expanded since

	CRISIS		RECOVERY			
	2008	2009	2010–12*	2013	2014	2015
China	100	126	165	212	231	253
Poland	100	113	145	167	187	207
Costa Rica†	100	134	140	166	179	n/a
Turkey	100	111	134	157	172	n/a
Colombia†	100	100	118	174	167	166
Korea, Rep.	100	106	133	155	166	168
Mexico	100	105	113	117	127[p]	134[p]
Norway	100	100	102	108	112	123
Russian Fed.	100	111	107	114	118	118
India†	100	106	120	n/a	n/a	n/a

Countries with fall in GERD during the crisis but above pre-crisis levels in 2015

	CRISIS		RECOVERY			
	2008	2009	2010–12*	2013	2014	2015
Slovakia	100	97	153	188	206	286
Chile	100	93	103	126	125	130[p]
Israel	100[d]	96[d]	104[d]	115[d]	122[d]	124[d]
Netherlands	100	99	111	116	121	124[p]
Austria	100	97	108	117	121	123[p]
Brazil†	100	99	112	124	121	n/a
Germany	100	99	108	112	116	118[p]
Singapore	100	82	95	101	114	n/a
United Kingdom	100	99	100	103	108	112[p]
United States	100[j]	99[j]	100[j]	104[j]	107[j]	111[j,p]

GERD below crisis levels in 2015

	CRISIS		RECOVERY			
	2008	2009	2010–12*	2013	2014	2015
Cuba†	100	125	91	107	91	n/a
Romania	100	75	78	66	67	89
Iceland	100	98	90	68	79	89
Spain	100	99	95	88	87	89
South Africa	100	93	86	89	n/a	n/a
Croatia†	100	88	76	81	78	86
Portugal	100	106	97	85	83	83[p]
Finland	100	97	97	88	84	77
Panama†	100	70	80	45	n/a	n/a

Source: OECD MSTI, February 2017; data used: Gross domestic expenditure on R&D (GERD) at constant 2010 PPP$, base year = 2008 (index 100).

*Average values for the 2010 through 2012 period. † Country data source is the UNESCO UIS database: UNESCO-UIS Science & Technology Data Center, update from March 2017. Data used: GERD in '000 PPP$ (in constant prices, 2005).

d = defence excluded (all or mostly); j = excludes most or all capital expenditure; p = provisional data.

Table 1.2: Business enterprise expenditure on R&D (BERD): Crisis and recovery compared

Countries with no fall in BERD during the crisis that have expanded since

	CRISIS		RECOVERY			
	2008	2009	2010–12*	2013	2014	2015
Poland	100	104	149	236	281	312
China	100	126	169	222	244	265
Costa Rica†	100	114	102	174	216	n/a
Turkey	100	101	132	168	193	n/a
Korea, Rep.	100	105	135	162	172	173
Ireland	100	117	118	122	128	n/a
Mexico	100	112	111	107	115	122[p]
France	100	102	109	114	115	117[p]
Russian Fed.	100	110	102	109	112	111
India†	100	102	118	n/a	n/a	n/a

Countries with fall in BERD during the crisis but above pre-crisis levels in 2015

	CRISIS		RECOVERY			
	2008	2009	2010–12*	2013	2014	2015
Colombia	100	73	106	139	172	179
Netherlands	100	93	119	129	135	138[p]
Estonia	100	98	199	150	118	131[p]
Israel	100[d]	97[d]	105[d]	116[d]	124[d]	128[d]
Norway	100	97	100	107	114	125[p]
United Kingdom	100	97	101	107	113	118[p]
Germany	100	97	106	108	113	115
United States	100[j]	96[j]	96[j]	103[j]	107[j]	112[j,p]
Chile	100	68	84	110	103	110[p]
Japan	100	88	93	99	104	103

BERD below crisis levels in 2015

	CRISIS		RECOVERY			
	2008	2009	2010–12*	2013	2014	2015
Australia	100	96	97	98	n/a	n/a
Sweden	100	90	88	92	87	97[p]
Singapore	100	70	81	84	97	n/a
Canada	100[g]	99[g]	96[g]	90[g]	88[g,p]	n/a
Spain	100	93	90	85	84	85
Portugal	100	100	92	80	77	78[p]
South Africa	100	84	69	70	n/a	n/a
Finland	100	93	91	81	77	69
Luxembourg	100	96	71	57	60	60
Uruguay†	100	115	51	32	16	n/a

Source: OECD MSTI, February 2017; data used: Business enterprise expenditure on R&D (BERD) at constant 2010 PPP$, base year = 2008 (index 100).

*Average values for the 2010 through 2012 period. † Country data source is the UNESCO UIS database: UNESCO-UIS Science & Technology Data Center, update from March 2017. Data used: GERD, performed by Business enterprise (in '000 PPP$, constant prices, 2005).

d = defence excluded (all or mostly); p = provisional data; g = excluding R&D in the social sciences and humanities; j = excludes most or all capital expenditure.

several traditionally strong R&D countries, including the USA, Germany, Japan, Korea, and China, business R&D growth is not rapid enough to offset the trends of zero or negative growth elsewhere (see Figure 1b and Box 1).

The use of intellectual property (IP)—a sign of continued innovation—has intensified, albeit only in selected middle- and high-income economies. The latest figures point to a 7.8% patent filing growth in 2015, much higher than it was in the previous five years, yet that growth is mainly driven by China.[22] Turning to the future, as governments prepare policies to sustain the current growth momentum, a focus on R&D and innovation should be a priority. Novel business practices or new technologies could be potential triggers of much-needed productivity increases and engines of future economic growth. Historically, and to the present day, governments have played an important role in building human capital and driving research—as sponsors of basic or less applied R&D, as facilitators of private R&D with tax reductions, or by exercising strong demand on innovation via government procurement or strategic initiatives.[23] Governments might need to boost their involvement to inspire business with the confidence to invest and innovate.[24]

As demonstrated by this year's GII theme, these R&D and innovation efforts are not and should not be limited to sectors conventionally considered to be high-tech. For this reason, the 2017 GII edition on the theme of 'Innovation Feeding the World' focuses on innovation in agriculture and food systems and the many scientific, technological, and other innovative advances made in this field.

Innovation feeding the world

It is commonplace to equate innovation with high-technology sectors. Yet the agriculture and food sector—traditionally considered low-technology—is an important source of technological change, innovation, and development. Today, more than ever before, failure to perceive agri-food systems as a source of innovation and to analyse their innovation input, outputs, linkages, and diffusion paths accordingly would be a mistake. Agri-food systems face an unprecedented rise in global food demand while, at the same time, competition for limited natural resources is at an all-time high. Feeding the world while simultaneously protecting the environment and providing balanced nutrition to growing populations remains a complex challenge.

Addressing the global food challenge

The stakes of innovation in agriculture and food are at least as high, if not higher, than in other fields. As evidenced by the GII chapters this year, progress in reducing malnutrition is still too slow:

- Global food demand in 2050 is expected to increase by at least 60% above 2006 levels.[25]
- Around 795 million people in the world, or about one in nine, suffer from hunger.[26]
- About one in four people living in Sub-Saharan Africa suffers from chronic hunger, yet the region with the largest number of undernourished people is Southern Asia (281 million).[27]
- One in three people in the world is malnourished in one form or another.[28]

The situation is not improving. Challenges such as rapidly growing food demand, stagnating farm incomes, diminishing natural resources, and climate change all aggravate the factors that contribute to issues of malnutrition worldwide. Food security is more and more affected because droughts, floods, heat waves, and other extreme weather events destroy agricultural output. Risks of natural resource depletion and degradation call for intensified efforts towards greener, more sustainable agricultural practices (see Chapters 3, 4, 5, and 9).

Estimates indicate that global agricultural productivity and innovation is not growing fast enough to meet future food demand, mostly because of the lagging total factor productivity growth—a proxy for innovation—in low-income countries (see Chapter 3).

Innovation can help avert a global food crisis if policy makers and other actors change course on a global scale (see Box 2).

Innovation in food and agriculture: From moldboard plow to smart, digital agriculture

The good news is that, historically, agricultural innovation has proven not only feasible but spectacularly successful, and has triggered key structural and socioeconomic development.

Innovations in agriculture and food production have been the starting point of humanity's progress towards organized social life. One can think in particular of the moldboard plow and the cotton gin in the 18th century; refrigeration in the 1850s; pasteurization in 1863; Mendel's scientific plant breeding and the combined harvester (early 20th century); and the green revolution in the 1950s, which took millions out of hunger.[29]

Box 2: Innovation, agriculture, and the UN 2030 Agenda for Sustainable Development

In September 2015, the Member States of the United Nations (UN) adopted the 2030 Agenda for Sustainable Development, incorporating 17 Sustainable Development Goals (SDGs) and 169 targets that are being implemented at the national level by the UN Member States to shape global development in the period 2015–30.

The Agenda applies to all countries universally and aims at fostering social, environmental, and economic development. All the SDGs rely to a greater or lesser extent upon innovation for their means of implementation: Goal 9 ('Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation') makes explicit reference to innovation and refers to several innovation factors referenced in the GII, such as infrastructure, access to credit, access to information and communication technologies (ICTs) and environmentally friendly technologies, scientific research, and technology capabilities.

As this report shows, the achievement of Goal 2 ('End hunger, achieve food security and improved nutrition and promote sustainable agriculture') will greatly benefit from innovation. The goal recognizes the role of new technologies in boosting agricultural productivity and the need for public and private investments in spurring technological change in this field.

The SDGs and their associated targets provide the basis for monitoring and reviewing countries' progress in implementing sustainable development at the global, regional, and national levels. This process of review depends on a framework of statistical indicators being developed through an international consultative process led by the UN Statistical Commission.

Disaggregated data are important for monitoring and reviewing countries' progress in implementing the SDGs as well as for assessing strengths and weaknesses and identifying resource needs and priorities. On the basis of the GII, numerous workshops are taking place in different countries to bring innovation actors together with the aim of improving data availability, boosting the country's innovation performance, and designing strategic policy actions. Partnerships are ongoing between the GII publishers and many UN partner organizations—such as the International Telecommunication Union (ITU), the International Labour Organization (ILO), the United Nations Educational, Scientific and Cultural Organization (UNESCO), and the United Nations Industrial Development Organization (UNIDO)—as well as private data providers to improve the required innovation metrics.

In the process of implementing the 2030 Agenda, the GII can provide countries with a data-based tool for policy making and contribute to this shared endeavour of working towards sustainable development globally.

As a result, agricultural productivity has enjoyed periods of extraordinary growth. From the 1960s until the 1990s, the expansion of land under cultivation and higher input use—especially in the form of fertilizers and high-yield varieties—accounted for the bulk of agricultural output growth (Chapter 3). Advances in genetic engineering gave rise to a wave of technological innovations and led the transition towards commercial agriculture in many regions. The green revolution enabled developing economies to import cheaper grains and grow crops with high-yield seed varieties, with tremendous benefits for the economy and society (see Chapters 5 and 10).[30]

Stimulating investment in innovative agriculture and food production

In the same spirit, today a new innovation drive is needed to confront declining agricultural productivity and the bottlenecks of today's agricultural innovation systems (see Chapters 7, 9, 10, and 11).

First and foremost, lagging agricultural productivity growth in low- and middle-income countries and lagging agricultural R&D spending (public and/or private) across all economies (Chapter 3) need to be reversed. To reach that goal, both the public and private sectors will need to keep the R&D pipeline flowing; investments to ensure that innovative technologies and techniques are brought to fruition are required.

Second, innovations need to be better diffused throughout the agricultural and food sector, in particular in developing countries. Unfortunately, waves of technological advances roll out rather slowly in many parts of the world. As a consequence, a number of developing countries, most notably in Sub-Saharan Africa, have yet to benefit from earlier waves of agricultural innovations, such as high-yield varieties and drip irrigation systems, slowing down their structural transformation and development processes.[31]

Indeed, in several developing countries, productivity growth is still the result of expansions of cultivated land and more intensive use of inputs; technological change is having a much smaller impact in these countries (Chapter 3). Arable land, however, cannot be expanded further because of growing urbanization and environmental requirements (Chapter 3). Concerns in these areas are already materializing (see the cases of Russia and Uganda in Chapters 9 and 11, respectively).

A wave of smart agricultural innovations on the horizon

Helping to meet this need for innovation in agricultural systems, a wave of new agricultural technologies and innovations is taking place that could help overcome lagging productivity. The pace of agricultural innovation has increased over the last 10 years, with innovations from other sectors spilling over to agricultural and food systems (see Chapters 3, 4, 5, and 8). In the next decades, advances in biotechnology, autonomous vehicles, and a broader shift of agricultural innovation to data, services, and software could enable vital progress.

Rapid progress is underway in radically new technologies and new processes as applied to agricultural and food production. Advances in areas such as genetics and nano- and biotechnologies have proven their ability to be a source of higher yields and better nutrient content, even though their full environmental and health impacts have yet to be fully understood. Chapter 9 mentions exciting examples of new-generation sequencing, bioreactor-based synthetic food production, total recycling, bio-controlled and artificial agroecosystems, and vertical farming, to name a few such innovations (see Table 1 in Chapter 9 and also Chapters 3, 4, 5 and 8).

An unprecedented convergence of biology, agronomy, plant and animal science, digitization, and robotics is transforming the agri-food value chain. Big data are reshaping the world of agriculture: digital agriculture has started to spread worldwide, helped by the development of innovations in information technology (IT)—for example, sensors, drones and robotics, and virtual and augmented reality—as well as data generation and analytics enabled by remote sensing, and geographic information systems.

Fostering innovation along the agricultural value chain, including in services and processes

New technologies aside, the brunt of agricultural innovation is found in improved processes and services that occur along the agricultural value chain, be it in high-income or low-income economies (see Table 1 in Chapter 10 and Figure 2 in Chapter 11), and not only in novel technologies. Activities along the agri-food value chain range from supplying inputs such as seeds, wholesalers, and retailer agro-dealers to farming activities such as planting, farming, and harvesting and to post-harvest activities such as bulking and processing of raw output, branding and marketing of value-added agri-food products. Effective linkages and improved service delivery along this chain are just as critical, if not more, than new technologies that can maximize the innovation potential in agriculture.

In the case of developing countries, there are many significant bottlenecks along the value chain. These are mostly obstacles concerned with liquidity constraints, agricultural inputs of imperfect quality, insufficient information and awareness, and a lack of post-harvest and distribution infrastructure (see Chapter 11).

For example, most developing countries suffer from important weaknesses when it comes to benefitting from inputs appropriate to their particular circumstances, such as suitable seeds and services geared towards the country's context, such as finance and distribution (see, for example, the case of Uganda in Chapter 11). The financial sector provides an example: small rural farmers often face significant barriers in accessing credits and insurance. This reduces investment while increasing households' vulnerability (see also Chapter 3).

Organizational innovations are also as important as product or process innovations. Digitization of retail and logistics, equipment-sharing, and life-long learning are examples of ways organizational innovations can increase agricultural productivity (Chapter 9). Complex organizational changes—such as changes intended to spur the consolidation of small farms into large commercial farms—also require innovation that makes farm management more efficient, for example (see Chapter 8).

Hence a mix of technological and non-technological innovation is required in agri-food value chains. Some technologies will need to diffuse and be adapted from rich countries to developing economies, while the latter are still adopting the technologies of the previous agricultural innovation wave (genetically modified crops, drip irrigation, and so on). At the same time, developing countries increasingly need to further engage in their own domestic R&D—for example, they need to pursue domestic seed varieties and set research priorities fitting for their specific contexts, such as R&D in aquaculture (see Chapter 9).

Incentivizing agricultural innovation with good institutions, stronger linkages, and out-of-the-box thinking

Public authorities have critical roles to play in helping stimulate innovation in food and agriculture. For a start, the agricultural and food sector should be part and parcel of any national innovation strategy (see Chapter 8 for Japan's approach to creating the project Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries). To this day, this is very rarely the case because innovation policies often focus on new sectors while neglecting strengths in traditional or resource-based industries.[32]

On this basis, the promotion of specific activities that have the power to convince local players that progress is feasible and desirable should be undertaken.

More traditionally, policy makers have a responsibility to provide funding mechanisms to stimulate innovation in agriculture and food production. The mechanisms can be in several forms:

- For example, as seen in Brazil (see Chapter 7), policy makers can create sectoral agricultural funds to foster technologies in areas such as agronomy, veterinary medicine, biotechnology, economics, and agricultural sociology; and to promote technological updates in the agriculture industry and stimulate the expansion of investments in tropical agricultural biotechnology and in the diffusion of new technologies.
- The creation of focused research institutes (e.g., the Institute of Innovation in Biotechnology in Sao Paolo) is also a possibility (see Chapter 7 on Brazil).
- Providing tax relief to enhance farmers' incomes and offering preferential access to land and market support for promising agricultural techniques and technologies is also a good way forward.

Crafting balanced legal frameworks

Improving national legal and regulatory frameworks in and around agriculture—for example, by promoting the uptake of patents and plant varieties; promoting the use of trademarks, which can support innovation; adopting public safety laws on biodiversity and genetically modified varieties; and more generally streamlining regulations and reducing bureaucracy around farmers—all contribute to a more conducive environment (see Chapter 10).

Governments and policy makers also have the delicate task of providing a proper balance between inefficient agriculture in need of more technology, better fertilizers, and so on and advanced bio-farming, as well as between feeding the poor with modern intensive agriculture and creating ground-breaking new crop varieties (see Chapter 8), while also looking at environmental issues and health.

Cooperation and consultation remain a key ingredients needed to get popular support for the resulting policies and to leave room for out-of-the-box thinking.

Fostering skills and inspiring agricultural entrepreneurship

One of the key obstacles to the rapid adoption of innovative approaches in agriculture and food production still is to be found in inadequate information, a lack of skills, and, sometimes, the lack of acceptance of new products or ways to produce them. Experiences from various parts of the world in this year's GII chapters indicate how priorities need to be pursued in this area.

First, agricultural extension efforts to disseminate knowledge about new technologies and techniques, and to demonstrate their business case, are required. These services include training in technology and managerial skills and in the diffusion of information such as metrological data. This would provide adequate information to farmers, ensure that key workers along the value chain have sufficient relevant skills, and encourage the adoption of new products and processes.

Second, farmers need to be empowered by providing access to digital technology and the new service platforms that have immense potential to positively impact agriculture (see Chapters 3 and 5).

Third, entrepreneurship within the agriculture sector needs to be recognized and inspired to a much more significant extent. In India, for example, venture capital has started flowing to agricultural projects through programmes such as Startup India (see Chapter 5). A flurry of new start-ups is on the rise, on par with other high-technology sectors, and with ideas that can have an immediate impact on societal well-being.

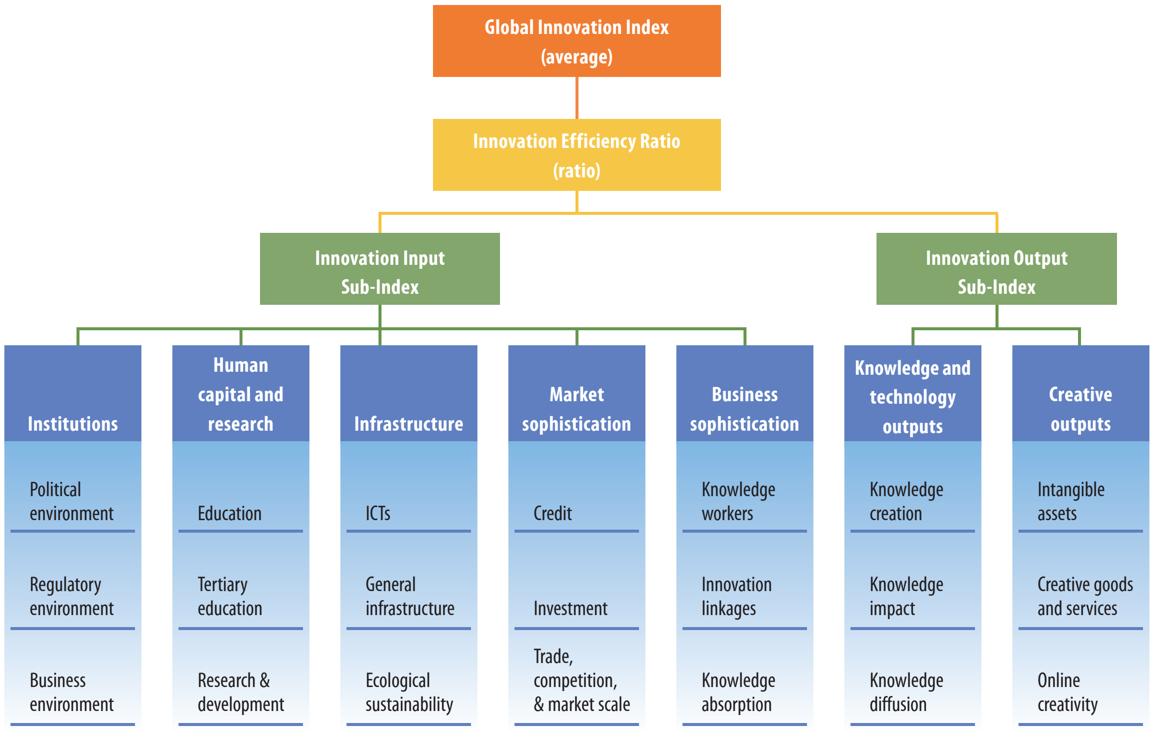
Fourth, both the private sector and government can also help infuse excellence and innovative attitudes in other vital sectors into the agriculture sector. In India, such an approach has helped enhance the impact of information technology (IT) in unlocking value for the grassroots level in areas such as mobile payments or health (see Chapter 5). Over the last five years, the Indian agriculture sector has also attracted leading IT companies and investors; available technology and digital solutions are expanding at an impressive pace.

Scaling up local initiatives and ensuring technology diffusion

Local (sub-national) initiatives are also important: grassroots innovations that can often be scaled up are happening in low- and middle-income economies' farming. In such contexts, links between public research institutions, firms, and the grassroots level are key.

Efforts to enhance the efficiency of the innovation system should focus on reducing lags between successful R&D efforts and the widespread adoption of agricultural innovations. In a number of countries (see Chapters 9, 10, and 11), several factors—including the lack of complementary investments and capacity—hamper spillovers from public research to enterprises. Accelerating technology transfers through the establishment of clear rules of engagement in university-industry interactions, including the commercialization of IP derived from these, is a good option.[33] Supporting the demand for innovation with farmers and commercial farming operations is equally important.

Figure 2: Framework of the Global Innovation Index 2017



More accurately measuring agricultural innovation to simulate progress

Agriculture today is radically different from agriculture a couple of decades ago: more digital, smarter, and more integrated. A better understanding of agricultural innovation in general, but these new forms of innovation in particular, is now crucial (Chapter 2 and Annex 4). Data are needed to better inform decision makers about gaps and opportunities in agricultural capacity, and to monitor and evaluate requirements and progress, recognizing the broader agricultural innovation system—including informal actors, households, extension services, rural advisory services and farmer organizations, and the quantitative and qualitative dimension of their interactions.[34] Annex 4 describes available and missing data sources, and which countries lead and lag in agricultural innovation.

A transition towards sustainable growth is paramount if the world is to cope successfully with the global challenges it is facing today. Agriculture and food systems can play a tremendous role in this, but a concerted effort towards more granular agriculture-specific data collection is needed to understand what works and what does not, and how governments and public policies can help promote innovation in agriculture and food.

The GII 2017 conceptual framework

The GII helps to create an environment in which innovation factors are continually evaluated. It provides a key tool of detailed metrics for 127 economies this year, representing 92.5% of the world's population and 97.6% of the world's GDP (in current US dollars).

Four measures are calculated: the overall GII, the Input and Output Sub-Indices, and the Innovation Efficiency Ratio (Figure 2).

- **The overall GII score** is the simple average of the Input and Output Sub-Index scores.
- **The Innovation Input Sub-Index** is comprised of five input pillars that capture elements of the national economy that enable innovative activities: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication.

- **The Innovation Output Sub-Index** provides information about outputs that are the results of innovative activities within the economy. There are two output pillars: (6) Knowledge and technology outputs and (7) Creative outputs.
- **The Innovation Efficiency Ratio** is the ratio of the Output Sub-Index score over the Input Sub-Index score. It shows how much innovation output a given country is getting for its inputs.

Each pillar is divided into three sub-pillars and each sub-pillar is composed of individual indicators, for a total of 81 indicators this year.

Further details on the GII framework and the indicators used are provided in Annex 1. It is important to note that each year the variables included in the GII computation are reviewed and updated to provide the best and most current assessment of global innovation. Other methodological issues—such as missing data, revised scaling factors, and new countries added to the sample—also impact year-on-year comparability of the rankings (details of these changes to the framework and factors impacting year-on-year comparability are provided in Annex 2).

Most notably, a more stringent criterion for the inclusion of countries in the GII was adopted in 2016, following the Joint Research Centre (JRC) recommendation of past GII audits (see Annex 3 in this report and in previous years). Economies and countries were included in the GII 2017 only if 66% of data were available within each of the two sub-indices and if at least two of sub-pillars in each pillar could be computed. This more stringent criterion for inclusion in the GII ensures that country scores for the GII and for the two Input and Output Sub-Indices are not particularly sensitive to the missing values. As noted by the audit, this more stringent threshold has notably improved the confidence in the country ranks for the GII and the two sub-indices, and thus the reliability of the GII rankings (see Annex 3). The rules on missing data and minimum coverage per sub-pillar will be progressively tightened, leading to the exclusion of countries that fail to meet the desired minimum coverage in any sub-pillar (see Annex 2 for more details).

The Global Innovation Index 2017 results

The GII 2017 results have shown consistency in areas such as top rankings and the innovation divide. However, there also have been some new high-level developments as described below.

Stability at the top, led by Switzerland, Sweden, and the Netherlands

In 2017, the GII remains relatively stable at the top. Switzerland leads the rankings for the seventh consecutive year, while Sweden maintains its 2nd place. The Netherlands ranks 3rd, although most of this improvement is the result of methodological changes and improved data availability. The USA remains stable at the 4th spot, while the UK moves down two positions to take 5th place. Denmark improves another two positions this year, ranking 6th. Singapore, Finland, and Ireland move down, occupying the 7th, 8th, and 10th spots, respectively. Germany, which entered the top 10 in 2016, continues its advancement, moving up one position from last year and occupying the 9th spot. Hence, despite some movement, the top 10 does not see any new entrant this year.

Figure 3 shows movement in the top 10 ranked economies over the last four years:

1. *Switzerland*
2. *Sweden*
3. *Netherlands*
4. *United States of America*
5. *United Kingdom*
6. *Denmark*
7. *Singapore*
8. *Finland*
9. *Germany*
10. *Ireland*

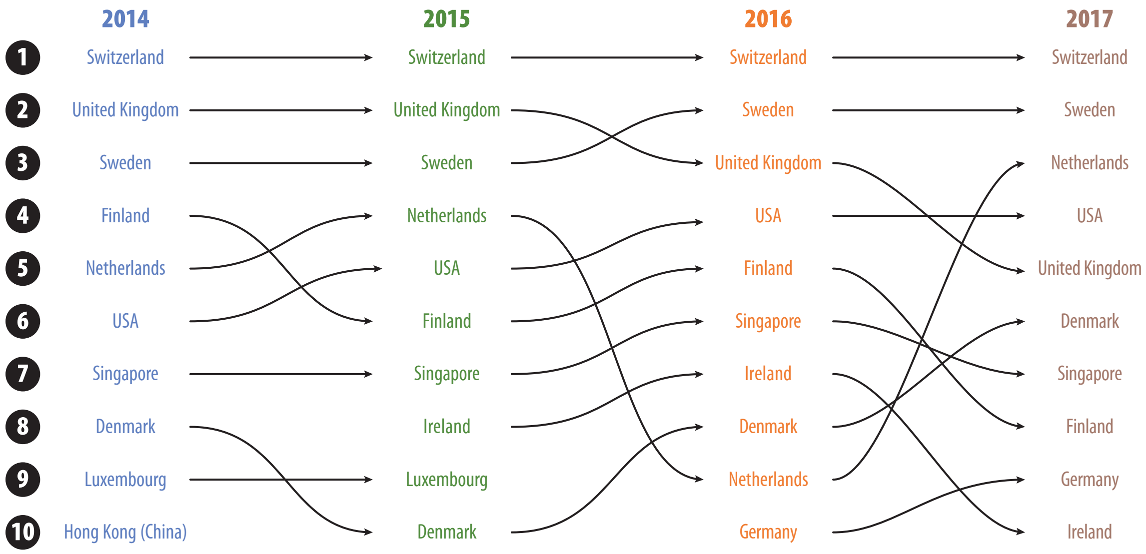
Furthermore, stability remains across the top 25 economies with only a few exceptions. China moves up by three places, becoming the 22nd most innovative economy in the world after entering the top 25 in the GII 2016. Israel gains four positions this year, ranking 17th and swapping spots with New Zealand (21st). Other economies move up by two or more places: Japan (14th), France (15th), and Norway (19th). Australia moves down four spots, ranking 23rd this year. Hong Kong (China) and Canada each lose two or more positions, ranking 16th and 18th respectively. The Czech Republic regains its place in the top 25, gaining three positions from last year and moving to 24th. Belgium leaves the top 25 this year, ranking 27th.

Box 3 discusses the measure of innovation quality among GII 2017 economies. Box 4 delves into the innovation divide between the top 25 ranked economies (24 of which are high-income) and the group of middle- and low-income economies.

2017 results: The world's top innovators

The following section describes and analyses the prominent features of the GII 2017 results for the global leaders in each component of the GII and the best performers in light of their income level.[35] A short discussion of the rankings at the regional level follows.[36]

Figure 3: Movement in the top 10 of the GII



Note: Year-on-year GII rank changes are influenced by performance and methodological considerations; see Annex 2.

Tables 1 through 3 on pages 14–19 present the rankings of all economies included in the GII 2017 for the GII and the Input and Output Sub-Indices.

The top 10 in the Global Innovation Index

Switzerland has earned the number 1 position in the GII for the seventh consecutive year. It has maintained this top spot since 2011, as well as its number 1 position in the Innovation Output Sub-Index and in the Knowledge and technology outputs pillar since 2012. Its lead seems largely uncontested. For the first time it ranks among the top 10 in all pillars and is the 3rd economy in the world in innovation quality (see Box 3). Thanks to its improvements in Institutions (8th), Infrastructure (6th), and Creative outputs (3rd), its Innovation Efficiency Ratio has improved from 5th to 2nd. As in previous years, it ranks among the top 25 in all sub-pillars, with only three exceptions: Business environment (33rd), Education (28th), and Information and communication technologies (ICTs, 30th). Switzerland ranks 1st in Knowledge creation and in a number of important indicators, including patent families in 2 or more offices, PCT patent applications, and high- and medium-high-tech manufactures. With its favourable business environment and solid innovation capabilities, Switzerland remains highly successful in transforming its resources into more numerous, and more varied, innovation outputs. Despite this strong performance, Switzerland presents a few areas of weakness, especially on the input side. These include ease of starting a business, graduates in science and engineering, gross capital formation, ease of getting credit, and growth rate of GDP per worker.

Sweden holds the second highest position in the GII, remaining the top Nordic economy and ranking among the top 10 in all pillars with the exception of Creative outputs (11th). It improves in the Innovation Input Sub-Index (2nd), with gains in all pillars but Market sophistication (10th). Among the largest improvements, Sweden gains 11 positions in Innovation linkages (6th), 10 positions in Knowledge impact (10th), 7 positions in ICTs (13th), and 6 positions in Knowledge absorption (7th). Its largest drops are in Tertiary education (28th), Ecological sustainability (20th), Trade, competition, and market scale (28th), and Creative goods and services (18th). At the indicator level, Sweden keeps its 1st position in PCT patent applications, while achieving a big leap in labour productivity growth. It improves the most in government's online service, e-participation, and JV-strategic alliance deals, while benefiting from the new measure averaging FDI net in-flows (see Annex 2). Areas of weakness include pupil-teacher ratio, GDP per unit of energy use, ease of getting credit, FDI net inflows, trademarks by

Table 1: Global Innovation Index rankings

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Efficiency Ratio	Rank
Switzerland	67.69	1	HI	1	EUR	1	0.95	2
Sweden	63.82	2	HI	2	EUR	2	0.83	12
Netherlands	63.36	3	HI	3	EUR	3	0.93	4
United States of America	61.40	4	HI	4	NAC	1	0.78	21
United Kingdom	60.89	5	HI	5	EUR	4	0.78	20
Denmark	58.70	6	HI	6	EUR	5	0.71	34
Singapore	58.69	7	HI	7	SEAO	1	0.62	63
Finland	58.49	8	HI	8	EUR	6	0.70	37
Germany	58.39	9	HI	9	EUR	7	0.84	7
Ireland	58.13	10	HI	10	EUR	8	0.85	6
Korea, Rep.	57.70	11	HI	11	SEAO	2	0.82	14
Luxembourg	56.40	12	HI	12	EUR	9	0.97	1
Iceland	55.76	13	HI	13	EUR	10	0.86	5
Japan	54.72	14	HI	14	SEAO	3	0.67	49
France	54.18	15	HI	15	EUR	11	0.71	35
Hong Kong (China)	53.88	16	HI	16	SEAO	4	0.61	73
Israel	53.88	17	HI	17	NAWA	1	0.77	23
Canada	53.65	18	HI	18	NAC	2	0.64	59
Norway	53.14	19	HI	19	EUR	12	0.66	51
Austria	53.10	20	HI	20	EUR	13	0.69	41
New Zealand	52.87	21	HI	21	SEAO	5	0.65	56
China	52.54	22	UM	1	SEAO	6	0.94	3
Australia	51.83	23	HI	22	SEAO	7	0.60	76
Czech Republic	50.98	24	HI	23	EUR	14	0.83	13
Estonia	50.93	25	HI	24	EUR	15	0.79	19
Malta	50.60	26	HI	25	EUR	16	0.84	8
Belgium	49.85	27	HI	26	EUR	17	0.67	47
Spain	48.81	28	HI	27	EUR	18	0.70	36
Italy	46.96	29	HI	28	EUR	19	0.73	31
Cyprus	46.84	30	HI	29	NAWA	2	0.74	28
Portugal	46.05	31	HI	30	EUR	20	0.71	33
Slovenia	45.80	32	HI	31	EUR	21	0.68	44
Latvia	44.61	33	HI	32	EUR	22	0.74	26
Slovakia	43.43	34	HI	33	EUR	23	0.75	25
United Arab Emirates	43.24	35	HI	34	NAWA	3	0.49	104
Bulgaria	42.84	36	UM	2	EUR	24	0.80	15
Malaysia	42.72	37	UM	3	SEAO	8	0.68	46
Poland	41.99	38	HI	35	EUR	25	0.67	48
Hungary	41.74	39	HI	36	EUR	26	0.73	30
Lithuania	41.17	40	HI	37	EUR	27	0.59	84
Croatia	39.80	41	HI	38	EUR	28	0.66	52
Romania	39.16	42	UM	4	EUR	29	0.69	39
Turkey	38.90	43	UM	5	NAWA	4	0.84	9
Greece	38.85	44	HI	39	EUR	30	0.56	87
Russian Federation	38.76	45	UM	6	EUR	31	0.61	75
Chile	38.70	46	HI	40	LCN	1	0.60	77
Viet Nam	38.34	47	LM	1	SEAO	9	0.84	10
Montenegro	38.07	48	UM	7	EUR	32	0.63	62
Qatar	37.90	49	HI	41	NAWA	5	0.61	68
Ukraine	37.62	50	LM	2	EUR	33	0.83	11
Thailand	37.57	51	UM	8	SEAO	10	0.75	24
Mongolia	37.13	52	LM	3	SEAO	11	0.74	27
Costa Rica	37.09	53	UM	9	LCN	2	0.69	43
Moldova, Rep.	36.84	54	LM	4	EUR	34	0.78	22
Saudi Arabia	36.17	55	HI	42	NAWA	6	0.53	96
Kuwait	36.10	56	HI	43	NAWA	7	0.79	18
South Africa	35.80	57	UM	10	SSF	1	0.53	97
Mexico	35.79	58	UM	11	LCN	3	0.61	74
Armenia	35.65	59	LM	5	NAWA	8	0.80	17
India	35.47	60	LM	6	CSA	1	0.66	53
TFYR of Macedonia	35.43	61	UM	12	EUR	35	0.59	80
Serbia	35.34	62	UM	13	EUR	36	0.61	67
Panama	34.98	63	UM	14	LCN	4	0.69	38
Mauritius	34.82	64	UM	15	SSF	2	0.48	109

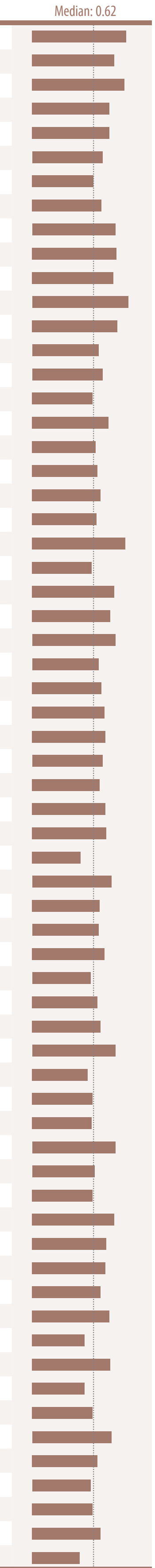


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Table 1: Global Innovation Index rankings *(continued)*

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Efficiency Ratio	Rank	Median: 0.62
Colombia	34.78	65	UM	16	LCN	5	0.52	100	
Bahrain	34.67	66	HI	44	NAWA	9	0.56	88	
Uruguay	34.53	67	HI	45	LCN	6	0.59	82	
Georgia	34.39	68	UM	17	NAWA	10	0.63	60	
Brazil	33.10	69	UM	18	LCN	7	0.52	99	
Peru	32.90	70	UM	19	LCN	8	0.49	106	
Brunei Darussalam	32.89	71	HI	46	SEAO	12	0.34	124	
Morocco	32.72	72	LM	7	NAWA	11	0.61	71	
Philippines	32.48	73	LM	8	SEAO	13	0.65	55	
Tunisia	32.30	74	LM	9	NAWA	12	0.62	65	
Iran, Islamic Rep.	32.09	75	UM	20	CSA	2	0.80	16	
Argentina	32.00	76	UM	21	LCN	9	0.55	94	
Oman	31.83	77	HI	47	NAWA	13	0.46	115	
Kazakhstan	31.50	78	UM	22	CSA	3	0.46	116	
Dominican Republic	31.17	79	UM	23	LCN	10	0.65	54	
Kenya	30.95	80	LM	10	SSF	3	0.66	50	
Lebanon	30.64	81	UM	24	NAWA	14	0.61	69	
Azerbaijan	30.58	82	UM	25	NAWA	15	0.50	103	
Jordan	30.52	83	UM	26	NAWA	16	0.65	57	
Jamaica	30.36	84	UM	27	LCN	11	0.57	86	
Paraguay	30.30	85	UM	28	LCN	12	0.61	72	
Bosnia and Herzegovina	30.23	86	UM	29	EUR	37	0.47	112	
Indonesia	30.10	87	LM	11	SEAO	14	0.69	42	
Belarus	29.98	88	UM	30	EUR	38	0.39	120	
Botswana	29.97	89	UM	31	SSF	4	0.38	121	
Sri Lanka	29.85	90	LM	12	CSA	4	0.65	58	
Trinidad and Tobago	29.75	91	HI	48	LCN	13	0.56	90	
Ecuador	29.14	92	UM	32	LCN	14	0.62	66	
Albania	28.86	93	UM	33	EUR	39	0.37	122	
Tajikistan	28.16	94	LM	13	CSA	5	0.59	83	
Kyrgyzstan	28.01	95	LM	14	CSA	6	0.47	114	
Tanzania, United Rep.	27.97	96	LI	1	SSF	5	0.73	29	
Namibia	27.94	97	UM	34	SSF	6	0.48	108	
Guatemala	27.90	98	LM	15	LCN	15	0.56	91	
Rwanda	27.36	99	LI	2	SSF	7	0.33	125	
Senegal	27.11	100	LI	3	SSF	8	0.54	95	
Cambodia	27.05	101	LM	16	SEAO	15	0.63	61	
Uganda	26.97	102	LI	4	SSF	9	0.47	113	
El Salvador	26.68	103	LM	17	LCN	16	0.48	107	
Honduras	26.36	104	LM	18	LCN	17	0.52	101	
Egypt	26.00	105	LM	19	NAWA	17	0.59	81	
Bolivia, Plurinational St.	25.64	106	LM	20	LCN	18	0.57	85	
Mozambique	24.55	107	LI	5	SSF	10	0.61	70	
Algeria	24.34	108	UM	35	NAWA	18	0.47	111	
Nepal	24.20	109	LI	6	CSA	7	0.49	105	
Ethiopia	24.16	110	LI	7	SSF	11	0.72	32	
Madagascar	24.15	111	LI	8	SSF	12	0.68	45	
Côte d'Ivoire	23.96	112	LM	21	SSF	13	0.69	40	
Pakistan	23.80	113	LM	22	CSA	8	0.62	64	
Bangladesh	23.72	114	LM	23	CSA	9	0.55	93	
Malawi	23.45	115	LI	9	SSF	14	0.53	98	
Benin	23.04	116	LI	10	SSF	15	0.47	110	
Cameroon	22.58	117	LM	24	SSF	16	0.56	92	
Mali	22.48	118	LI	11	SSF	17	0.60	78	
Nigeria	21.92	119	LM	25	SSF	18	0.52	102	
Burkina Faso	21.86	120	LI	12	SSF	19	0.24	127	
Zimbabwe	21.80	121	LI	13	SSF	20	0.56	89	
Burundi	21.31	122	LI	14	SSF	21	0.41	117	
Niger	21.18	123	LI	15	SSF	22	0.36	123	
Zambia	20.83	124	LM	26	SSF	23	0.59	79	
Togo	18.41	125	LI	16	SSF	24	0.28	126	
Guinea	17.41	126	LI	17	SSF	25	0.40	118	
Yemen	15.64	127	LM	27	NAWA	19	0.40	119	

Note: World Bank Income Group Classification (July 2016): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income. Regions are based on the United Nations Classification: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

Table 2: Innovation Input Sub-Index rankings

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median: 43.15
Singapore	72.25	1	HI	1	SEAO	1	
Sweden	69.72	2	HI	2	EUR	1	
Switzerland	69.60	3	HI	3	EUR	2	
Finland	68.93	4	HI	4	EUR	3	
United States of America	68.87	5	HI	5	NAC	1	
Denmark	68.68	6	HI	6	EUR	4	
United Kingdom	68.25	7	HI	7	EUR	5	
Hong Kong (China)	66.95	8	HI	8	SEAO	2	
Netherlands	65.79	9	HI	9	EUR	6	
Canada	65.57	10	HI	10	NAC	2	
Japan	65.45	11	HI	11	SEAO	3	
Australia	64.61	12	HI	12	SEAO	4	
New Zealand	64.14	13	HI	13	SEAO	5	
Norway	63.99	14	HI	14	EUR	7	
France	63.41	15	HI	15	EUR	8	
Korea, Rep.	63.34	16	HI	16	SEAO	6	
Germany	63.33	17	HI	17	EUR	9	
Austria	62.92	18	HI	18	EUR	10	
Ireland	62.86	19	HI	19	EUR	11	
Israel	61.01	20	HI	20	NAWA	1	
Iceland	60.10	21	HI	21	EUR	12	
Belgium	59.53	22	HI	22	EUR	13	
United Arab Emirates	57.96	23	HI	23	NAWA	2	
Luxembourg	57.36	24	HI	24	EUR	14	
Spain	57.28	25	HI	25	EUR	15	
Estonia	56.99	26	HI	26	EUR	16	
Czech Republic	55.72	27	HI	27	EUR	17	
Malta	54.91	28	HI	28	EUR	18	
Italy	54.43	29	HI	29	EUR	19	
Slovenia	54.40	30	HI	30	EUR	20	
China	54.22	31	UM	1	SEAO	7	
Cyprus	53.92	32	HI	31	NAWA	3	
Portugal	53.80	33	HI	32	EUR	21	
Lithuania	51.92	34	HI	33	EUR	22	
Latvia	51.25	35	HI	34	EUR	23	
Malaysia	50.94	36	UM	2	SEAO	8	
Poland	50.20	37	HI	35	EUR	24	
Greece	49.73	38	HI	36	EUR	25	
Slovakia	49.66	39	HI	37	EUR	26	
Brunei Darussalam	49.27	40	HI	38	SEAO	9	
Hungary	48.36	41	HI	39	EUR	27	
Chile	48.31	42	HI	40	LCN	1	
Russian Federation	48.21	43	UM	3	EUR	28	
Croatia	47.96	44	HI	41	EUR	29	
Bulgaria	47.61	45	UM	4	EUR	30	
Saudi Arabia	47.33	46	HI	42	NAWA	4	
Mauritius	47.13	47	UM	5	SSF	1	
Qatar	46.96	48	HI	43	NAWA	5	
South Africa	46.85	49	UM	6	SSF	2	
Montenegro	46.83	50	UM	7	EUR	31	
Romania	46.36	51	UM	8	EUR	32	
Colombia	45.75	52	UM	9	LCN	2	
TFYR of Macedonia	44.53	53	UM	10	EUR	33	
Mexico	44.52	54	UM	11	LCN	3	
Bahrain	44.41	55	HI	44	NAWA	6	
Peru	44.21	56	UM	12	LCN	4	
Costa Rica	43.97	57	UM	13	LCN	5	
Serbia	43.79	58	UM	14	EUR	34	
Botswana	43.58	59	UM	15	SSF	3	
Brazil	43.47	60	UM	16	LCN	6	
Uruguay	43.47	61	HI	45	LCN	7	
Oman	43.46	62	HI	46	NAWA	7	
Belarus	43.24	63	UM	17	EUR	35	
Kazakhstan	43.15	64	UM	18	CSA	1	

(Continued on next page)

Table 2: Innovation Input Sub-Index rankings *(continued)*

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median: 43.15
Thailand	42.92	65	UM	19	SEAO	10	
India	42.84	66	LM	1	CSA	2	
Mongolia	42.71	67	LM	2	SEAO	11	
Turkey	42.32	68	UM	20	NAWA	8	
Georgia	42.16	69	UM	21	NAWA	9	
Albania	42.03	70	UM	22	EUR	36	
Viet Nam	41.75	71	LM	3	SEAO	12	
Argentina	41.38	72	UM	23	LCN	8	
Moldova, Rep.	41.35	73	LM	4	EUR	37	
Panama	41.28	74	UM	24	LCN	9	
Bosnia and Herzegovina	41.14	75	UM	25	EUR	38	
Rwanda	41.07	76	LI	1	SSF	4	
Ukraine	41.05	77	LM	5	EUR	39	
Azerbaijan	40.70	78	UM	26	NAWA	10	
Morocco	40.59	79	LM	6	NAWA	11	
Kuwait	40.30	80	HI	47	NAWA	12	
Tunisia	39.99	81	LM	7	NAWA	13	
Armenia	39.71	82	LM	8	NAWA	14	
Philippines	39.40	83	LM	9	SEAO	13	
Jamaica	38.69	84	UM	27	LCN	10	
Trinidad and Tobago	38.22	85	HI	48	LCN	11	
Kyrgyzstan	38.16	86	LM	10	CSA	3	
Lebanon	37.99	87	UM	28	NAWA	15	
Dominican Republic	37.80	88	UM	29	LCN	12	
Namibia	37.76	89	UM	30	SSF	5	
Paraguay	37.62	90	UM	31	LCN	13	
Kenya	37.19	91	LM	11	SSF	6	
Jordan	37.07	92	UM	32	NAWA	16	
Uganda	36.71	93	LI	2	SSF	7	
Sri Lanka	36.28	94	LM	12	CSA	4	
Ecuador	36.07	95	UM	33	LCN	14	
El Salvador	36.06	96	LM	13	LCN	15	
Guatemala	35.86	97	LM	14	LCN	16	
Iran, Islamic Rep.	35.71	98	UM	34	CSA	5	
Indonesia	35.68	99	LM	15	SEAO	14	
Tajikistan	35.50	100	LM	16	CSA	6	
Burkina Faso	35.28	101	LI	3	SSF	8	
Senegal	35.23	102	LI	4	SSF	9	
Honduras	34.77	103	LM	17	LCN	17	
Cambodia	33.19	104	LM	18	SEAO	15	
Algeria	33.12	105	UM	35	NAWA	17	
Egypt	32.69	106	LM	19	NAWA	18	
Bolivia, Plurinational St.	32.62	107	LM	20	LCN	18	
Nepal	32.51	108	LI	5	CSA	7	
Tanzania, United Rep.	32.31	109	LI	6	SSF	10	
Benin	31.30	110	LI	7	SSF	11	
Niger	31.18	111	LI	8	SSF	12	
Malawi	30.75	112	LI	9	SSF	13	
Bangladesh	30.64	113	LM	21	CSA	8	
Mozambique	30.45	114	LI	10	SSF	14	
Burundi	30.21	115	LI	11	SSF	15	
Pakistan	29.43	116	LM	22	CSA	9	
Cameroon	29.03	117	LM	23	SSF	16	
Nigeria	28.94	118	LM	24	SSF	17	
Togo	28.81	119	LI	12	SSF	18	
Madagascar	28.78	120	LI	13	SSF	19	
Côte d'Ivoire	28.39	121	LM	25	SSF	20	
Ethiopia	28.16	122	LI	14	SSF	21	
Mali	28.14	123	LI	15	SSF	22	
Zimbabwe	27.98	124	LI	16	SSF	23	
Zambia	26.14	125	LM	26	SSF	24	
Guinea	24.86	126	LI	17	SSF	25	
Yemen	22.38	127	LM	27	NAWA	19	

Note: World Bank Income Group Classification (July 2016): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income. Regions are based on the United Nations Classification: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

Table 3: Innovation Output Sub-Index rankings

Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median: 25.60
Switzerland	65.78	1	HI	1	EUR	**1**	
Netherlands	60.92	2	HI	2	EUR	2	
Sweden	57.92	3	HI	3	EUR	3	
Luxembourg	55.43	4	HI	4	EUR	**4**	
United States of America	53.93	5	HI	5	NAC	1	
United Kingdom	53.52	6	HI	6	EUR	**5**	
Germany	53.46	7	HI	7	EUR	6	
Ireland	53.41	8	HI	8	EUR	7	
Korea, Rep.	52.06	9	HI	9	SEAO	1	
Iceland	51.42	10	HI	10	EUR	8	
China	50.87	11	UM	1	SEAO	2	
Denmark	48.71	12	HI	11	EUR	9	
Finland	48.06	13	HI	12	EUR	10	
Israel	46.75	14	HI	13	NAWA	1	
Malta	46.29	15	HI	14	EUR	11	
Czech Republic	46.24	16	HI	15	EUR	12	
Singapore	45.14	17	HI	16	SEAO	3	
France	44.94	18	HI	17	EUR	13	
Estonia	44.87	19	HI	18	EUR	14	
Japan	43.99	20	HI	19	SEAO	4	
Austria	43.27	21	HI	20	EUR	**15**	
Norway	42.29	22	HI	21	EUR	16	
Canada	41.73	23	HI	22	NAC	2	
New Zealand	41.59	24	HI	23	SEAO	5	
Hong Kong (China)	40.81	25	HI	24	SEAO	6	
Spain	40.34	26	HI	25	EUR	17	
Belgium	40.17	27	HI	26	EUR	18	
Cyprus	39.75	28	HI	27	NAWA	2	
Italy	39.50	29	HI	28	EUR	19	
Australia	39.06	30	HI	29	SEAO	7	
Portugal	38.30	31	HI	30	EUR	20	
Bulgaria	38.08	32	UM	2	EUR	21	
Latvia	37.97	33	HI	31	EUR	22	
Slovenia	37.21	34	HI	32	EUR	23	
Slovakia	37.20	35	HI	33	EUR	24	
Turkey	35.48	36	UM	3	NAWA	3	
Hungary	35.13	37	HI	34	EUR	25	
Viet Nam	34.92	38	LM	1	SEAO	8	
Malaysia	34.49	39	UM	4	SEAO	9	
Ukraine	34.19	40	LM	2	EUR	26	
Poland	33.78	41	HI	35	EUR	27	
Moldova, Rep.	32.33	42	LM	3	EUR	28	
Thailand	32.22	43	UM	5	SEAO	10	
Romania	31.95	44	UM	6	EUR	**29**	
Kuwait	31.91	45	HI	36	NAWA	4	
Croatia	31.63	46	HI	37	EUR	30	
Armenia	31.60	47	LM	4	NAWA	5	
Mongolia	31.55	48	LM	5	SEAO	11	
Lithuania	30.42	49	HI	38	EUR	31	
Costa Rica	30.20	50	UM	7	LCN	1	
Russian Federation	29.31	51	UM	8	EUR	32	
Montenegro	29.30	52	UM	9	EUR	33	
Chile	29.09	53	HI	39	LCN	**2**	
Qatar	28.84	54	HI	40	NAWA	6	
Panama	28.67	55	UM	10	LCN	3	
United Arab Emirates	28.52	56	HI	41	NAWA	7	
Iran, Islamic Rep.	28.47	57	UM	11	CSA	1	
India	28.11	58	LM	6	CSA	2	
Greece	27.96	59	HI	42	EUR	34	
Mexico	27.07	60	UM	12	LCN	4	
Serbia	26.90	61	UM	13	EUR	35	
Georgia	26.61	62	UM	14	NAWA	8	
TFYR of Macedonia	26.32	63	UM	15	EUR	36	
Uruguay	25.60	64	HI	43	LCN	5	

(Continued on next page)

Table 3: Innovation Output Sub-Index rankings *(continued)*

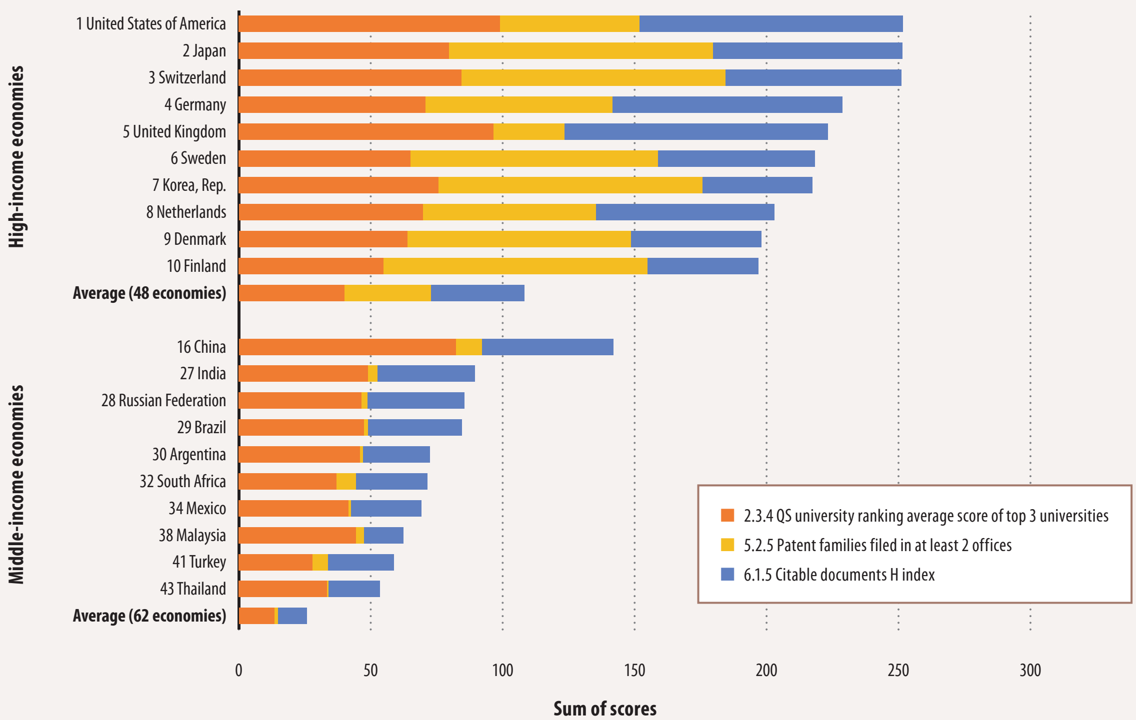
Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median: 25.60
Philippines	25.57	65	LM	7	SEAO	12	
Saudi Arabia	25.00	66	HI	44	NAWA	9	
Bahrain	24.92	67	HI	45	NAWA	**10**	
Morocco	24.85	68	LM	8	NAWA	11	
South Africa	24.74	69	UM	16	SSF	1	
Kenya	24.71	70	LM	9	SSF	2	
Tunisia	24.62	71	LM	10	NAWA	12	
Dominican Republic	24.54	72	UM	17	LCN	6	
Indonesia	24.52	73	LM	11	SEAO	13	
Jordan	23.96	74	UM	18	NAWA	13	
Colombia	23.82	75	UM	19	LCN	7	
Tanzania, United Rep.	23.63	76	LI	1	SSF	3	
Sri Lanka	23.42	77	LM	12	CSA	3	
Lebanon	23.28	78	UM	20	NAWA	14	
Paraguay	22.99	79	UM	21	LCN	8	
Brazil	22.72	80	UM	22	LCN	9	
Argentina	22.62	81	UM	23	LCN	10	
Mauritius	22.51	82	UM	24	SSF	4	
Ecuador	22.20	83	UM	25	LCN	11	
Jamaica	22.03	84	UM	26	LCN	12	
Peru	21.60	85	UM	27	LCN	13	
Trinidad and Tobago	21.27	86	HI	46	LCN	14	
Cambodia	20.91	87	LM	13	SEAO	14	
Tajikistan	20.81	88	LM	14	CSA	4	
Azerbaijan	20.46	89	UM	28	NAWA	15	
Oman	20.19	90	HI	47	NAWA	16	
Ethiopia	20.16	91	LI	2	SSF	5	
Guatemala	19.93	92	LM	15	LCN	15	
Kazakhstan	19.85	93	UM	29	CSA	5	
Côte d'Ivoire	19.53	94	LM	16	SSF	6	
Madagascar	19.53	95	LI	3	SSF	7	
Bosnia and Herzegovina	19.32	96	UM	30	EUR	37	
Egypt	19.31	97	LM	17	NAWA	17	
Senegal	18.98	98	LI	4	SSF	8	
Bolivia, Plurinational St.	18.66	99	LM	18	LCN	16	
Mozambique	18.64	100	LI	5	SSF	9	
Pakistan	18.16	101	LM	19	CSA	6	
Namibia	18.11	102	UM	31	SSF	10	
Honduras	17.96	103	LM	20	LCN	17	
Kyrgyzstan	17.86	104	LM	21	CSA	7	
El Salvador	17.31	105	LM	22	LCN	18	
Uganda	17.23	106	LI	6	SSF	11	
Mali	16.82	107	LI	7	SSF	12	
Bangladesh	16.80	108	LM	23	CSA	8	
Belarus	16.72	109	UM	32	EUR	38	
Brunei Darussalam	16.51	110	HI	48	SEAO	15	
Botswana	16.36	111	UM	33	SSF	13	
Malawi	16.15	112	LI	8	SSF	14	
Cameroon	16.12	113	LM	24	SSF	15	
Nepal	15.90	114	LI	9	CSA	9	
Albania	15.69	115	UM	34	EUR	39	
Zimbabwe	15.61	116	LI	10	SSF	16	
Algeria	15.56	117	UM	35	NAWA	18	
Zambia	15.52	118	LM	25	SSF	17	
Nigeria	14.90	119	LM	26	SSF	18	
Benin	14.78	120	LI	11	SSF	19	
Rwanda	13.66	121	LI	12	SSF	20	
Burundi	12.40	122	LI	13	SSF	21	
Niger	11.18	123	LI	14	SSF	22	
Guinea	9.97	124	LI	15	SSF	23	
Yemen	8.90	125	LM	27	NAWA	19	
Burkina Faso	8.45	126	LI	16	SSF	24	
Togo	8.02	127	LI	17	SSF	25	

Note: World Bank Income Group Classification (July 2016): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income. Regions are based on the United Nations Classification: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

Box 3: Innovation quality: The USA, Japan, the UK, China, and India at the top of their income groups

Measuring the quality of innovation-related input and output indicators is as essential as tracking their magnitude. To this end, three additional indicators were introduced into the GII in 2013: (1) quality of local universities (indicator 2.3.4, QS university ranking average score of top 3 universities); (2) internationalization of local inventions (indicator 5.2.5, patent families filed in three offices, changed to patent families filed in two offices in the GII 2016); and (3) the number of citations that local research documents receive abroad (indicator 6.1.5, citable documents H index). Figure 3.1 shows how the scores on these three indicators add up, and captures the top 10 highest performing high- and middle-income economies.

Figure 3.1: Metrics for quality of innovation: Top 10 high- and top 10 middle-income economies



Source: GII 2017 data.

Notes: Numbers to the left of the economy name are the innovation quality rank. Economies are classified by income according to the World Bank Income Group Classification (July 2016). Upper- and lower-middle income categories are grouped together as middle-income economies.

(Continued on next page)

origin, and printing and publishing manufactures.

The Netherlands reaches the 3rd position this year, ranking 2nd in the Innovation Output Sub-Index and 4th in the Innovation Efficiency Ratio. Indeed, the Netherlands had lost five positions last year as a result of large fluctuations in selected data points (see page 26 in the GII 2016), which are now better accounted for.[37] As a result, this year the Netherlands ranks 6th in FDI net inflows and 1st in outflows. As discussed in more detail in Box 4, newly available data positively affect two pillars of the Netherlands—Business sophistication (1st) and Knowledge and technology outputs (2nd). The Netherlands has improved its rankings in a number of other areas as well, including Education (18th), Innovation linkages (7th), and Knowledge impact (17th), in part because of gains in GERD financed by abroad and expenditure in education. Areas of weakness include

Box 3: Innovation quality: The USA, Japan, the UK, China, and India at the top of their income groups *(continued)*

Top 10 high-income economies: The USA, Japan, Switzerland, and Germany in the lead

Among the high-income group, five economies—the United States of America (USA), Japan, Switzerland, Germany, and the United Kingdom (UK)—have remained among the top five in innovation quality since the inception of this metric. This year the USA moves to the 1st position, taking the place of Japan. The USA achieves this ranking as a result of continuous top scores in particular quality indicators and an improvement in its score in patent families. The USA takes the top position in citable papers, sharing this spot with the UK for the fifth consecutive year. In 2017 the USA also remains the world leader in the quality of its universities, outranking the UK for the second consecutive year. Also contributing to the USA's improvement, Japan shows a reduction in the scores for both university rankings and citable documents this year.

This year, for the first time, Switzerland ranks 3rd in the quality of innovation metric. Although showing a slightly weaker performance than last year in the quality of universities and a constant one in citable documents, the country enjoys a top score in patent families, helping it to achieve an overall quality score above those of both the UK and Germany. These two countries, on the other hand, show stable scores in citable documents this year, but a reduction in those for patent families and university rankings, respectively.

Sweden improves its rankings, moving up two positions to replace the Republic of Korea (Korea) at the 6th position. Although Korea keeps the top spot in patent families, a reduction in its scores for university rankings, combined with a significant improvement in patent families for Sweden, can explain this switch. The Netherlands (8th, up by two) scores better in patent families, compensating for a fall in university rankings. Denmark and Finland enter the top 10 this year, replacing France and Canada. While the latter two show high scores in both university rankings and citable papers, improved scores for patents filed from both Denmark and Finland is the main reason for this change.

Top 10 middle-income economies: China and India lead; the Russian Federation and Argentina re-join the group

A large gap remains between high-income and middle-income economies. Without China, the difference in average scores between these two groups in both the university rankings (1.13) and citable documents (0.64) is expanding, while in patents filed the distance is narrowing (0.14).

China moves up one spot to 16th position in innovation quality, retaining for the fifth consecutive year its position as the top middle-income economy and getting closer to high-income economies. This movement can be attributed to higher scores in university rankings (4th) and citable documents (14th). Although other middle-income economies still depend greatly on their university rankings to move ahead in the quality of innovation, China—and to some extent South Africa—display a balance between the three components of the quality index.

India is 2nd in innovation quality for the second consecutive year. India's positive performance is the result of maintaining its 2nd position in both university rankings and citable documents among middle-income economies. The country shows a small reduction in the score of patent families, which, however, does not affect its quality of innovation ranking.

With slight reductions in all three indicators, the Russian Federation moves to the 3rd position among the upper-middle-income economies and 28th overall, positioned between India and Brazil. Brazil's performance also shows slight reductions in scores for all three indicators, resulting in a ranking of 29th among middle-income economies.

Argentina, 5th among middle-income economies and 30th overall, shows reduced scores in university rankings and patent families and a marginal improvement in citable documents, yet its overall score puts it ahead of South Africa (6th among middle-income and 32nd overall) and Mexico (7th and 34th).

The inclusion of the Russian Federation and Argentina in the middle-income group led to the downward movement of Mexico, Malaysia, Turkey, and Thailand—economies that have been in the middle-income top 10 since the innovation quality metric was introduced. In addition, this inclusion also moved Colombia and Ukraine out of this list, although the performance of these economies has diverged greatly from that of previous years.

Tertiary education (49th), General infrastructure (30th), Ecological sustainability (39th), Credit (35th), and Investment (26th).

The United States of America (USA) maintains its 4th position this year. The USA keeps its top ranking in pillar 4—Market sophistication—and ranks among the top 25 in all other pillars. It improves its position in Human capital and research (13th), Business sophistication (8th), and Creative outputs (10th), while losing eight positions in Infrastructure (21st) and three in Knowledge and technology outputs (7th). At the sub-pillar level, the USA ranks in the top 25 with just four exceptions: Education (41st), Tertiary education (54th), Ecological sustainability (61st), and Intangible assets (38th). In the latter, the country improves by seven positions this year, a welcome improvement as this is the only output sub-pillar where the USA does not rank in the top 25. The USA holds the top rank in many indicators, including QS university ranking,

Box 4: The global innovation divide

The top 25 GII ranks are occupied by a stable set of high-income countries that consistently lead in innovation. One major change took place last year: China, as the only middle-income economy included in this group of innovation leaders, took up the 25th position in 2016. China remains in this top group and keeps moving ahead (22nd this year). China's innovation ranking in 2017 reflects scores in Business sophistication and Knowledge and technology outputs that are above the average of the rest of the 11–25 group. In particular, top scores in some indicators—domestic market scale, firms offering formal training, patents by origin, utility models by origin, high-tech exports less re-exports, industrial designs by origin, and creative goods exports—are all factors contributing to this improved ranking. Over the past two years, in both absolute and relative terms in relation to other countries, China has shown the strongest improvement in patent applications by origin, university rankings, citable documents H index, utility model applications by origin, gross expenditure on R&D, and PCT international applications by origin. In addition, China this year displays a strong performance in three indicators introduced in the GII 2016: global R&D companies, domestic market scale, and research talent in business enterprise.

Stability is a feature among the top 10 economies this year, with Switzerland at number 1 for the seventh consecutive year. Although some variations in rankings are noticed, such as the Netherlands regaining 3rd place (thanks in part to methodological reasons explained in the country description on page 20), no economy moves in or out of this group in 2017. The Netherlands' noteworthy upward movement relies mostly on its consistently high performance in areas such as Business sophistication, Creative outputs, and Knowledge and technology outputs. Within Knowledge diffusion, available data for intellectual property receipts and ICT services exports rank the Netherlands in the top 10. FDI net outflows is also a strength and partly responsible for this improvement in ranking. In addition, top marks for intellectual property payments, ICT services imports, and country-code TLDs help explain this rise.

Some changes occur this year in the composition of the top 25 group. For one, Belgium drops out of the top 25 this year while the Czech Republic moves back by relying on a better performance in high- and medium-high-tech manufactures, as well as improved scores for domestic credit to private sector and FDI net outflows.

The distance between the top 25 and the groups that follow is still apparent. Figure 4.1 shows the average scores for six groups: (1) the top 10, composed of all high-income economies; (2) ranks 11 through 25, which are also all high-income economies with the sole exception of upper-middle-income China; (3) other high-income economies; (4) upper-middle-income economies; (5) lower-middle-income economies; and (6) low-income economies.

The difference between the top 10 innovation leaders and others in the top 25

Overall, the top 10 perform better than the 11–25 group in all pillars. The gap between these two groups is larger this year in both of the output-side pillars of the index. This contrast shows also that variations in performance are narrower in two of the input-side pillars, Institutions and Market sophistication. In contrast, these gaps have expanded in Human capital and research, Infrastructure, and Business sophistication.

A number of high-income economies in the 11–25 range—Hong Kong (China) (16th), Canada (18th), Norway (19th), and New Zealand (21st)—perform above the top 10 average in various pillars (i.e., Institutions, Infrastructure, and Market sophistication). This year, for the first time, China displays a score higher than the top 10 average in Knowledge and technology outputs. Furthermore, China shows that the gaps are narrower between the top 10 average scores and its scores in Institutions, Human capital and research, Infrastructure, and Creative outputs. Conversely, this distance is larger this year in both Market and Business sophistication. This change is in addition to China scoring higher in Business sophistication and Knowledge and technology outputs than its peers in the 11–25 group.

Middle-income economies: China, the only middle-income economy among the top 25 group; Bulgaria and Malaysia still at great distance

Aside from China, which has been among the top 25 since 2016, this year Bulgaria and Malaysia are the two middle-income economies nearest to that group, with Malaysia slipping back to 37th and Bulgaria overtaking it. Bulgaria (36th) is now the closest upper-middle-income economy to the top 25. In particular, Bulgaria performs better this year in Information and communication technologies (ICTs) with an improved performance in government's online service and e-participation as well as in variables in other pillars, including research talent in business enterprise and growth rate of PPP$ GDP per worker. Malaysia, on the other hand, maintains strengths in graduates in science and engineering, high-tech imports and exports, and creative goods exports, among other indicators. Both of these economies continue to operate close to those high-income economies outside of the top 10, which is especially evident in Business sophistication, Knowledge and technology outputs, and Creative outputs.

With the exception of these two countries, the gap between the group of 11–25 ranked economies (as well as high-income economies) and the upper-middle-income group remains wide, especially in Institutions, Human capital and technology, and Infrastructure; the gap is less wide in Creative outputs. With respect to last year, partially influenced by methodological considerations, the divide between these groups increases in Institutions and, to a lesser extent, in Market sophistication. Yet the gap seems to be lessening in Infrastructure and Human capital and research.

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Box 4: The global innovation divide *(continued)*

Only a few upper-middle-income economies—Romania (42nd), Turkey (43rd), the Russian Federation (45th), Viet Nam (47th), Montenegro (48th), and Ukraine (50th)—are among the top 50 this year.

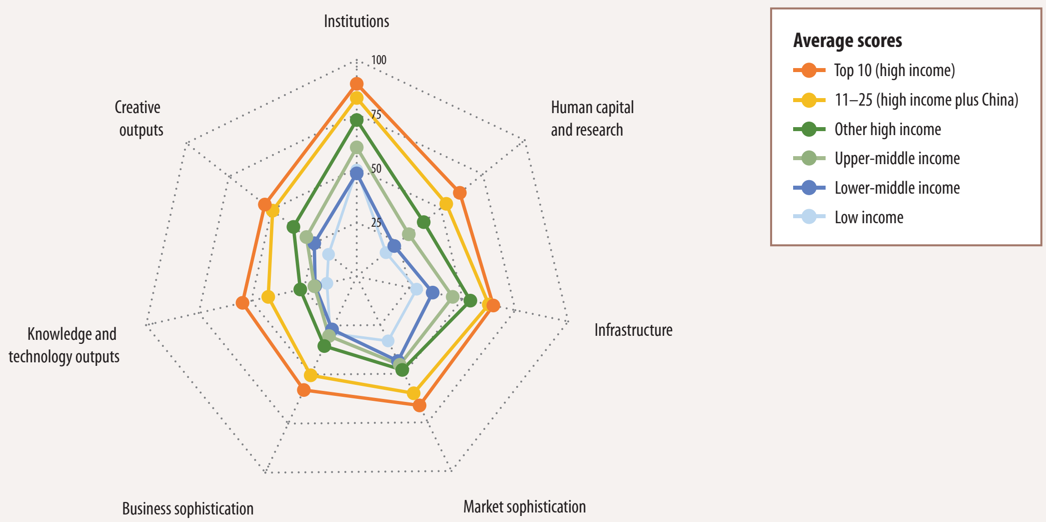
Low-income economies moving closer to middle-income ones

Continuing with the trend identified in earlier editions, the group of low-income economies keeps closing the gap that separates them from the middle-income group. However, this gap remains significant in Infrastructure, Market sophistication, Creative outputs, and Knowledge and technology outputs. This year there is no difference between these groups in the Institutions and Business sophistication pillars, areas in which this group also continues to perform above the average of the lower-middle-income group. This suggests that efforts to strengthen institutions and enable the necessary factors to promote stronger business environments continue to expand among these countries.

The persistence of regional innovation divides: Regional scores

The regional rankings based on the GII scores shows that the Northern America region—consisting of the USA and Canada—is still at the top (57.5; 2 economies), followed by Europe (47.1; 39 economies) and South East Asia, East Asia, and Oceania (44.0; 15 economies). Northern Africa and Western Asia (34.3; 19 economies) and Latin America and the Caribbean (31.7; 18 economies) have similar scores while the difference in average scores between Central and Southern Asia (28.5; 9 economies) and Sub-Saharan Africa (24.8; 25 economies) is expanding. When contrasted with the 2016 results, these averages show Latin America and the Caribbean to be the region with the widest average improvement, followed by Central and Southern Asia, Northern Africa and Western Asia, and Europe. Conversely, Sub-Saharan Africa shows the largest average score reduction, followed by South East Asia, East Asia, and Oceania and Northern America.

Figure 4.1: Innovation divide: China rising among the top 25



Source: GII 2017 data.

Note: Countries/economies are classified according to the World Bank Income Group Classification (July 2016).

venture capital deals, citable documents, computer software spending, and IP receipts; it also gains the 1st position in global R&D companies, state of cluster development (see also the Special Section on Clusters, which shows that the USA has largest number of clusters in the world), ICTs and organizational model creation, and cultural and creative services exports. This year the country also ranks 1st in the quality of innovation aggregate, overtaking Japan (see Box 3).

The United Kingdom (UK) moves to 5th place this year. The UK improves its position in a number of input pillars, namely Institutions (9th), Human capital and research (6th), and Business sophistication (13th).[38] At the sub-pillar levels, the UK's largest gains are in Political environment (18th), Education (22nd), and Knowledge absorption (28th). The country loses ground in both output pillars—Knowledge and technology outputs (13th) goes down by four, with the largest drop in Knowledge diffusion (38th); and Creative outputs (4th) by one. At the indicator level, expenditure on education, government expenditure by pupil, IP payments, ICT services imports and exports, growth rate of GDP per worker, and national feature films see some of the largest improvements. By contrast, items such as PISA results, ICT use, and patent families lose most positions (see also Box 3). The UK maintains its 1st spot in citable documents, and gains the 1st rank in government's online services, e-participation, and ICT and business model creation.

Denmark ranks 6th in this year's GII, improving in both the Innovation Input and Output Sub-Indices, where it ranks respectively 6th and 12th. Denmark has the most notable forward shift in the top 10 (progressing continuously, from 10th overall in the GII 2015 and 8th in 2016). The country improves in all pillars except for Market sophistication, where it retains the 6th spot, and Knowledge and technology outputs (16th), where it loses two positions. At the sub-pillar level, Demark improves the most in Education (4th), ICTs (14th), Ecological sustainability (11th), Innovation linkages (17th), Knowledge diffusion (17th), and Intangible assets (25th). Denmark ranks in the top 3 in a number of indicators, including expenditures on education, researchers, ICT use, and scientific and technical articles. It also improves its position in many areas such as government expenditure per pupil, PISA scales, GDP per unit of energy use, university/industry research collaboration, JV–strategic alliance deals, ICT services exports, and ICTs and organizational model creation. Opportunities for further improvement still exist, notably in Tertiary education (19th), General infrastructure (44th), Trade, competition, and market scale (37th), and Knowledge impact (34th). Relatively weak indicators include graduates in science and engineering, gross capital formation, utility models by origin, growth rate of GDP per worker, and trademarks by origin.

Singapore still holds the top rank in the South East Asia, East Asia, and Oceania region while dropping by one position (see Box 6). It keeps its top spot in the Innovation Input Sub-Index and gains three positions in the Innovation Output Sub-Index (17th). Singapore ranks in the top 5 in all input pillars and 1st in Institutions. In terms of innovation outputs, Singapore loses one position in Knowledge and technology outputs (11th) while gaining one in Creative outputs (32nd). At the sub-pillar level, Singapore holds its 1st spot in Political environment, Regulatory environment, and Tertiary education, and gains the top rank in Investment. It improves substantially also in Education and Creative goods and services, moving up by nine positions in both sub-pillars. Despite these improvements, Singapore shows a relatively weak position in Education, where it ranks 76th. In this sub-pillar, Singapore is weak in all indicators except PISA results. Room for improvement also exists in growth rate of GDP per worker, ICT services exports, and trademarks and industrial designs by origin. Apart from these areas of opportunity, Singapore maintains its 1st place in FDI net outflows, while losing it in high- and medium-high-tech manufactures, high-tech exports, market capitalization, and FDI net inflows. Singapore ranks 1st also in other eight indicators: government effectiveness, regulatory quality, cost of redundancy dismissal, PISA scales, tertiary inbound mobility, ease of protecting minority investors, applied tariff rate, and IP payments.

Finland moves down to the 8th position this year from 5th in 2016. Finland keeps its 4th place in the Input Sub-Index, but loses three positions in the Output Sub-Index (13th). It maintains its 1st rank in Human capital and research, while improving in Infrastructure (8th). In all other pillars, however, Finland loses between one and four positions. At the sub-pillar level, 12 out of 21 sub-pillars move down. The largest drops are in Creative goods and services (40th), Political environment (8th), and Knowledge diffusion (14th). The largest gains are in ICTs (9th) and Knowledge impact (32nd). Finland also loses positions in a number of indicators, including venture capital deals, GERD performed by business, IP receipts and payments, ICTs and business model creation, ICTs and organizational model creation, cultural and creative services exports, and national feature films.

Indeed, as this list shows, Finland's downward movement this year is the result of a drop in a variety of indicators. Apart from Human capital and research and the sub-pillar Business environment, Finland ranks 1st in several indicators: rule of law, ease of resolving insolvency, environmental performance, and patent families.

Germany continues its climb up the GII rankings, gaining a position from last year when it entered the top 10 for the first time. Germany is 1st in logistics performance and patents by origin. It is 2nd in global R&D companies expenditures, down from 1st place in 2016, and 3rd in state of cluster development and citable documents—the same as last year. On the pillar level, Germany safeguards all its respectable positions while improving in Infrastructure (20th). It ranks in the top 25 economies across all pillars, and in the top 10 economies for output pillars. Areas of opportunity include Education (29th), Ecological sustainability (36th), Credit (28th), Investment (41st), and Creative goods and services (28th). At the indicator level, Germany improves in government expenditure by pupil (up by 5 spots), tertiary enrolment (up by 11), government's online service (up by 13), market capitalization (up by 6), FDI net inflows (up by 19), and ICTs and business model creation (up by 6). Germany has opportunity for improvement in ease of starting a business, gross capital formation, females employed with advanced degrees, IP payments, growth rate of GDP per worker, and new businesses.

Ireland is ranked 10th this year, down three positions from last year. Ireland ranks in the top 25 across all pillars, but loses positions in Market sophistication (25th), Business sophistication (10th), Knowledge and technology outputs (5th), and Creative outputs (13th). At the sub-pillar level, Ireland places in the top 2 in two important sub-pillars: Knowledge impact (2nd) and Knowledge diffusion (1st). Opportunities lie in General infrastructure (34th), Credit (40th), Investment (29th), Knowledge creation (38th), and Creative goods and services (33rd). Ireland shows weakness in a number of particular indicators, including domestic credit to private sector, market capitalization, intensity of local competition, industrial designs by origin, and cultural and creative services exports. Ireland holds the top position in IP payments, ICT services exports, and FDI net outflows, and shows a better ranking than in 2016 in a number of important indicators, including PISA results, researchers, global R&D companies, gross capital formation, and GDP per unit of energy use.

The top 10 in the Innovation Input Sub-Index

The Innovation Input Sub-Index considers the elements of an economy that enable innovative activity across five pillars. The top 10 economies in the Innovation Input Sub-Index are Singapore, Sweden, Switzerland, Finland, the USA, Denmark, the UK, Hong Kong (China), the Netherlands, and Canada. Hong Kong (China) and Canada are the only economies in this group that are not also in the GII top 10. The Netherlands entered the top 10 in 2017, while Japan, ranked 9th on the input side last year, exited the top 10 this year.

Hong Kong (China) drops from 2nd to 8th in the Innovation Input Sub-Index this year and ranks 16th overall, down from 14th in 2016. It retains its good positions in Institutions (3rd) and Market sophistication (2nd), but falls in three out of five input pillars, with the largest drop in Human capital and research (28th). In 9 of the 15 input sub-pillars, Hong Kong (China) ranks in the top 10, holding top spots in Regulatory environment (2nd), Business environment (2nd), Ecological sustainability (1st), Credit (3rd), and Knowledge absorption (3rd). Hong Kong (China), however, drops significantly in Education (73rd), which is a weak sub-pillar this year, and R&D (33rd). This is partly the result of a new missing value (school life expectancy) and a drop in global R&D companies (43rd). Other weak indicators include GERD financed by abroad, IP payments, and ICT services imports and exports. Despite these downward movements, Hong Kong (China) preserves its top spot in JV–strategic alliance deals, high-tech imports, and FDI net inflows and improves its rank in PISA results, patents by origin, and utility models by origin.

Canada remains in the 10th position in the Innovation Input Sub-Index, while ranking 18th overall, down three positions from 2016. Canada's strengths on the input side are a result of having top 25 rankings in six of the seven pillars. Canada shows particular strengths in Institutions (7th) and Market sophistication (3rd), while improving in Human capital and research (20th). This year, however, Canada loses seven positions in Infrastructure (18th) and four in Business sophistication (24th). In Infrastructure, it loses positions in all sub-pillars—in particular in Ecological sustainability, where it loses 19 positions in ISO 14001 environmental certificates (73rd). In Business sophistication, Canada drops most in innovation linkages, driven by a decline in ranking in university/industry research collaboration. Top 10 sub-pillar rankings for Canada this year are Political environment (6th, a strength), Regulatory environment (10th), Business environment (7th), General infrastructure (7th), Credit (8th), and Investment (2nd, also a strength). Canada improves in

Education in 2017, in part because of stronger rankings in expenditure on education, government expenditure by pupil, and PISA results.

The top 10 in the Innovation Output Sub-Index

The Innovation Output Sub-Index variables provide information on elements that are the result of innovation within an economy. Although scores on the Input and Output Sub-Indices might differ substantially, leading to important shifts in rankings from one sub-index to the other for particular countries, the data confirm that efforts made to improve enabling environments are rewarded with better innovation outputs. The top 10 economies in the Innovation Output Sub-Index this year are Switzerland, the Netherlands, Sweden, Luxembourg, the USA, the UK, Germany, Ireland, Korea, and Iceland.

The 10 economies leading the Innovation Output Sub-Index remain broadly consistent with their rankings in 2016, with several shifts and one substitution: three economies move upward within the top 10 (the Netherlands, the USA, and Germany), while five economies move downward (Sweden, Luxembourg, the UK, Ireland, and Iceland). Korea enters the top 10 on the Output side, while Finland exits the top 10 in 2017. Seven of these economies are ranked in the GII top 10; the profiles of the other three economies are discussed below.

Luxembourg ranks 4th in the Innovation Output Sub-Index in 2017 and 12th in the overall GII. On the output side, Luxembourg loses four positions in Knowledge and technology outputs (15th), while gaining 1st place in Creative outputs. In this pillar, it maintains its strengths in cultural and creative services exports, national feature films, and generic top-level domains (TLDs) and improves in industrial designs by origin and ICT and organizational model creation. Luxembourg also keeps the top position in the Innovation Efficiency Ratio rankings.

The Republic of Korea (Korea) attains the 9th position in the Innovation Output Sub-Index this year, up by two positions. Korea gains six positions in Creative outputs, ranking 15th this year. It improves in Creative goods and services (35th) and maintains the top spot in industrial designs by origin. Although the country drops one spot in Knowledge and technology outputs (6th), it improves in one of its areas of greatest strength—Knowledge creation (2nd)—where it maintains its top rankings in patents by origin and PCT patent applications and advances to the top spot in utility models by origin. Korea also improves its rank in Human capital and research (2nd), where it holds its 1st place in R&D. Although its gross R&D expenditure goes down by one position, Korea manages to retain its 2nd and 3rd positions in GERD performed by business and GERD financed by business, respectively. The country's areas of relative weakness include ICT services exports and printing and publishing manufactures on the side of outputs; and tertiary inbound mobility, GDP per unit of energy use, knowledge-intensive employment, and FDI inflows on the inputs side.

Iceland ranks 10th in the Innovation Output-Sub Index in 2017. This year, Iceland gains four positions in Knowledge and technology outputs (18th) and reaches 2nd place in Creative outputs. Iceland maintains the top spot in Creative goods and services and Online creativity, ranking 1st in three of the indicators across these sub-pillars: national feature films, printing and publishing manufactures, and generic top-level domains (TLDs). Iceland advances its ranking in Knowledge creation (13th) and Knowledge diffusion (21st), ranking 1st in scientific and technical articles and improving in PCT patent applications, growth rate of GDP per worker, ISO 9001 quality certificates, IP receipts, ICT services exports, and FDI net outflows.

Top performers by income group

Viewing economies among their income-group peers can illustrate important relative competitive advantages and help decision makers glean important lessons for improved performance that are applicable on the ground. The GII also assesses results relative to the development stages of countries.

Table 4 shows the 10 best-ranked economies in each index by income group. Switzerland, Sweden, and the Netherlands are among the high-income top 10 on the three main indices, and the top 3 in the Innovation Output Sub-Index. Compared to last year, Hungary and Estonia leave the group, making space for the Czech Republic and Korea.

Among the 10 highest-ranked upper-middle-income economies, nine remain from 2016 (see also Box 4): China (22nd this year), Bulgaria (36th), Malaysia (37th), Romania (42nd), Turkey (43rd), Montenegro (48th), Thailand (51st), Costa Rica (53rd), and South Africa (57th). The newcomer to this group of the 10 best upper-middle-income performers is the Russian Federation (45th), which displaces Mauritius (64th). China, Malaysia, Bulgaria, and Romania are among the 10 best-ranked upper-middle-income economies across all three main indices and in the Innovation Efficiency Ratio.

The same analysis for lower-middle-income countries shows that eight of the top 10 countries

Table 4: Ten best-ranked economies by income group (rank)

	Global Innovation Index	Innovation Input Sub-Index	Innovation Output Sub-Index	Innovation Efficiency Ratio
High-income economies (48 in total)				
1	**Switzerland (1)**	Singapore (1)	**Switzerland (1)**	Luxembourg (1)
2	**Sweden (2)**	**Sweden (2)**	**Netherlands (2)**	**Switzerland (2)**
3	**Netherlands (3)**	**Switzerland (3)**	**Sweden (3)**	**Netherlands (4)**
4	United States of America (4)	Finland (4)	Luxembourg (4)	Iceland (5)
5	United Kingdom (5)	United States of America (5)	United States of America (5)	Ireland (6)
6	Denmark (6)	Denmark (6)	United Kingdom (6)	Germany (7)
7	Singapore (7)	United Kingdom (7)	Germany (7)	Malta (8)
8	Finland (8)	Hong Kong (China) (8)	Ireland (8)	**Sweden (12)**
9	Germany (9)	**Netherlands (9)**	Korea, Rep. (9)	Czech Republic (13)
10	Ireland (10)	Canada (10)	Iceland (10)	Korea, Rep. (14)
Upper-middle-income economies (35 in total)				
1	**China (22)**	**China (31)**	**China (11)**	**China (3)**
2	**Bulgaria (36)**	**Malaysia (36)**	**Bulgaria (32)**	Turkey (9)
3	**Malaysia (37)**	Russian Federation (43)	Turkey (36)	**Bulgaria (15)**
4	**Romania (42)**	**Bulgaria (45)**	**Malaysia (39)**	Iran, Islamic Rep. (16)
5	Turkey (43)	Mauritius (47)	Thailand (43)	Thailand (24)
6	Russian Federation (45)	South Africa (49)	**Romania (44)**	Panama (38)
7	Montenegro (48)	Montenegro (50)	Costa Rica (50)	**Romania (39)**
8	Thailand (51)	**Romania (51)**	Russian Federation (51)	Costa Rica (43)
9	Costa Rica (53)	Colombia (52)	Montenegro (52)	**Malaysia (46)**
10	South Africa (57)	TFYR of Macedonia (53)	Panama (55)	Dominican Republic (54)
Lower-middle-income economies (27 in total)				
1	**Viet Nam (47)**	**India (66)**	**Viet Nam (38)**	**Viet Nam (10)**
2	**Ukraine (50)**	**Mongolia (67)**	**Ukraine (40)**	**Ukraine (11)**
3	**Mongolia (52)**	**Viet Nam (71)**	**Moldova, Rep. (42)**	**Armenia (17)**
4	**Moldova, Rep. (54)**	**Moldova, Rep. (73)**	**Armenia (47)**	**Moldova, Rep. (22)**
5	**Armenia (59)**	**Ukraine (77)**	**Mongolia (48)**	**Mongolia (27)**
6	**India (60)**	Morocco (79)	**India (58)**	Côte d'Ivoire (40)
7	Morocco (72)	Tunisia (81)	**Philippines (65)**	Indonesia (42)
8	**Philippines (73)**	**Armenia (82)**	Morocco (68)	Kenya (50)
9	Tunisia (74)	**Philippines (83)**	Kenya (70)	**India (53)**
10	Kenya (80)	Kyrgyzstan (86)	Tunisia (71)	**Philippines (55)**
Low-income economies (17 in total)				
1	**Tanzania, United Rep. (96)**	Rwanda (76)	**Tanzania, United Rep. (76)**	**Tanzania, United Rep. (29)**
2	Rwanda (99)	Uganda (93)	Ethiopia (91)	Ethiopia (32)
3	**Senegal (100)**	Burkina Faso (101)	Madagascar (95)	Madagascar (45)
4	Uganda (102)	**Senegal (102)**	**Senegal (98)**	**Mozambique (70)**
5	**Mozambique (107)**	**Nepal (108)**	**Mozambique (100)**	Mali (78)
6	**Nepal (109)**	**Tanzania, United Rep. (109)**	Uganda (106)	Zimbabwe (89)
7	Ethiopia (110)	Benin (110)	Mali (107)	**Senegal (95)**
8	Madagascar (111)	Niger (111)	**Malawi (112)**	**Malawi (98)**
9	**Malawi (115)**	**Malawi (112)**	**Nepal (114)**	**Nepal (105)**
10	Benin (116)	**Mozambique (114)**	Zimbabwe (116)	Benin (110)

Note: Economies with top 10 positions in the GII, the Input Sub-Index, the Output Sub-Index and the Innovation Efficiency Ratio within their income group are highlighted in bold.

from 2016 remain in the top 10 this year. These include Viet Nam (47th), Ukraine (50th), the Republic of Moldova (54th), Armenia (59th), India (60th), Morocco (72nd), the Philippines (73rd), and Kenya (80th). New this year to the top 10 lower-middle-income countries are Mongolia (52nd) and Tunisia (74th), which displace Georgia (68th) and Tajikistan (94th). Seven of the top 10 lower-middle-income countries have rankings in the top 10 for each of the three indices and the Innovation Efficiency Ratio, with the exceptions of Morocco, Tunisia, and Kenya.

There has also been a strong consistency among low-income countries, with eight out of 10 economies remaining in the top 10. The United Republic of Tanzania is the top-ranked low-income country (96th), having moved up nine spots in the overall GII since 2016, and with improvements in the Innovation Input (109th) and Output (76th) Sub-Indices (see Box 5). Following in the ranking of low-income countries are Rwanda (99th), Senegal (100th), which displaces the now-lower-middle-income economy Cambodia (101st), Uganda (102nd), Mozambique (107th), Nepal (109th), Ethiopia (110th), Madagascar (111th), Malawi (115th), and Benin (116th), which displaces Mali (118th). Ranking well across all main indices of the GII, the United Republic of Tanzania, Senegal, Mozambique, Nepal, and Malawi are among the top 10 low-income countries. All economies in the low-income top 10, except Rwanda and Uganda, are in the low-income top 10 in the Innovation Efficiency Ratio.

Maximizing innovation resources and synergies: The Innovation Efficiency Ratio

The Innovation Efficiency Ratio is calculated as the ratio of the Output Sub-Index score over the Input Sub-Index score. It assesses the effectiveness of innovation systems and policies. It must be noted, however, that economies might also reach a relatively high Innovation Efficiency Ratio as a result of particularly low input scores. Because of this, efficiency ratios must be analysed jointly with GII, Input, and Output scores, and with the development stages of the economies in mind.

The 10 countries with the highest Innovation Efficiency Ratios are countries that combine certain levels of innovation inputs with more robust output results (see Table 1): Luxembourg, Switzerland, China, the Netherlands, Iceland, Ireland, Germany, Malta, Turkey, and Viet Nam. Compared to previous years, new middle-income economies joined the top 10 most efficient economies: China, which entered the top 10 last year, is accompanied this year by Turkey and a lower-middle-income economy, Viet Nam, which makes the most spectacular progress this year (see Box 6).

Economies from Europe; South East Asia, East Asia, and Oceania; and Northern Africa and West Asia take up the first 20 positions in this ratio ranking. Among high-income economies, Sweden, the Czech Republic, Korea, Kuwait, Estonia, and the UK are in the group of the 20 most efficient economies in innovation. Among upper-middle-income economies, Bulgaria and the Islamic Republic of Iran are in the top 20 in terms of efficiency. From the lower-middle-income group, the top 20 most efficient economies include Ukraine and Armenia. No low-income economies are in the top 20 this year in innovation efficiency rankings.

Clustering innovation leaders, innovation achievers, and innovation performers at and below development relative to GDP: The GII bubble chart

The GII helps also identify countries' performance in innovation relative to their level of GDP. Figure 4 on pages 30–31 presents the GII scores plotted against GDP per capita in PPP$ (in natural logs). The economies that appear close to the trend line show results that are in accordance with what is expected based on their level of development. The further up and above the trend line a country appears, the better its innovation performance is when compared with that of its peers at the same stage of development. Red-coloured bubbles in the figure correspond to the efficient innovators (a majority of them are situated above the trend line), while the blue-coloured bubbles represent those countries in the lower half of the Innovation Efficiency Ratio.

In the group of innovation leaders we find the same top 25 economies as in 2016, with two exceptions: the Czech Republic is moving back into this group while Belgium is moving out. All of these are high-income economies, with the sole exception of China, which belongs to the upper-middle-income group. These economies are located in four regions, with the majority in South East Asia, East Asia, and Oceania and in Europe, and the rest in Northern America and in Northern Africa and Western Asia. All of the economies in this group have a GII score above 50. These economies show mature innovation systems with solid institutions and high levels of market and business sophistication, allowing investment in human capital and infrastructure to translate into quality innovation outputs.

Economies that perform at least 10% above their peers for their level of GDP are called 'innovation achievers.' These are shown in Table 5 listed by income group and years as an innovation achiever. These economies show better results in innovation because they continuously improve their innovation systems, have more structured institutional frameworks, develop linkages that allow knowledge absorption and the flow of highly skilled human capital, and foster a higher integration with international markets. Although these traits translate into proper resource allocation for education, higher levels of economic growth, and income for workers, they are not homogenous among these economies.

A total of 17 economies compose the group of innovation achievers. This group has grown since the 2016 edition of the GII. Most of these economies—nine in total—come from the Sub-Saharan Africa region, followed by three economies in the Eastern region of Europe. A stronger performance in innovation outputs this year allows the Czech Republic to leave the achiever group and move into the group of leader economies. Portugal moves also out of this group and into the group of economies performing on par with their development for their level of GDP, partially as a result of a weaker performance in general infrastructure and knowledge absorption. Two new economies join this group: Burundi and the United Republic of Tanzania from Sub-Saharan Africa, while Armenia from Northern Africa and Western Asia and Bulgaria from the Eastern Europe region appear in this list for the second year in a row.

Importantly, Kenya, Rwanda, Senegal, Uganda, Mozambique, and Malawi stand out for being innovation achievers at least five times in the previous six years. Madagascar has done so in the two most recent years and both Burundi and the United Republic of Tanzania only in 2017. With the exception of Senegal, Bulgaria, and the latter two economies, all have been identified as innovation achievers in the two most recent years. Kenya, the chief innovation achiever in the region, has been considered as such every year since 2011. Most of these economies perform above their peers in Innovation linkages, particularly in GERD financed by abroad and FDI net inflows. These economies also share strengths in government expenditure on education per pupil, gross capital formation, and the growth rate of GDP per worker.

This analysis also allows for identifying a group of economies that perform at least 10% below their peers for their level of GDP. This cluster includes 39 countries from different regions and income groups: 9 are from the high-income group (6 of these are from the Northern Africa and Western Asia region), 17 are from the upper-middle-income group, 11 are from the lower-middle-income group, and 2 are low-income economies.

Table 5: Innovation achievers: Income group and years as an innovation achiever

Economy	Income group	Years as an innovation achiever (total)
Viet Nam	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)
Kenya	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)
Moldova, Rep.	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)
India	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)
Armenia	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012 (6)
Ukraine	Lower-middle income	2017, 2016, 2015, 2014, 2012 (5)
Rwanda	Low income	2017, 2016, 2015, 2014, 2012 (5)
Uganda	Low income	2017, 2016, 2015, 2014, 2013 (5)
Mozambique	Low income	2017, 2016, 2015, 2014, 2012 (5)
Malawi	Low income	2017, 2016, 2015, 2014, 2012 (5)
Senegal	Low income	2017, 2015, 2014, 2013, 2012 (5)
Tajikistan	Lower-middle income	2017, 2016, 2013 (3)
Malta	High income	2017, 2016, 2015 (3)
Madagascar	Low income	2017, 2016 (2)
Bulgaria	Upper-middle income	2017, 2015 (2)
Burundi	Low income	2017 (1)
Tanzania, United Rep.	Low income	2017 (1)

Note: World Bank Income Group Classification (July 2016): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income.

Regional rankings

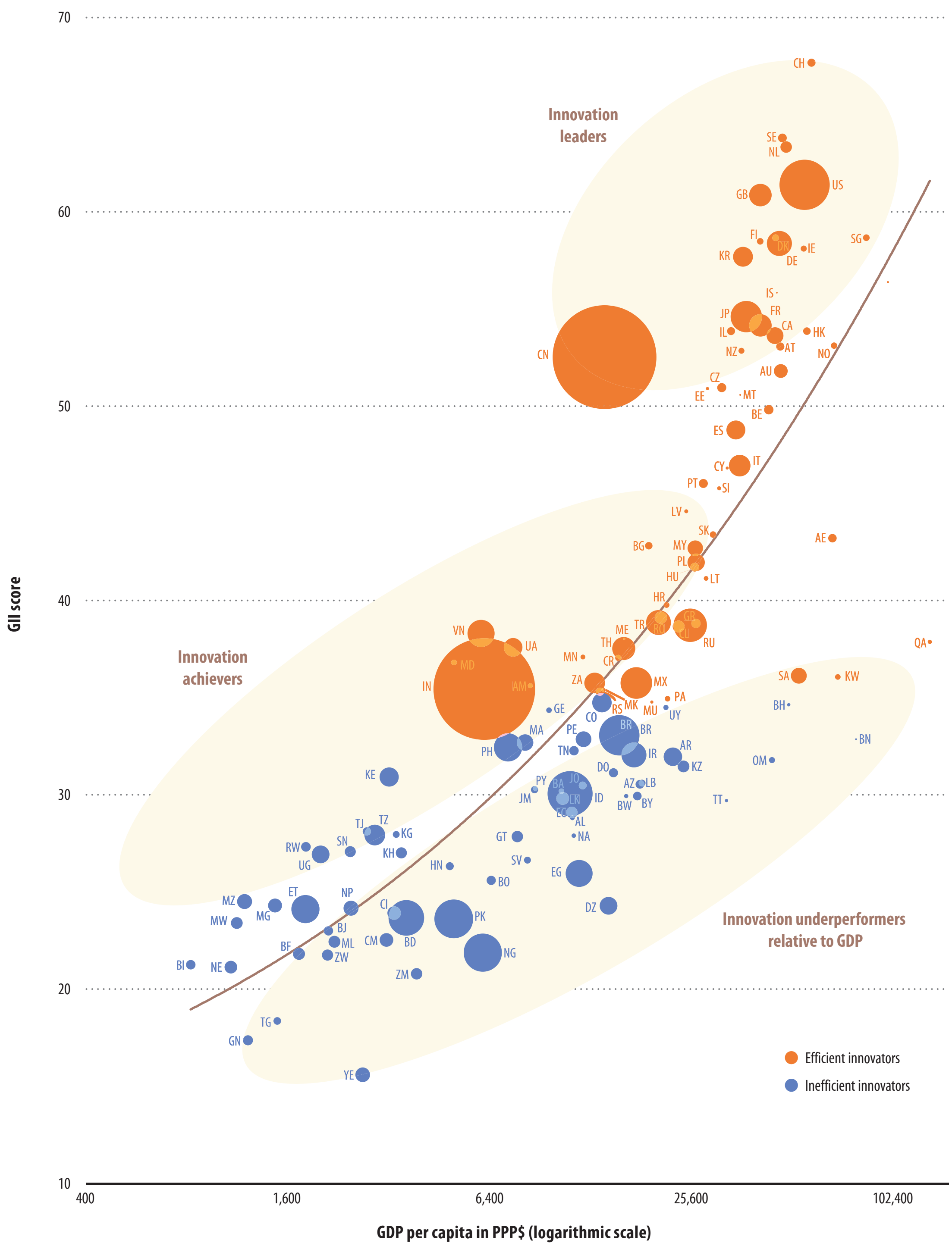
This section discusses regional and sub-regional trends, with snapshots for some of the economies leading in the rankings.

Table 6 on page 32 presents a heatmap with the scores for the top 10, along with average scores by income and regional group. To put the discussion of rankings further into perspective, Figure 5 on page 33 presents, for each region, bars representing the median pillar scores (second quartile) as well as the range of scores determined by the first and second quartile; regions are presented in decreasing order of their average GII rankings (except for the EU, which is placed at the end).

Northern America (2 economies)

Northern America, the UN-defined region that includes both the USA and Canada, holds two of the top

Figure 4: GII scores and GDP per capita in PPP$ (bubbles sized by population)



Note: 'Efficient innovators' are countries/economies with Innovation Efficiency ratios ≥ 0.66; 'Inefficient innovators' have ratios < 0.66; the trend line is a polynomial of degree three with intercept (R^2 = 0.6431).

Figure 4: GII scores and GDP per capita in PPP$ (bubbles sized by population): ISO-2 Country Codes

Country/ Economy	Code
Albania	AL
Algeria	DZ
Argentina	AR
Armenia	AM
Australia	AU
Austria	AT
Azerbaijan	AZ
Bahrain	BH
Bangladesh	BD
Belarus	BY
Belgium	BE
Benin	BJ
Bolivia, Plurinational St.	BO
Bosnia and Herzegovina	BA
Botswana	BW
Brazil	BR
Brunei Darussalam	BN
Bulgaria	BG
Burkina Faso	BF
Burundi	BI
Cambodia	KH
Cameroon	CM
Canada	CA
Chile	CL
China	CN
Colombia	CO
Costa Rica	CR
Côte d'Ivoire	CI
Croatia	HR
Cyprus	CY
Czech Republic	CZ
Denmark	DK
Dominican Republic	DO
Ecuador	EC
Egypt	EG
El Salvador	SV
Estonia	EE
Ethiopia	ET
Finland	FI
France	FR
Georgia	GE
Germany	DE
Greece	GR

Country/ Economy	Code
Guatemala	GT
Guinea	GN
Honduras	HN
Hong Kong (China)	HK
Hungary	HU
Iceland	IS
India	IN
Indonesia	ID
Iran, Islamic Rep.	IR
Ireland	IE
Israel	IL
Italy	IT
Jamaica	JM
Japan	JP
Jordan	JO
Kazakhstan	KZ
Kenya	KE
Korea, Rep.	KR
Kuwait	KW
Kyrgyzstan	KG
Latvia	LV
Lebanon	LB
Lithuania	LT
Luxembourg	LU
Madagascar	MG
Malawi	MW
Malaysia	MY
Mali	ML
Malta	MT
Mauritius	MU
Mexico	MX
Moldova, Rep.	MD
Mongolia	MN
Montenegro	ME
Morocco	MA
Mozambique	MZ
Namibia	NA
Nepal	NP
Netherlands	NL
New Zealand	NZ
Niger	NE
Nigeria	NG
Norway	NO

Country/ Economy	Code
Oman	OM
Pakistan	PK
Panama	PA
Paraguay	PY
Peru	PE
Philippines	PH
Poland	PL
Portugal	PT
Qatar	QA
Romania	RO
Russian Federation	RU
Rwanda	RW
Saudi Arabia	SA
Senegal	SN
Serbia	RS
Singapore	SG
Slovakia	SK
Slovenia	SI
South Africa	ZA
Spain	ES
Sri Lanka	LK
Sweden	SE
Switzerland	CH
Tajikistan	TJ
Tanzania, United Rep.	TZ
Thailand	TH
TFYR of Macedonia	MK
Togo	TG
Trinidad and Tobago	TT
Tunisia	TN
Turkey	TR
Uganda	UG
Ukraine	UA
United Arab Emirates	AE
United Kingdom	GB
United States of America	US
Uruguay	UY
Viet Nam	VN
Yemen	YE
Zambia	ZM
Zimbabwe	ZW

Table 6: Heatmap for GII top 10 economies and regional and income group averages (1–100)

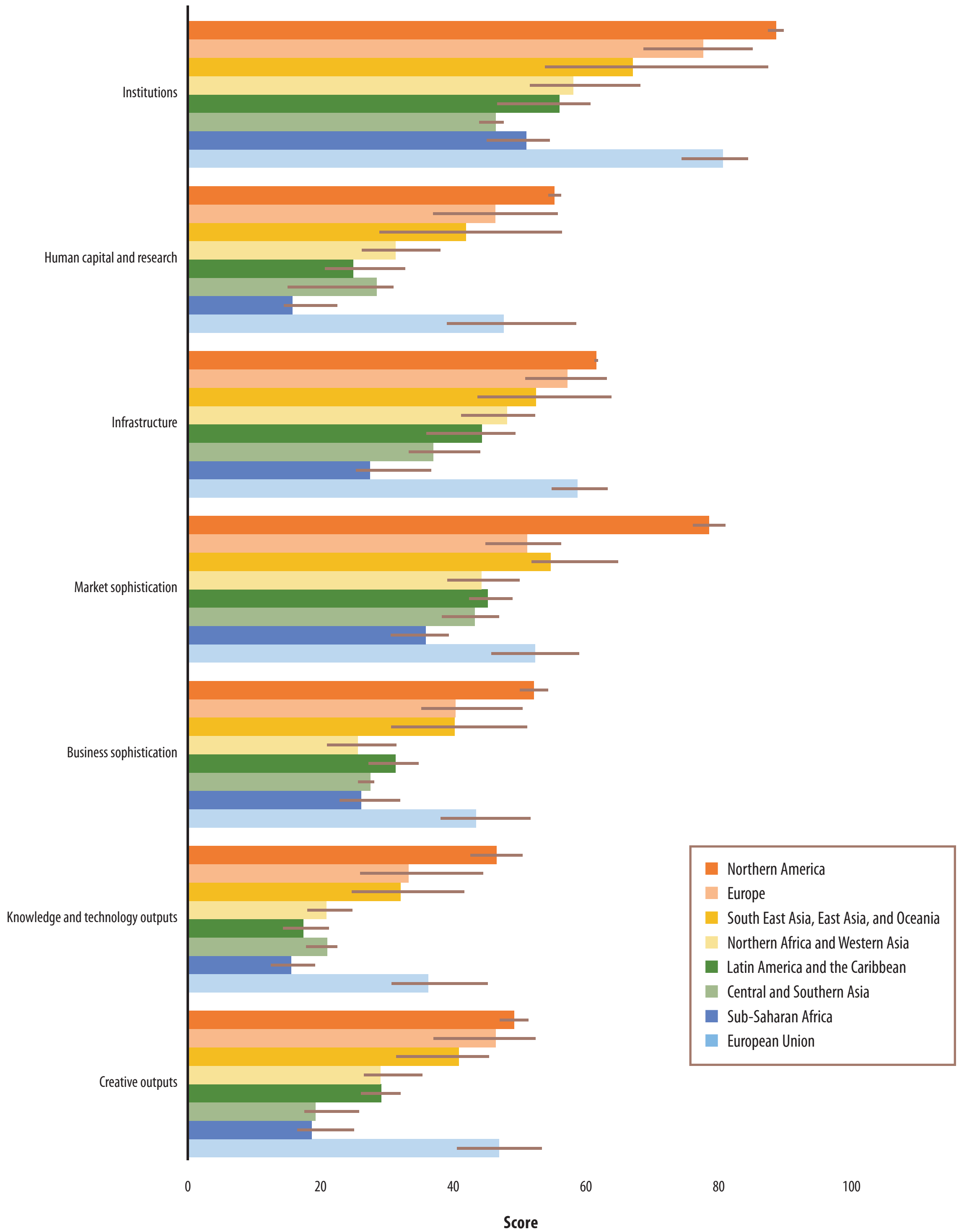
Country/Economy	GII	Institutions	Human capital and research	Infrastructure	Market sophistication	Business sophistication	Input	Knowldege and technology outputs	Creative outputs	Output	Efficiency
Switzerland	67.69	89.47	63.29	65.10	67.51	62.61	69.60	69.06	62.50	65.78	0.95
Sweden	63.82	88.31	63.71	69.13	64.87	62.58	69.72	62.51	53.33	57.92	0.83
United Kingdom	63.36	88.24	54.70	63.32	59.02	63.69	65.79	62.88	58.97	60.92	0.93
United States of America	61.40	86.25	57.21	61.04	83.45	56.41	68.87	54.38	53.48	53.93	0.78
Finland	60.89	88.44	63.32	67.14	70.19	52.18	68.25	46.49	60.54	53.52	0.78
Singapore	58.70	91.43	66.13	63.19	70.17	52.50	68.68	43.93	53.48	48.71	0.71
Ireland	58.69	94.36	63.67	69.15	71.20	62.88	72.25	47.33	42.94	45.14	0.62
Denmark	58.49	92.18	66.41	64.35	61.59	60.12	68.93	48.79	47.32	48.06	0.70
Netherlands	58.39	83.53	60.13	61.55	60.00	51.44	63.33	51.06	55.85	53.46	0.84
Germany	58.13	87.62	55.07	62.06	55.05	54.51	62.86	55.88	50.94	53.41	0.85
Average	**37.12**	**63.05**	**34.03**	**46.19**	**47.23**	**34.97**	**45.10**	**25.77**	**32.53**	**29.15**	**0.63**
Region											
Northern America	57.53	88.62	55.26	61.54	78.56	52.13	67.22	46.52	49.14	47.83	0.71
Europe	47.10	75.57	46.41	56.10	51.72	42.93	54.54	35.24	44.05	39.65	0.72
South East Asia, East Asia, and Oceania	44.03	69.62	41.40	52.80	57.37	41.08	52.46	33.73	37.50	35.61	0.68
Northern Africa and Western Asia	34.33	59.33	32.43	46.35	44.87	28.62	42.32	22.80	29.89	26.34	0.61
Latin America and the Caribbean	31.73	54.51	26.84	43.56	45.11	31.11	40.23	17.35	29.13	23.24	0.58
Central and Southern Asia	28.53	47.28	24.25	37.52	43.78	27.29	36.02	20.57	21.51	21.04	0.59
Sub-Saharan Africa	24.88	52.19	18.53	30.45	36.21	27.88	33.05	14.77	18.64	16.71	0.51
Income level											
High income	48.85	79.28	48.34	58.64	55.46	44.41	57.23	36.65	44.30	40.47	0.70
Upper-middle income	34.13	59.47	31.50	45.74	45.69	31.05	42.69	21.14	30.00	25.57	0.60
Lower-middle income	28.80	47.61	22.34	35.91	43.48	27.02	35.27	19.75	24.92	22.34	0.62
Low income	23.38	49.11	17.44	28.32	33.13	28.99	31.40	14.17	16.55	15.36	0.49

Worst Average Best

Source: GII 2017 data.

Note: Darker shadings indicate better performances. Countries/economies are classified according to the World Bank Income Group (July 2016; see https://blogs.worldbank.org/opendata/new-country-classifications-2016); and special classification based on the online version of the United Nations publication *Standard Country or Area Codes for Statistical Use,* originally published as Series M, No. 49, and now commonly referred to as the M49 standard (April 2017; see https://unstats.un.org/unsd/methodology/m49/).

Figure 5: Median scores by regional group and by pillar



Source: GII 2017 data.

Note: The bars show the median scores (second quartiles); the lines show the range for scores between the first and third quartiles. Countries/economies are classified according to the United Nations geographical classification. The European Union overlaps (it includes 27 European countries, and Cyprus in Western Asia).

25 economies in this year's GII. Both the USA and Canada are high-income economies and rank in the top 10 economies in terms of GDP. The USA ranks 4th overall this year, unchanged from 2016, and is in the top 10 economies in both the Innovation Input Sub-Index (5th) and the Innovation Output Sub-Index (5th). Canada is 18th overall and is in the top 25 economies in the Innovation Input Sub-Index (10th) and the Innovation Output Sub-Index (23rd), unchanged from last year.

Sub-Saharan Africa (25 economies)

For several editions, the GII has noted that the Sub-Saharan Africa region performs relatively well on innovation (see Box 5). Since 2012, Sub-Saharan Africa has had more countries among the group of innovation achievers than any other region. It will be important for Africa

Box 5: Sub-Saharan Africa: The innovation momentum in the most promising region continues

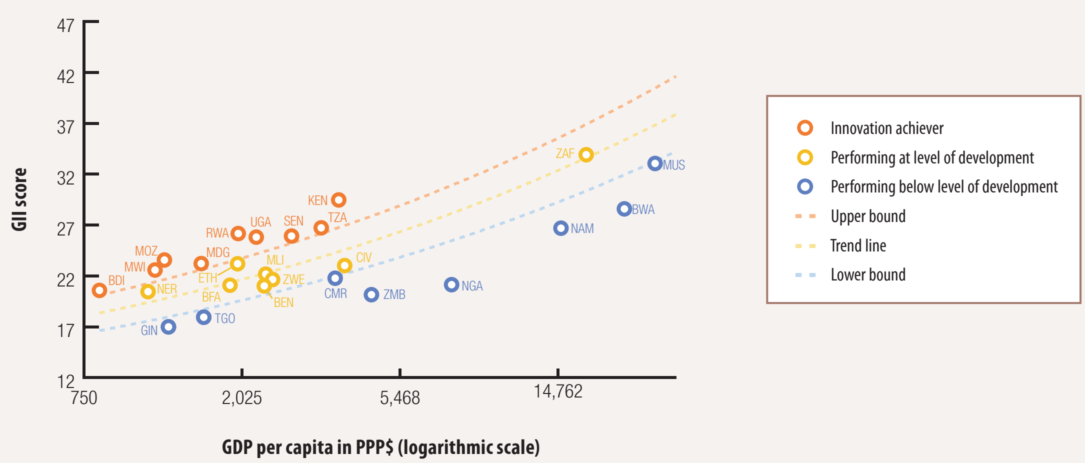
Since 2012 and to this day, the number of Sub-Saharan Africa countries in the group of innovation achievers has been the highest among all regions.[1] Strengths in the region remain in areas considered crucial for the expansion of innovation locally. Factors such as improved business environments offer the necessary stimulus to maintain the positive development seen in Sub-Saharan Africa over the past years.

Boosted by economies such as Mauritius, Botswana, South Africa, Namibia, Rwanda, and Burkina Faso, this year Sub-Saharan Africa has its highest scores in Institutions and Market sophistication, where these countries perform on par or better than some of their peers in Europe and South East Asia, East Asia, and Oceania. In addition to developments in Business sophistication, efforts to improve Human capital and research as well as Infrastructure have also translated into higher regional scores in these pillars. Although larger economies such as South Africa, Botswana, Namibia, and Kenya help foster the expansion in Infrastructure, others such as Senegal, Mauritius, Rwanda, and Zimbabwe are helping to do so in Human capital and research.

This box showcases the regional innovation performance of Sub-Saharan Africa countries by considering both the overall GII scores and those of the seven individual GII pillars. Countries are termed 'innovation achievers' and said to outperform their peers if their GII scores are higher than expected based on their level of economic development (as measured by GDP per capita). Countries also have the opportunity to be 'pillar outperformers' if they outperform their peers on more than half of the seven GII pillars. Countries that meet both of these benchmarks are referred to as 'innovation outperformers'.

Although the number of countries featured in the GII this year is similar to last year's, the number of countries identified as innovation achievers is slightly higher.[2] Figure 5.1 shows the performance of all 25 economies in Sub-Sahara Africa. This year over 50% of innovation achievers come from Sub-Saharan Africa, allowing this region to continue to lead in this metric. A total of nine economies—Kenya, Rwanda, Uganda, Mozambique, Malawi, Senegal, Madagascar, Burundi, and the United Republic of Tanzania

Figure 5.1: Innovation achievers in Sub-Saharan Africa



Note: BDI = Burundi; BEN = Benin; BFA = Burkina Faso; BWA = Botswana; CIV = Côte d'Ivoire; CMR = Cameroon; ETH = Ethiopia; GIN = Guinea; KEN = Kenya; MDG = Madagascar; MLI = Mali; MOZ = Mozambique; MUS = Mauritius; MWI = Malawi; NAM = Namibia; NER = Niger; NGA = Nigeria; RWA = Rwanda; SEN = Senegal; TGO = Togo; TZA = Tanzania, United Republic of; UGA = Uganda; ZAF = South Africa; ZMB = Zambia; ZWE = Zimbabwe.

(Continued on next page)

to preserve its current innovation momentum.

This year South Africa takes the top spot among all economies in the region (57th), followed by Mauritius (64th), Kenya (80th), Botswana (89th), the United Republic of Tanzania (96th), Namibia (97th), Rwanda (99th), and Senegal (100th). Among these, only Botswana and the United Republic of Tanzania improve their GII ranking compared to 2016, while Kenya remains stable and the other four economies (South Africa, Mauritius, Namibia, and Rwanda) lose positions.

The remaining 17 economies in this region can be found at ranks lower than 100. Eight of them have improved since 2016: Benin (116th), Cameroon (117th), Burkina Faso (120th), Burundi (122nd), Niger (123rd), Zambia (124th), Togo (125th), and Guinea (126th). See Box 5 for more details.

Because of issues with data coverage, Ghana drops out of the GII this

Box 5: Sub-Saharan Africa: The innovation momentum in the most promising region continues *(continued)*

(Tanzania)—perform better than their level of development would predict (see Figure 5.1 for details). The innovation achiever economies are shown in red and located above the upper-bound, farthest from the trend line. A total of eight economies are identified as performing at development (yellow). In the same way, the remaining eight are signalled as performing below development (blue).[3]

Kenya, Mozambique, Malawi, Rwanda, Uganda, and Senegal stand out for being innovation achievers at least five times in the past six years. Kenya, the chief innovation achiever in the region, has been credited as such every year since 2011—including in 2017. With the exception of Malawi, these economies, along with Mauritius, South Africa, Tanzania, and Niger, outperform their peers in more than half of the seven GII pillars and thus are also labelled pillar outperformers.[4]

Most of these innovation achiever economies outperform in Institutions, Infrastructure, and Market sophistication; they outperform this year also in Human capital and research and in Business sophistication, but not as much as they could.[5] Uganda outperforms in all seven pillars, followed by Kenya and Rwanda that do so in six. South Africa and Tanzania outperform in five; while Mauritius, Mozambique, and Niger only in four. Malawi outperforms in three, while Madagascar and Burundi do so in two and therefore are the only innovation achievers that are not pillar outperformers.

This year four of the innovation achievers mentioned above—Kenya, Rwanda, Uganda, and Mozambique—are labelled innovation outperformers within the Sub-Saharan Africa region.[6] Table 5.1 shows the full list of achievers and outperformers in this region.

However, although the region's relatively strong performance in innovation signals strengths, differences between the innovation levels of some of its economies still show large disparities. Because, since the big dip experienced in parts of the region last year, economies in Africa aim for economic recovery in 2017 and in the years following, and while commodity prices are recovering, it will be important for other less-developed economies to keep improving their innovation performance to maintain the momentum of the region's innovation efforts.

Table 5.1: Sub-Saharan Africa: Innovation achievers, pillar outperformers, and innovation outperformers, 2011–17

Economy	Income group	Years as an innovation achiever (total)	Years as a pillar outperformer (total)	Innovation outperformer
Kenya	Lower-middle income	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)	Yes
Rwanda	Low income	2017, 2016, 2015, 2014, 2012 (5)	2017, 2016, 2015, 2014, 2013, 2012, 2011 (7)	Yes
Uganda	Low income	2017, 2016, 2015, 2014, 2013 (5)	2017, 2016, 2015, 2014, 2013 (5)	Yes
Mozambique	Low income	2017, 2016, 2015, 2014, 2012 (5)	2017, 2016, 2015, 2014, 2013, 2012 (6)	Yes
Malawi	Low income	2017, 2016, 2015, 2014, 2012 (5)	2016, 2015, 2014, 2012, 2011 (5)	No
Senegal	Low income	2017, 2015, 2014, 2013, 2012 (5)	2017, 2015 (2)	No
Madagascar	Low income	2017, 2016 (2)	2012 (1)	No
Burundi	Low income	2017 (1)		No
Tanzania, United Rep.	Low income	2017 (1)	2017, 2014 (2)	No

Note: World Bank Income Group Classification (July 2016): LI = low income; LM = lower-middle income; UM = upper-middle income; and HI = high income. This table includes GII 2017. Economies identified as an innovation achiever and a pillar outperformer for two or more consecutive years, including 2016 and 2015, are also considered innovation outperformers.

Notes

Notes for this box appear at the end of the chapter.

year, while Zimbabwe is added (see Annex 2).

Latin America and the Caribbean (18 economies)

Latin America and the Caribbean includes only upper- and lower-middle-income economies, with three exceptions: Chile, Uruguay, and Trinidad and Tobago, which are all high-income economies. Still leading the region in the GII rankings for another year, Chile (46th) loses two positions, and is followed by Costa Rica (53rd, down by eight) and Mexico (58th, up by three).

Following these countries, and ranking in the top half of the GII this year, is Panama (63rd). The top 100 economies overall include Colombia (65th), Uruguay (67th), Brazil (69th), Peru (70th), Argentina (76th), Dominican Republic (79th), Jamaica (84th), Paraguay (85th), Trinidad and Tobago (91st), Ecuador (92nd), and Guatemala (98th). The remaining economies in the region rank below 100 in the GII this year: El Salvador (103rd), Honduras (104th), and the Plurinational State of Bolivia (106th).

Although important regional potential exists, the GII rankings of countries in Latin America relative to other regions have not steadily improved. In recent years and in 2017, no economies from this region are identified as innovation achievers (see Box 4 in the 2015 edition of the GII).

As previously mentioned, the minimum data coverage threshold rule was adjusted this year to retain only those economies with sufficient data coverage in the GII. As a result, Nicaragua and the Bolivarian Republic of Venezuela drop from the GII 2017 (see Annex 2).

Chile ranks 46th in the GII this year, at the top spot in the region, but down two positions since 2016. It is ranked 42nd and 53rd in the Innovation Input Sub-Index and Innovation Output Sub-Index, respectively, with a place in the top 50 economies across five pillars: Institutions (41st), Infrastructure (47th), Market sophistication (50th), Business sophistication (46th), and Knowledge and technology outputs (49th). Its improvements in 2017 lie in Knowledge and technology outputs, where it gains 10 positions, and Human capital and research (61st), where it advances one spot. In Knowledge and technology outputs, major improvements are in Knowledge diffusion (34th), with better rankings in IP receipts and FDI net outflows, and in a number of individual indicators, including PCT patent applications, scientific and technical articles, and growth rate of GDP per worker. In Human capital and research, Chile improves mainly in Education (65th), gaining eight positions since last year and seeing its ranking in every indicator in this sub-pillar improve. Tertiary education (55th) also gains one position, as Chile becomes the 5th economy in the world in tertiary enrolment. Despite the improvements, Chile still shows areas of weakness in pillar 2, Human capital and research, in a total of four indicators including government expenditure in education (60th), pupil-teacher ratio (83rd), tertiary inbound mobility (96th), and global companies by R&D (43rd).

Brazil is ranked 69th in the GII 2017, the same position as last year. Brazil's strongest pillar ranking is in Business sophistication (43rd), where it sees one of its highest rankings in IP payments (8th). Brazil's biggest improvements are in Human capital and research (50th, up by 10) and Creative outputs (83rd, up by 7). In Human capital and research, Brazil improved its rank in all sub-pillars, in particular in expenditure on education and QS university ranking. In Creative outputs, gains are seen in Intangible assets and Online creativity, primarily in ICTs and business model creation, Wikipedia edits, and video uploads on YouTube. Although Business environment and Tertiary education still have room for improvement, Brazil is also relatively weak in Credit and Knowledge impact. Some indicators where the economy could improve further include PISA results, graduates in science and engineering, tertiary inbound mobility, gross capital formation, JV-strategic alliance deals, and growth rate of GDP per worker. Persistence will be needed in a time of political and economic uncertainty to benefit from the economic uptick as described at the outset of the chapter.

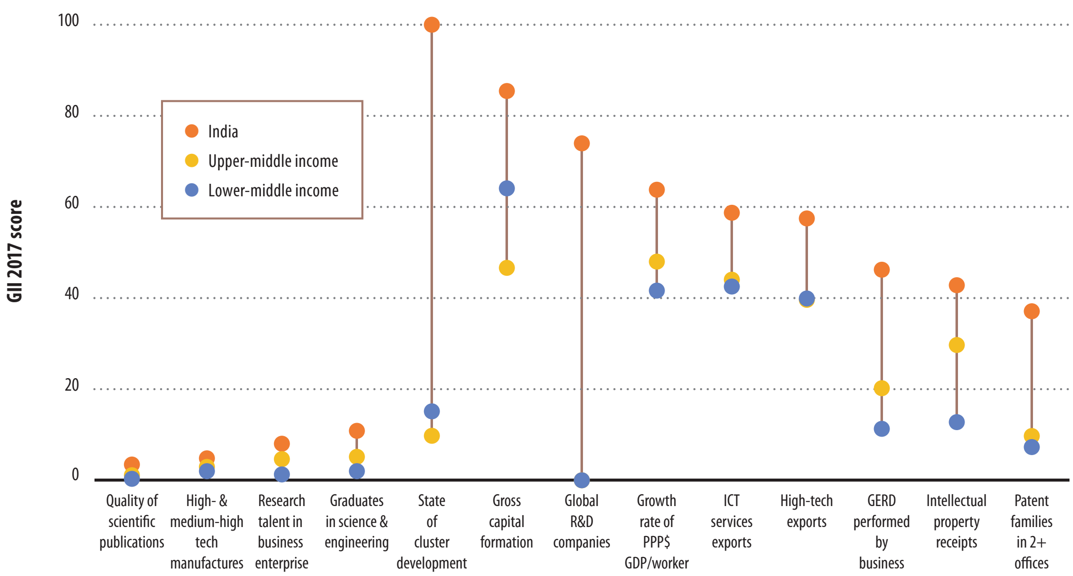
Central and Southern Asia (9 economies)

Economies of the Central and Southern Asia region have seen further improvements in their rankings since 2016, with seven economies improving their rankings and with India moving into the top half of the GII this year.

India maintains its top place in the region, moving up six spots—from 66th last year to 60th this year overall. The Islamic Republic of Iran becomes 2nd in the region, moving from 78th to 75th and leaving its 78th spot to Kazakhstan, which drops three positions from 2016. The remaining economies rank in order within the region as follows: Sri Lanka shows a one-position improvement this year (90th); this is followed by Tajikistan (94th), Kyrgyzstan (95th), Nepal (109th), Pakistan (113th), and Bangladesh (114th). Despite the improvements in data coverage in the region, Bhutan does not meet the 66% data coverage threshold (see Annex 2) and is thus excluded from the 2017 GII.

India remains 1st in the region and 6th among lower-middle-income

Figure 6: India ahead of average lower-middle- and upper-middle-income economies



Source: GII 2017 data.

economies. India has also outperformed on innovation relative to its GDP per capita for many years in a row (see Figure 4). India ranks 60th overall in the GII this year, is also among the top 50 economies in two pillars: Market sophistication (39th) and Knowledge and technology outputs (38th). It improves its rankings in five pillars: Institutions (up 4 spots), Infrastructure (up 14 spots), Business sophistication (up 2 spots), Knowledge and technology outputs (up 5 spots), and Creative outputs (up 9 spots). By contrast, Human capital and research (64th) and Market sophistication lose one and six positions respectively. At the sub-pillar level, India enjoys its largest gains in areas such as Knowledge absorption, Knowledge impact, and Intangible assets. Despite remaining a weak sub-pillar, India improves in Education, where it advances four positions because of better relative government expenditure by pupil.

At the indicator level, India improves in a number of areas this year, including government's online services, e-participation, logistics performance, gross capital formation, high-tech imports, and industrial designs. Also worth mentioning is the six-position gain in global R&D companies, where India ranks 14th, considerably better than the respective groups of lower- and upper-middle-income economies on average. Other such areas in which India does far better than most middle-income economies include graduates in science and engineering, gross capital formation, state of cluster development, GERD performed by business, research talent, and patent families in two or more offices on the input side; and quality of scientific publications, growth rate of GDP per worker, high-tech and ICT services exports, high-tech manufactures, and IP receipts on the output side (Figure 6).

India still has more potential. Business environment (121st) is an area where the country can improve on most indicators. On the input side, in environmental performance, PISA results, and tertiary inbound mobility Indian scores are lower than the average for lower-middle-income economies. The same is true for other Human capital and research indicators, including researchers and tertiary enrolment, and for FDI net inflows. On the output side, a number of indicators—such as scientific and technical articles and trademarks by origin—are lower than upper-middle-income economy averages. Other indicators on the output side that show room for improvement include indicators measuring new businesses and industrial design filings.

In the same way as other countries (on Viet Nam, see Box 6), India has worked intensively to improve its innovation performance, including by hosting innovation workshops and instituting important work in recent years with the use of the GII, and by instituting a high-level Task Force on Innovation to suggest ways the country can improve its innovation eco-system.[39] In this context, India has considerably improved its data coverage in the 2016 and 2017 editions of the GII. Work is ongoing to overcome other data issues—for example, issues with R&D-related indicators, such as GERD performed by business data dating from 2011 (see India's Country/Economy Profile for missing or outdated variables).

South East Asia, East Asia, and Oceania (15 economies)

This year all economies but Cambodia (101st) within the South East Asia, East Asia, and Oceania region are ranked within the top 100 in the GII. With the exception also of Cambodia and of Brunei Darussalam, which enters the GII this year thanks to improved data coverage, all other economies in the region are also in the top 100 in the Innovation Input Sub-Index, the Innovation Output Sub-Index, and the Innovation Efficiency Ratio.

The top five economies in the region rank in the top 25 overall for the GII, the Innovation Input Sub-Index, and the Innovation Output Sub-Index: Singapore (7th), Korea (11th), Japan (14th), Hong Kong (China) (16th), and New Zealand (21st). China ranks next (22nd), being the third most efficient economy in the world; Australia follows (at 23rd).

Malaysia moves down two positions to 37th, due mostly to a 10-position drop in Institutions (53rd), a drop driven by lower

Box 6: ASEAN: Singapore and the new Asian Tigers?

Ten out of the 15 economies in the South East Asia, East Asia, and Oceania region are members of the Association of Southeast Asian Nations (ASEAN).[1] These economies are Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam. In 2015, intra-ASEAN exports represented the 26% of exports by ASEAN countries.[2] Electrical machinery and equipment is the single most exported commodity within ASEAN.[3]

Since the 1980s, Singapore—along with Hong Kong (China), the Republic of Korea, and, to some extent, Malaysia—has been labelled one of the Asian Tigers. Singapore has managed to sustain its high economic growth rate to become one of the richest economies in the world. Correspondingly, it has ranked in the top 10 since the first edition of the GII. In comparison, the other ASEAN members are less rich and advanced.

However, some of the ASEAN economies—in particular, Indonesia, the Philippines, Thailand, and Viet Nam—are now considered to be 'new Asian Tigers' on the rise. These economies participate more and more in a number of regional and global value chains, including some in relatively high-tech sectors. These countries have also become active in improving their innovation performance, sometimes in showcasing best practice use of the GII findings, paired with remarkable innovation results. In 2017, for example, the Vietnamese government mandated Resolution 19-2017/NQ-CP.[4] Through this resolution, the Vietnamese government has assigned responsibilities to ministries, agencies, and local governments to undertake actions to improve Viet Nam's performance, and the Ministry of Science and Technology (MOST) has been tasked with coordinating these efforts. A MOST workshop in cooperation with the World Intellectual Property Organization (WIPO) was organized in Hanoi in March 2017 to address missing and outdated data and to help leverage Viet Nam's innovation strengths and overcome related weaknesses.

In the broader ASEAN analysis, both differences and similarities in innovation performance are evident across ASEAN economies. Figures 6.1 and 6.2 show the scores of these economies in selected innovation input and output indicators. Three findings emerge from these figures. First, a certain stability exists at the top of the ASEAN rankings. Singapore has the highest scores among ASEAN members in all selected indicators, except for expenditure on education (topped by Viet Nam), gross capital formation (topped by Brunei Darussalam), ICT service exports (topped by the Philippines), and trademarks by origin (topped by Thailand). Cambodia is relatively new in terms of economic catch-up. Although improving, it lags behind in most of the input indicators selected here, although it is second in FDI net inflows among ASEAN economies, foreshadowing welcome development ahead.

Second, each economy is making an effort to build its innovation system: in each, areas of excellence are emerging, while others are still works in progress. For example, Viet Nam shows the best score of the group in expenditure on education and is also performing well in ICT use, gross capital formation, and FDI net inflows; at the same time, it has some of the lowest scores in tertiary enrolment, state of cluster development, university/industry research collaboration, and knowledge-intensive employment. Malaysia ranks second in the ASEAN group in expenditure on education, state of cluster development, university/industry research collaboration, and ICT use, but has low scores in PISA scores in reading, maths, and science; tertiary enrolment; and knowledge-intensive employment.

Third, the distance between the top performer and the other ASEAN economies in output indicators is much larger than the distance in inputs. It takes time for economies to create the conditions and accumulate the capabilities required to convert a fertile innovation environment and solid innovation inputs into tangible innovation outputs and outcomes. Among ASEAN economies, Singapore is the top performer in the selected innovation outputs, with two exceptions: ICT services exports, where the Philippines leads; and trademarks by origin, where Viet Nam presents the highest score in the group. Malaysia has the second highest scores in patents by origin, scientific and technical articles, and ICT services exports. Thailand's strengths are in citable documents and trademarks by origin, where it places 2nd.

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Box 6: ASEAN: Singapore and the new Asian Tigers? *(continued)*

Figure 6.1: ASEAN scores in selected input indicators

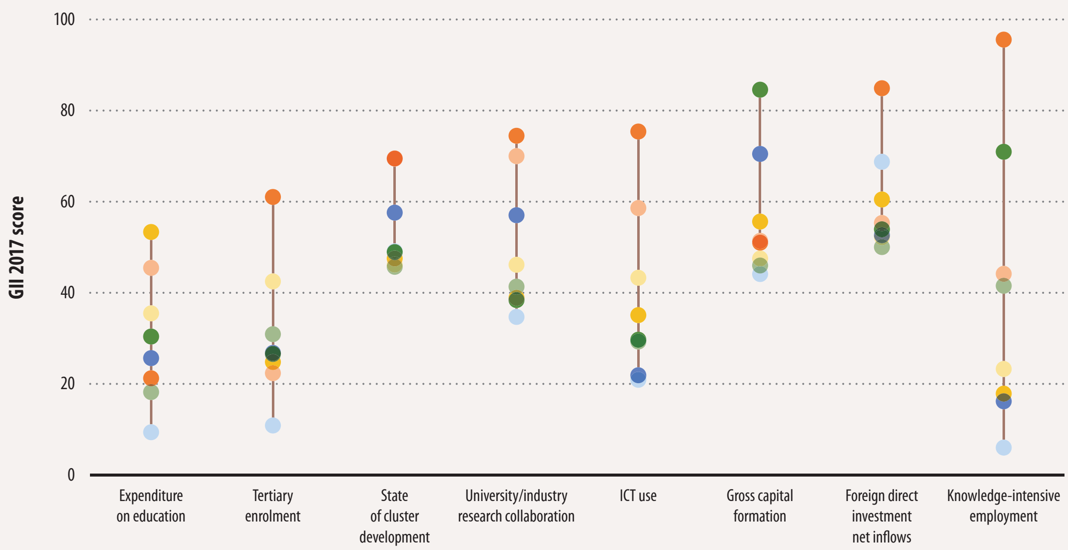
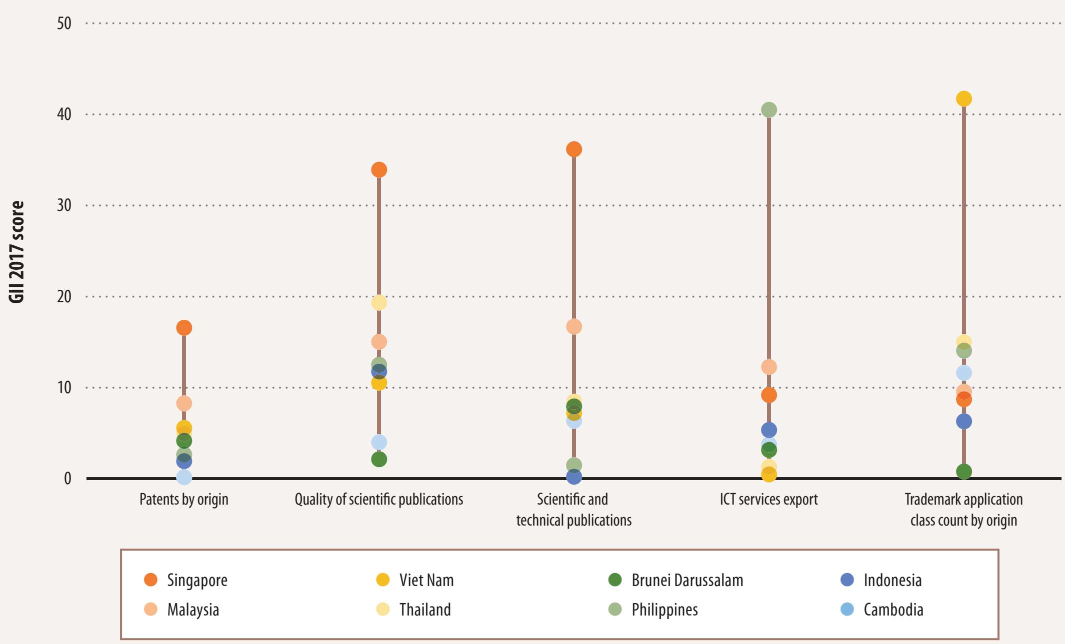


Figure 6.2: ASEAN scores in selected output indicators



Source: GII 2017 data.

Note: No data are available for Lao People's Democratic Republic or Myanmar, which are also omitted from the GII 2017.

Notes

1 Among other objectives, ASEAN aims to accelerate economic growth and socioeconomic development, promoting active collaboration and mutual assistance on matters of common interest, including trade. Details are available at http://asean.org/asean/about-asean/overview/.

2 Data from ASEANstats, available at http://asean.org/storage/2016/11/Table18_as-of-6-dec-2016.pdf.

3 Data from ASEANstats, available at http://asean.org/storage/2016/11/Table23_as-of-6-dec-2016.pdf.

4 For more information, see Viet Nam's Ministry of Planning and Investment website at http://www.mpi.gov.vn/en/Pages/tinbai.aspx?idTin=35994&idcm=121.

rankings in Business environment (50th, down by 22) and a 19-position fall in Business sophistication (48th)—driven mainly by its rank in Knowledge workers, where Malaysia moved from 35th to 93rd this year (see also Box 6). The latter move is affected by the use of two more recent data points for firms offering formal training (from 25th to 79th) and GERD financed by business (from 11th to 75th). Malaysia is also among the middle-income economies that are the closest to the top 25 this year (see Box 4 on the innovation divide).

Viet Nam, by contrast, gains 12 positions this year, ranking 47th. Viet Nam maintains its top place among lower-middle-income economies and enters the world's top 10 in the Innovation Efficiency Ratio (see Box 6). Thailand (51st) and Mongolia (52nd) follow Viet Nam, ranking in the top half of the GII this year as well. Brunei Darussalam, the Philippines, and Indonesia rank 71st, 73rd, and 87th, respectively. Cambodia closes the rankings for the region, coming in at 101st.

Japan has risen in the GII rankings each year for the last four years, moving up to 14th in 2017. Japan ranks 11th overall in the Innovation Input Sub-Index and 20th overall in the Innovation Output Sub-Index, up by four positions since 2016. This year Japan improves its rank in Institutions (13th) and Knowledge and technology outputs (12th), where it advances in all sub-pillars. Japan ranks in the top 10 economies for six sub-pillars: Research and development (3rd), Information and communication technologies (5th), Trade, competition, and market scale (3rd), Knowledge absorption (8th), Knowledge creation (9th), and Knowledge diffusion (10th). Japan ranks 1st in a number of input and output indicators, including intensity of local competition, GERD financed by business, patent families in two or more offices, patents by origin, and PCT patent applications. Opportunities for further improvement still exist, including in ease of getting credit, growth rate of GDP per worker, new businesses, and cultural and creative services exports.

Northern Africa and Western Asia (19 economies)

Israel (17th) and Cyprus (30th) achieve the top two spots in the region for the fifth consecutive year, improving by four and one positions, respectively. Third in the region is the United Arab Emirates (35th) which moves up six places from last year, the most striking upward move in the region. In the case of the United Arab Emirates, data collaboration has also increased data availability, reducing missing values from 17 last year to 11 this year. Important data points, however, are still missing, making it difficult to evaluate certain pillars, most notably in Education, where three out of five variables are not available, and Knowledge workers, with two out of five indicators missing.

Sixteen of the 19 economies in the Northern Africa and Western Asia region are in the top 100, including Turkey (43rd), Qatar (49th), Saudi Arabia (55th), Kuwait (56th), Armenia (59th), Bahrain (66th), Georgia (68th), Morocco (72nd), Tunisia (74th), Oman (77th), Lebanon (81st), Azerbaijan (82nd), and Jordan (83rd). Of all the economies in the region, Kuwait sees the most improvement in its overall GII ranking, having moved up 11 spots.

Israel moves up four places, from 21st to 17th in 2017, remaining number 1 in the Northern Africa and Western Asia region. Israel is the only economy in the region to rank in the top 10 for any pillar (5th, Business sophistication, up one spot; and 9th, Knowledge and technology outputs, up three). The country ranks 20th and 14th in the Innovation Input Sub-Index and Innovation Output Sub-Index, respectively, seeing the most gains in Tertiary education (62nd, up 11 spots), Knowledge absorption (9th, up 7 spots), and Knowledge diffusion (8th, up 6 spots). Israel keeps its 1st place in researchers, venture capital deals, GERD performed by business, and research talent in business enterprise. It also gains top 3 positions in gross expenditure on R&D (1st), university/industry research collaboration (3rd), ICT services export (1st), and Wikipedia edits (3rd). Weaknesses for Israel are found in the input side of the GII and are more prominent in variables such as gross fixed capital formation. On the output side, two areas show possibilities for improvement: the growth rate of GDP per worker and trademarks by origin.

Europe (39 economies)

In this year's edition of the GII, 15 of the top 25 economies come from Europe. This region is home to the top 3 economies of the GII 2017: Switzerland (1st), Sweden (2nd), and the Netherlands (3rd). Following these regional leaders among this group of top 25 are the UK (5th), Denmark (6th), Finland (8th), Germany (9th), Ireland (10th), Luxembourg (12th), Iceland (13th), France (15th), Norway (19th), Austria (20th), the Czech Republic (24th), and Estonia (25th). It should be noted that most of the economies in this region have the fewest missing values, leading them to display the most accurate GII rankings (see Annex 2). This includes the following economies with 100% data coverage in the Innovation Input Sub-Index, the Innovation Output Sub-Index, or both: Denmark, Finland, Germany, France, Austria, the Czech Republic, Italy, Portugal, Bulgaria, Poland, Hungary, Romania, and the Russian Federation.

Eighteen economies follow among the top 50 and have maintained relatively stable rankings since 2014: Malta (26th), Belgium (27th), Spain (28th), Italy (29th), Portugal (31st), Slovenia (32nd), Latvia (33rd), Slovakia (34th), Bulgaria (36th), Poland (38th), Hungary (39th), Lithuania (40th), Croatia (41st), Romania (42nd), Greece (44th), the Russian Federation (45th), Montenegro (48th, which joins the top 50 this year), and Ukraine (which joins the top 50 this year at the 50th position, moving up by six).

The remaining European economies remain among the top 100 economies overall. The region's rankings continue as follows: the Republic of Moldova (54th), the Former Yugoslav Republic of Macedonia (61st), Serbia (62nd), Bosnia and Herzegovina (86th), Belarus (88th), and Albania (93rd), with Serbia and Bosnia and Herzegovina as the only improving economies in this group.

France moves up another three spots in 2017, from 18th to 15th. France ranks 15th in the Innovation Input Sub-Index and gains one spot in the Innovation Output Sub-Index (18th). It ranks in the top 25 economies in all pillars, showing improvements in Institutions (24th), Market sophistication (11th), Knowledge and technology outputs (20th), and Creative outputs (12th). France's three most-improved sub-pillars—Investment (10th), Knowledge impact (36th), and Intangible assets (7th)—gain positions in market capitalization, growth rate of GDP per worker, and ICT and business model creation. France loses the most positions in Infrastructure (12th), and in all its sub-pillars, including losses of the top spots in government's online service and e-participation. Furthermore, France becomes relatively weak in pupil-teacher ratio, while retaining all the other areas of weaknesses that it presented last year.

Assessing regional innovation clusters

This year the GII makes a first attempt at assessing sub-national innovation clusters. The Special Section on Clusters in this report sets out the approach and main findings in more detail.

The importance of innovation hubs at the sub-national and international level has been at the forefront of GII discussions for the last 10 years for two main reasons.

- First, successful innovation clusters, and thus agglomerations of innovation activity, are considered essential for national innovation performance. By pooling talent, know-how, research labs, and manufacturing capabilities they constitute 'spikes' or 'peaks of excellence' with critical innovation linkages. A discussion on this issue has been at the forefront of almost every GII edition. In particular, the GII 2013 on the theme 'Local Dynamics of Innovation' analysed clusters, asking which kinds of linkages exist among them, and to what extent knowledge spillovers occur. Importantly, some of these clusters are international in nature. They do not coincide with boundaries of sub-national cities or regions; rather they cross national borders.
- Second, over the last 10 years, one of the most frequent questions asked by countries has been whether the GII model can be applied at the sub-national level to assess innovation clusters more broadly. Various countries have approached the GII co-publishers to create regional innovation indices on the basis of the GII model. In January 2017, the Indian government decided to rank the performance of Indian states in the 'India Innovation Index'.[40]

A shared conviction underlying both points is that the interaction of critical innovation inputs and outputs happens at the local level, and this phenomenon requires improved metrics. Yet this is where the problem lies, as shown in Table 7.[41]

Despite the progress that has been made, measuring the territorial dimension of innovation remains challenging. Only a few GII indicators are readily available at the regional or city level for a large set of countries. A case in point is that, at this time, the GII model relies on a survey-based question to assess the 'state of cluster development' (indicator 5.2.1) rather than official data. As a testament to imperfect data availability on this critical innovation dimension, efforts to replace this variable with hard data from recognized sources have so far failed. Besides, clusters often do not stop at national borders. By definition, they thus do not map to nationally available data sources; the search for readily available data is elusive.

To make progress on this front, a first step is to identify clusters in an innovative way. The GII 2017 edition makes progress in this regard. In the Special Section on Clusters at the end of the report, Bergquist, Fink, and Raffo propose a novel approach to assess the inventive capacity in clusters based on patenting data. By the means of inventor addresses, and using underlying geo-coding, the

Table 7: Top cluster of countries or cross-border regions within the top 100

Rank	Cluster name	Territory(ies)
1	Tokyo–Yokohama	Japan
2	Shenzhen–Hong Kong (China)	China/Hong Kong (China)
3	San Jose–San Francisco, CA	United States
4	Seoul	Korea, Rep.
10	Paris	France
12	Frankfurt–Mannheim	Germany
18	Eindhoven	Netherlands/Belgium
21	London	United Kingdom
22	Tel Aviv	Israel
24	Stockholm	Sweden
31	Zurich	Switzerland/Germany
34	Helsinki–Espoo	Finland
35	Singapore	Singapore
36	Basel	Switzerland/France/Germany
39	Copenhagen	Denmark
43	Bengaluru	India
44	Sydney	Australia
45	Rotterdam–The Hague	Netherlands
47	Montreal, QC	Canada
52	Barcelona	Spain
54	Brussels–Leuven	Belgium
57	Moscow	Russian Federation
58	Milan	Italy
65	Lausanne	Switzerland/France
71	Vienna	Austria
82	Aachen	Germany/Netherlands/Belgium
92	Kuala Lumpur	Malaysia

Source: Derived from Annex 2 of the Special Section on Clusters.

authors identify the largest inventive clusters as measured by PCT patenting activity, possibly up to the street level thanks to advanced mapping techniques. Table 7 presents some of the leading innovation clusters that result from this analysis.

In the coming years, attempts to foster data on local innovation clusters should receive increased attention, and consideration of clusters may possibly become a more important component of the GII and other innovation measurement efforts.

Conclusions

The theme for this year's GII is 'Innovation Feeding the World'. This chapter has provided an overview of the current trends, strategies, and policies for innovation in agriculture and food systems. Within agri-food systems, innovation needs to be a priority to achieve sustainable productivity growth and address the global food challenge. Successfully addressing this challenge will require a mix of technological and non-technological solutions: organizational changes, public and private investment in R&D, and more effective technology transfer mechanisms are all important elements of agri-food innovation systems.

Historically, innovation in agriculture has proven not only feasible but highly successful. Today, a new innovation drive is required among high-, middle-, and low-income economies. In high- and middle-income economies, a new innovation wave is on the horizon: innovations from other sectors are spilling over to agricultural and food systems, making them smart and digital. In low-income economies, the focus is on reducing the bottlenecks of agri-food innovation systems, while speeding up innovation convergence with more productive economies. In all economies, public policy is fundamental to promoting an enabling environment that encourages technology uptake, entrepreneurship and skills, and innovation. The remaining chapters of the report provide more details on this year's theme from academic, business, and particular country perspectives from leading experts and decision makers.

This chapter has also presented the main GII 2017 results, distilling main messages and noting some important evolutions that have taken place since last year. Three main findings stand out. First—and in a turn of events—a novel and more sustained growth momentum is currently in place. Second, more rapid economic growth can lay the foundation for innovation-driven economic development, but more investment would be needed to boost productivity growth, which is still at historic lows. To this end, R&D efforts from both the public and private sector would also need to be intensified.

Third, while the GII results point to a certain stability at the top, new opportunities are emerging: new Asian Tigers are active in improving their innovation performance, and new innovation actors from various regions are climbing in the GII rankings.

Over the last years, the GII has established itself as a leading reference on innovation, becoming a 'tool for action' for decision makers wishing to improve their countries' innovation performance. Numerous workshops in different countries have brought innovation actors together, helped improve data availability, and contributed to designing effective innovation policies. These exchanges on the ground also generate feedback that, in turn, improves the GII and assists the journey towards improved innovation measurement and policy. This valuable feedback will continue to be integrated into future iterations of this lead chapter of the GII in the years to come.

Notes for Box 5

1 In 2011 most innovation achievers were located in the South East Asia, East Asia, and Oceania region. In 2012 and 2013 Europe and Sub-Saharan Africa shared the same number of innovation achievers: six and four in each year, respectively.

2 This can be partially attributed to improvements to data coverage. A stricter cut-off rule that increases the minimum required threshold for all countries in the GII to at least 66% of all indicators in each of the sub-indices was introduced this year (see Appendix IV: Technical Notes for more details). This procedure translates into more precise measurements of the innovation performance of each country and thus into a better identification of those that can be identified as innovation achievers. As a result of this improvement, however, two economies from this region identified as innovation achievers in previous years are no longer in the GII ranks: Gambia (2014) and Ghana (2011).

3 The general trend line is defined by the scores and economic development level of all countries considered in the GII. The threshold bounds are defined as 10% above and 10% below the scores defined by trend line (see Box 2 in Escalona Reynoso et al., 2015).

4 In addition to these 9 Sub-Saharan Africa countries, 26 countries (35 total) were identified as pillar outperformers this year. These come from Europe (9); South East Asia, East Asia, and Oceania (6); Latin America and the Caribbean (5); Northern Africa and Western Asia (4); and Central and Southern Asia (2).

5 This can be partially attributed to the higher overall average scores in both of these indicators displayed by the region, which makes it harder for individual countries to perform above that level.

6 For a country to be labelled an 'innovation outperformer' it has to be identified as an 'innovation achiever' and it must also score above its income group average in four or more GII pillars for two or more years, including the two most recent—2015 and 2016. In 2017, 10 economies were identified as innovation outperformers. The other countries identified as innovation outperformers this year are Viet Nam, the Republic of Moldova, India, Armenia, Ukraine, and Tajikistan. See Escalona Reynoso et al. (2015) for more details.

Notes for Chapter 1

1 Conference Board, 2017; IMF, 2017; OECD, 2017a. According to the World Bank (2017), the world economy will grow at 2.7% in 2017, up by 0.4% from 2016, with a downward revision of 0.1% from June 2016. For 2018, the OECD (2017a) and IMF (2017) forecast a growth rate of 3.6% without recent revisions. The World Bank (2017) predicted global GDP growth at 2.9%, and recently revised it downward by 0.1%.

2 IMF, 2017.

3 IMF, 2017; OECD, 2017a; World Bank, 2017.

4 IMF, 2017, with Russian GDP growth recently revised upwards.

5 World Bank, 2017.

6 Adler et al., 2017; OECD, 2017a; WIPO, 2015; World Bank, 2017.

7 World Bank, 2017.

8 Adler et al., 2017; Cornell et al., 2016. Estimates indicate that worldwide productivity growth slowed down in 2015 and remained at the same modest rate of 1.5% in 2016 (Conference Board, 2016, 2017).

9 The Conference Board, Total Economy Database (adjusted version), May 2017 release, available at http://www.conference-board.org/data/economydatabase/.

10 Fernald, 2014. See also Chapter 1 in WIPO 2015.

11 WTO, 2017.

12 UNCTAD, 2016, 2017.

13 Cornell et al., 2016; WIPO, 2015, 2017 (forthcoming). On slowing technology diffusion see also Andrews et al., 2015; Decker et al., 2016; Haltiwanger, 2011; Haltiwanger et al., 2014; OECD, 2015.

14 See Lee, 2016, for the case of Korea, for instance.

15 IMF, 2017; UNCTAD, 2017; WTO, 2017. The productivity forecast draws on The Conference Board, Total Economy Database (adjusted version), May 2017 release, available at http://www.conference-board.org/data/economydatabase/.

16 OECD, 2009, 2017a.

17 IMF, 2016.

18 These estimates are based on preliminary calculations using GDP, GERD, and BERD figures at constant $PPP 2005 prices from the UNESCO-UIS Science & Technology Data Center, updated March 2017. Economies included: Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belgium, Belize, Benin, Bermuda, Bhutan, Bolivia (Plurinational State of), Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Canada, Central African Republic, Chad, Chile, China, China (Hong Kong Special Administrative Region), China (Macao Special Administrative Region), Colombia, Comoros, Congo, Costa Rica, Croatia, Cuba, Cyprus, Czech Republic, Côte d'Ivoire, Democratic Republic of the Congo, Denmark, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Estonia, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran (Islamic Republic of), Iraq, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Latvia, Lebanon, Lesotho, Liberia, Libya, Lithuania, Luxembourg, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia (Federated States of), Mongolia, Montenegro, Morocco, Mozambique, Namibia, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Palau, Palestine, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Puerto Rico, Qatar, Republic of Korea, Republic of Moldova, Romania, Russian Federation, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Slovakia, Slovenia, Solomon Islands, South Africa, Spain, Sri Lanka, Sudan, Suriname,

Swaziland, Sweden, Switzerland, Taiwan (China), Tajikistan, Thailand, The Former Yugoslav Republic of Macedonia, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Tuvalu, Uganda, Ukraine, United Arab Emirates, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Uruguay, Uzbekistan, Vanuatu, Venezuela (Bolivarian Republic of), Viet Nam, Yemen, Zambia, Zimbabwe.

19 The top three spenders relative to GDP are Israel, Korea, and Japan, with Israel overtaking Korea in 2015. Based on our estimates, China is the only emerging economy with R&D intensity above the global average. Other middle-income economies, such as Malaysia, Brazil, India, and South Africa, present lower R&D intensities, between 1.3% and 0.7%.

20 Cornell et al., 2016; OECD, 2017b.

21 Despite these aggregate figures, some surveys indicate that top world R&D companies raised their R&D expenditures in 2015 and 2016 (European Commission, 2016; Strategy&, 2016).

22 WIPO, 2016. At the same time, worldwide patent applications under WIPO's Patent Cooperation Treaty (PCT) saw a 1.4% increase in 2015; a significant fall in growth compared with previous years (WIPO, 2016).

23 OECD, 2009, 2017b; WIPO, 2015.

24 A recent IMF analysis shows that, if advanced economies increased private R&D by 40% on average, they could increase their GDP by 5% in the long term (IMF, 2016).

25 FAO, 2016.

26 FAO et al., 2015.

27 FAO et al., 2015.

28 Malnutrition manifests itself in various forms beyond undernutrition, such as micronutrient malnutrition, obesity, calorie deficiencies, anemia, or diabetes (IFPRI, 2016). See also Chapter 6.

29 Pingali, 2012.

30 It was estimated that in the absence of the green revolution, crop yields in developing countries would have decreased by 23.5%, with prices between 35% and 66% higher in 2000. Caloric intake would have fallen by 14.4%, and the percentage of malnourished children would have increased by 8% (Evenson and Gollin, 2003).

31 Juma, 2011, 2015; Juma and Gordon, 2015.

32 See Dutta et al., 2015.

33 See, for example, WIPO, 2011. See also the ongoing WIPO project on 'International Comparison of Knowledge Transfer Policies and Practices' in collaboration with the Chinese Ministry of Science and Technology (MOST); further details are available at http://www.wipo.int/econ_stat/en/economics/studies/.

34 On informal actors, see Kraemer-Mbula and Wunsch-Vincent, 2016.

35 Economies are grouped according to the World Bank classification (July 2016) gross national income (GNI) per capita, calculated using the World Bank Atlas method. The groups are: low income, US$1,025 or less; lower-middle income, US$1,026 to US$4,035; upper-middle income, US$4,036 to US$12,475; and high income, US$12,476 or more.

36 Since 2012, the regional groups have been based on the United Nations Classification: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; and SSF = Sub-Saharan Africa.

37 To address their inherent volatility (see previous GII editions) and thus reduce the swings in the ranking induced by FDI flows, this year the GII takes 3-year averages of FDI net inflows and outflows (see Annex 2).

38 Note that any assessment of how the UK's planned withdrawal from the European Union affected the country's GII rank would be speculative, at best. First, most of the data predate the actual related referendum. As is the case with other high-income countries, 37% of the UK's indicators are from 2016; the remaining 63% reflect 2015 and earlier years. Second, the causal relations between plans or the actual withdrawal from the EU and the 2016 GII indicators are complex and uncertain in size and direction.

39 See the Preface to this report by the Confederation of Indian Industry.

40 Government of India, Press Information Bureau, 2017.

41 See also Dutta et al., 2013; Hollanders, 2013; Primi, 2013.

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The Global Innovation Index (GII) Conceptual Framework

The rationale for the Global Innovation Index

The Global Innovation Index (GII) project was launched by Professor Dutta at INSEAD in 2007 with the simple goal of determining how to find metrics and approaches that better capture the richness of innovation in society and go beyond such traditional measures of innovation as the number of research articles and the level of research and development (R&D) expenditures.[1]

There were several motivations for setting this goal. First, innovation is important for driving economic progress and competitiveness—both for developed and developing economies. Many governments are putting innovation at the centre of their growth strategies. Second, the definition of innovation has broadened—it is no longer restricted to R&D laboratories and to published scientific papers. Innovation could be and is more general and horizontal in nature, and includes social innovations and business model innovations as well as technical ones. Last but not least, recognizing and celebrating innovation in emerging markets is seen as critical for inspiring people—especially the next generation of entrepreneurs and innovators.

Now in its 10th edition, the GII helps to create an environment in which innovation factors are under continual evaluation, and it provides a key tool for decision makers and a rich database of detailed metrics for refining innovation policies.

The GII is not meant to be the ultimate and definitive ranking of economies with respect to innovation. Measuring innovation outputs and impacts remains difficult, hence great emphasis is placed on measuring the climate and infrastructure for innovation and on assessing related outcomes.

Although the end results take the shape of several rankings, the GII is more concerned with improving the 'journey' to better measure and understand innovation and with identifying targeted policies, good practices, and other levers that foster innovation. The rich metrics can be used—on the level of the index, the sub-indices, or the actual raw data of individual indicators—to monitor performance over time and to benchmark developments against countries in the same region or income classification.

Drawing on the expertise of the GII's Knowledge Partners and its prominent Advisory Board, the GII model is continually updated to reflect the improved availability of statistics and our understanding of innovation. This year the model continues to evolve, although its mature state now requires only minor updates (refer to Annex 2).

An inclusive perspective on innovation

The GII adopts a broad notion of innovation, originally elaborated in the *Oslo Manual* developed by the European Communities and the Organisation for Economic Co-operation and Development (OECD):[2]

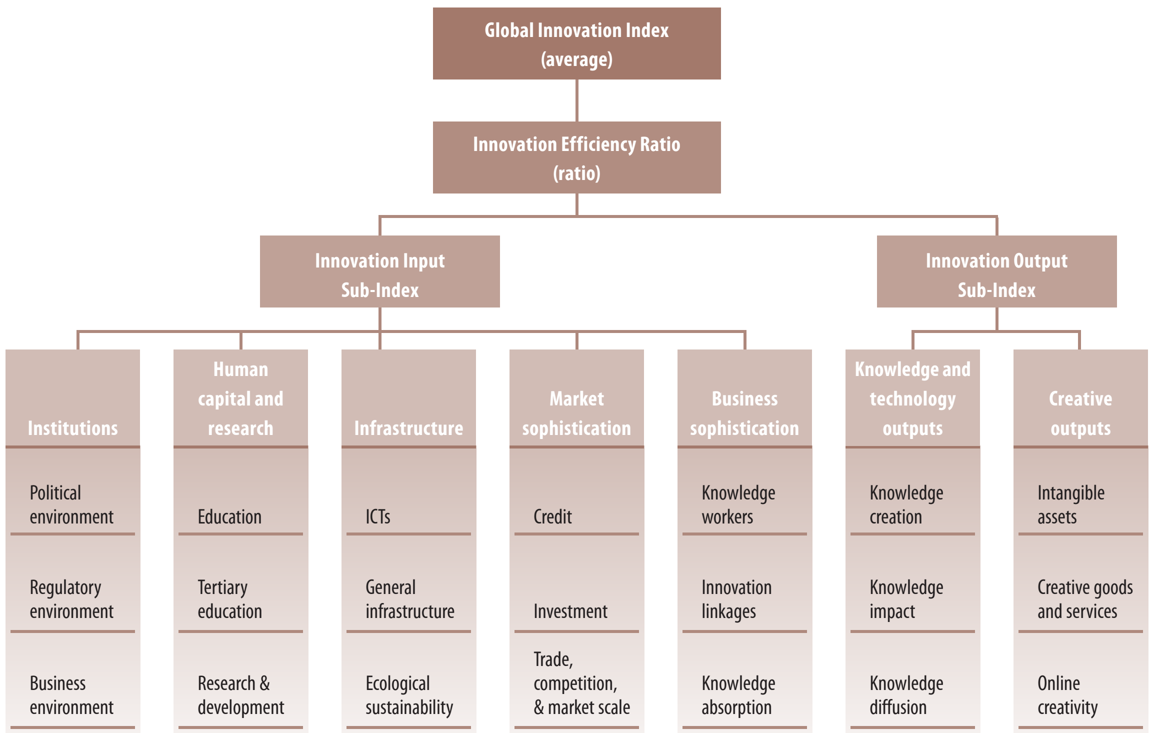
> An innovation is the implementation of a new or significantly improved product (good or service), a new process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations.

This definition reflects the evolution of the way innovation has been perceived and understood over the last two decades.[3]

Economists and policy makers used to focus on R&D-based technological product innovation, largely produced in-house and mostly in manufacturing industries. This type of innovation was performed by a highly educated labour force in R&D-intensive companies. The process leading to such innovation was conceptualized as closed, internal, and localized. Technological breakthroughs were necessarily 'radical' and took place at the 'global knowledge frontier'. This characterization implied the existence of leading and lagging countries, with low- or middle-income economies only catching up.

Today innovation capability is seen more as the ability to exploit new technological combinations; it embraces the notion of incremental innovation and 'innovation without research'. Non-R&D innovative expenditure is an important

Figure 1: Framework of the Global Innovation Index 2017



component of reaping the rewards of technological innovation. Interest in understanding how innovation takes place in low- and middle-income countries is increasing, along with an awareness that incremental forms of innovation can impact development. Furthermore, the process of innovation itself has changed significantly. Investment in innovation-related activity has consistently intensified at the firm, country, and global levels, adding both new innovation actors from outside high-income economies and nonprofit actors. The structure of knowledge production activity is more complex and geographically dispersed than ever.

A key challenge is to find metrics that capture innovation as it actually happens in the world today.[4] Direct official measures that quantify innovation outputs remain extremely scarce.[5] For example, there are no official statistics on the amount of innovative activity—defined as the number of new products, processes, or other innovations—for any given innovation actor, let alone for any given country (see Box 1, Annex 1 of Chapter 1 in the GII 2013). Most measures also struggle to appropriately capture the innovation outputs of a wider spectrum of innovation actors, such as the services sector or public entities.

The GII aims to move beyond the mere measurement of such simple innovation metrics. To do so will require the integration of new variables, with a trade-off between the quality of the variable on the one hand and achieving good country coverage on the other hand.

The timeliest possible indicators are used for the GII: 38.7% of data obtained are from 2016, 38.1% are from 2015, 11.3% are from 2014, 5.7% from 2013, and the small remainder 6.3% from earlier years.[6]

The GII conceptual framework

The GII is an evolving project that builds on its previous editions while incorporating newly available data and that is inspired by the latest research on the measurement of innovation. This year the GII model includes 127 countries/economies, which represent 92.5% of the world's population and 97.6% of the world's GDP (in current US dollars). The GII relies on two sub-indices—the Innovation Input Sub-Index and the Innovation Output Sub-Index—each built around pillars. Four measures are calculated (see Figure 1):

1. **Innovation Input Sub-Index:** Five input pillars capture elements of the national economy that enable innovative activities.

2. **Innovation Output Sub-Index:** Innovation outputs are the results of innovative activities within the economy. Although the Output Sub-Index includes only two pillars, it has the same weight in calculating the overall GII scores as the Input Sub-Index.

3. **The overall GII score** is the simple average of the Input and Output Sub-Indices.

4. **The Innovation Efficiency Ratio** is the ratio of the Output Sub-Index to the Input Sub-Index. It shows how much innovation output a given country is getting for its inputs.

Each pillar is divided into three sub-pillars, each of which is composed of individual indicators, for a total of 81 indicators this year. The GII pays special attention to presenting a scoreboard for each economy that includes strengths and weaknesses (Appendix I Country/Economy Profiles), making accessible the data series (Appendix II Data Tables), and providing data sources and definitions (Appendix III) and detailed technical notes (Appendix IV). Adjustments to the GII framework, including a detailed analysis of the factors influencing year-on-year changes, are detailed in Annex 2. In addition, since 2011 the GII has been submitted to an independent statistical audit performed by the Joint Research Centre of the European Union (results are detailed in Annex 3).

A table is included here for each pillar. That table provides a list of the pillar's indicators, specifying their type (composite indicators are identified with an asterisk '*', survey questions with a dagger '†', and the remaining indicators are hard data); their weight in the index (indicators with half weight are identified with the letter 'a'); and the direction of their effect (indicators for which higher values imply worse outcomes are identified with the letter 'b'). The table then provides each indicator's average values (in their respective units) per income group (World Bank classification) and for the whole sample of 127 countries/economies retained in the final computation (Tables 1a through 1g).

Table 1a: Institutions pillar

	Indicator	High income	Upper-middle income	Lower-middle income	Low income	Mean
		Average value by income group				
1	**Institutions**					
1.1	*Political environment*					
1.1.1	Political stability and safety*	0.69	–0.23	–0.80	–0.66	–0.06
1.1.2	Government effectiveness*	1.21	0.04	–0.50	–0.78	0.26
1.2	*Regulatory environment*					
1.2.1	Regulatory quality*a	1.19	0.03	–0.45	–0.63	0.28
1.2.2	Rule of law*a	1.1.9	–0.22	–0.60	–0.64	0.18
1.2.3	Cost of redundancy dismissal, salary weeksb	14.60	17.95	26.60	16.18	18.29
1.3	*Business environment*					
1.3.1	Ease of starting a business*	90.29	84.76	82.13	79.87	85.64
1.3.2	Ease of resolving insolvency*	68.24	51.63	39.85	38.80	53.69
1.3.3	Ease of paying taxes*	83.83	69.51	59.52	57.51	71.19

Note: (*) index, (†) survey question, (a) half weight, (b) higher values indicate worse outcomes.

The Innovation Input Sub-Index

The first sub-index of the GII, the Innovation Input Sub-Index, has five enabler pillars: Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication. Enabler pillars define aspects of the environment conducive to innovation within an economy.

Pillar 1: Institutions

Nurturing an institutional framework that attracts business and fosters growth by providing good governance and the correct levels of protection and incentives is essential to innovation. The Institutions pillar captures the institutional framework of a country (Table 1a).

The Political environment sub-pillar includes two indices: one that reflects perceptions of the likelihood that a government might be destabilized; and one that reflects the quality of public and civil services, policy formulation, and implementation.

The Regulatory environment sub-pillar draws on two indices aimed at capturing perceptions on the ability of the government to formulate and implement cohesive policies that promote the development of the private sector and at evaluating the extent to which the rule of law prevails (in aspects such as contract enforcement, property rights, the police, and the courts). The third indicator evaluates the cost of redundancy dismissal as the sum, in salary weeks, of the cost of advance notice requirements added to severance payments due when terminating a redundant worker.

The Business environment sub-pillar expands on three aspects that directly affect private entrepreneurial endeavours by using the World Bank indices on the ease of starting a business; the ease of resolving insolvency (based on the recovery rate recorded as the cents on the

Table 1b: Human capital & research pillar

	Indicator	High income	Upper-middle income	Lower-middle income	Low income	Mean
		Average value by income group				
2	**Human capital and research**					
2.1	*Education*					
2.1.1	Expenditure on education, % GDP	5.49	4.56	4.21	4.75	4.75
2.1.2	Govt expend. on edu./pupil, secondary[1]	24.86	17.65	17.97	25.17	21.17
2.1.3	School life expectancy, years	16.56	14.31	11.86	9.67	13.95
2.1.4	PISA scales in reading, maths & science[a]	489.53	416.63	405.24	n/a	459.98
2.1.5	Pupil-teacher ratio, secondary[a,b]	11.25	15.06	20.07	27.26	16.52
2.2	*Tertiary education*					
2.2.1	Tertiary enrolment, % gross[a]	66.29	47.38	28.27	7.28	44.83
2.2.2	Graduates in science & engineering, %	22.76	21.04	22.06	14.44	21.32
2.2.3	Tertiary inbound mobility, %[a]	9.96	3.45	1.53	3.4.2	5.77
2.3	*Research and development (R&D)*					
2.3.1	Researchers, FTE/mn pop	3,680.04	792.86	449.14	68.47	1,938.71
2.3.2	Gross expenditure on R&D, % GDP	1.65	0.55	0.34	0.36	0.96
2.3.3	Global R&D firms, avg. exp. top 3, mn $US	1,332.33	154.67	37.95	0.00	554.25
2.3.4	QS university ranking, average score top 3*	39.97	18.48	6.93	0.18	21.70

Note: (*) index, (†) survey question, (a) half weight, (b) higher values indicate worse outcomes. FTE = full-time equivalence.

[1] Scaled by percent of GDP per capita.

Table 1c: Infrastructure pillar

	Indicator	High income	Upper-middle income	Lower-middle income	Low income	Mean
		Average value by income group				
3	**Infrastructure**					
3.1	*Information and communication technologies (ICTs)*					
3.1.1	ICT access*	8.08	5.98	4.41	2.68	6.01
3.1.2	ICT use*	6.86	4.36	2.30	0.86	4.41
3.1.3	Governments online service*	0.77	0.57	0.46	0.28	0.58
3.1.4	E-participation*	0.75	0.57	0.49	0.30	0.59
3.2	*General infrastructure*					
3.2.1	Electricity output, kWh/cap[a]	9,396.97	3,285.84	1,135.44	221.18	5,031.15
3.2.2	Logistics performance*[a]	3.60	2.83	2.64	2.56	3.04
3.2.3	Gross capital formation, % GDP	21.81	25.33	22.27	24.49	23.22
3.3	*Ecological sustainability*					
3.3.1	GDP/unit of energy use, 2010 PPP$/kg oil eq	10.15	9.73	8.84	4.36	9.29
3.3.2	Environmental performance*	82.18	74.11	65.77	47.86	72.08
3.3.3	ISO 14001 environ. certificates/bn PPP$ GDP[a]	4.45	2.73	0.56	0.23	2.60

Note: (*) index, (†) survey question, (a) half weight, (b) higher values indicate worse outcomes. KwH = kilowatt hours.

dollar recouped by creditors through reorganization, liquidation, or debt enforcement/foreclosure proceedings); and the ease of paying taxes.

Pillar 2: Human capital and research

The level and standard of education and research activity in a country are prime determinants of the innovation capacity of a nation. This pillar tries to gauge the human capital of countries (Table 1b).

The first sub-pillar includes a mix of indicators aimed at capturing achievements at the elementary and secondary education levels. Education expenditure and school life expectancy are good proxies for coverage. Government expenditure per pupil, secondary gives a sense of the level of priority given to secondary education by the state. The quality of education is measured through the results to the OECD Programme for International Student Assessment (PISA), which examines 15-year-old students' performances in reading, mathematics, and science, as well as the pupil-teacher ratio.

Higher education is crucial for economies to move up the value chain beyond simple production processes and products. The sub-pillar on tertiary education aims at capturing coverage (tertiary enrolment); priority is given to the sectors traditionally associated with innovation (with a series on the percentage of tertiary graduates in science, engineering, manufacturing, and construction); and the inbound and mobility of tertiary students, which plays a crucial role in the exchange of ideas and skills necessary for innovation.

The last sub-pillar, on R&D, measures the level and quality of R&D activities, with indicators on researchers (full-time equivalence), gross expenditure, the R&D expenditures of top global R&D spenders, and the quality of scientific and research institutions as measured by the average score of the top three universities in the QS World University Ranking of 2016. The R&D expenditures of the top three firms in a given country looks at the average expenditure of these three firms that are part of the top 2,500 R&D spenders worldwide. The QS university rankings indicator gives the average scores of the country's top three universities that belong to the top 700 universities worldwide. These indicators are not aimed at assessing the average level of all institutions within a particular economy.

Pillar 3: Infrastructure

The third pillar includes three sub-pillars: Information and communication technologies (ICTs), General infrastructure, and Ecological sustainability (Table 1c).

Good and ecologically friendly communication, transport, and energy infrastructures facilitate the production and exchange of ideas, services, and goods and feed into the innovation system through increased productivity and efficiency, lower transaction costs, better access to markets, and sustainable growth.

The ICTs sub-pillar includes four indices developed by international organizations on ICT access, ICT use, online service by governments, and online participation of citizens.

The sub-pillar on general infrastructure includes the average of electricity output in kWh per capita; a composite indicator on logistics performance; and gross capital formation, which consists of outlays on additions to the fixed assets and net inventories of the economy, including land improvements (fences, ditches, drains); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings.

The sub-pillar on ecological sustainability includes three indicators: GDP per unit of energy use (a measure of efficiency in the use of energy), the Environmental Performance Index of Yale and Columbia Universities, and the number of certificates of conformity with standard ISO 14001 on environmental management systems issued.

Pillar 4: Market sophistication

The availability of credit and an environment that supports investment, access to the international market, competition, and market scale are all critical for businesses to prosper and for innovation to occur. The Market sophistication pillar has three sub-pillars structured around market conditions and the total level of transactions (Table 1d).

Table 1d: Market sophistication pillar

	Indicator	Average value by income group: High income	Upper-middle income	Lower-middle income	Low income	Mean
4	**Market sophistication**					
4.1	*Credit*					
4.1.1	Ease of getting credit*	59.79	60.29	55.74	36.76	55.98
4.1.2	Domestic credit to private sector, % GDP	99.09	59.83	41.61	23.82	66.31
4.1.3	Microfinance gross loans, % GDP	0.15	0.95	3.63	0.98	1.79
4.2	*Investment*					
4.2.1	Ease of protecting minority investors*	62.98	58.86	53.33	43.63	57.20
4.2.2	Market capitalization, % GDP[a]	93.18	41.80	28.10	21.82	60.25
4.2.3	Venture capital deals/bn PPP$ GDP[a]	0.11	0.02	0.02	0.03	0.06
4.3	*Trade, competition, and market scale*					
4.3.1	Applied tariff rate, weighted mean, %[a,b]	1.84	3.79	5.35	8.99	4.08
4.3.2	Intensity of local competition†	5.42	5.01	4.88	4.67	5.10
4.3.3	Domestic market scale, bn PPP$	1,120.76	1,183.87	700.32	48.06	905.18

Note: (*) index, (†) survey question, (a) half weight, (b) higher values indicate worse outcomes.

The Credit sub-pillar includes a measure on the ease of getting credit aimed at measuring the degree to which collateral and bankruptcy laws facilitate lending by protecting the rights of borrowers and lenders, as well as the rules and practices affecting the coverage, scope, and accessibility of credit information. Transactions are given by the total value of domestic credit and, in an attempt to make the model more applicable to emerging markets, by the gross loan portfolio of microfinance institutions.

The Investment sub-pillar includes the ease of protecting minority investors index as well as two indicators on the level of transactions. These two indicators look at whether market size is matched by market dynamism and provide a hard data metric on venture capital deals.

The last sub-pillar tackles trade, competition, and market scale. The market conditions for trade are given in the first indicator measuring the average tariff rate weighted by import shares. The second indicator is a survey question that reflects the intensity of competition in local markets. Efforts made at finding hard data on competition so far remain unsuccessful. Domestic market scale, as measured by an economy's GDP, was incorporated in 2016, so the last sub-pillar takes into consideration the impact that the size of an economy has on its capacity to introduce and test innovations in the market place.

Pillar 5: Business sophistication

The last enabler pillar tries to capture the level of business sophistication to assess how conducive firms are to innovation activity (Table 1e). The Human capital and research pillar (pillar 2) made the case that the accumulation of human capital through education, particularly higher education and the prioritization of R&D activities, is an indispensable condition for innovation to take place. That logic is taken one step further here with the assertion that businesses foster their productivity, competitiveness, and innovation potential with the employment of highly qualified professionals and technicians.

The first sub-pillar includes four quantitative indicators on knowledge workers: employment in knowledge-intensive services; the availability of formal training at the firm level; R&D performed by

Table 1e: Business sophistication pillar

	Indicator	High income	Upper-middle income	Lower-middle income	Low income	Mean
		Average value by income group				
5	**Business sophistication**					
5.1	*Knowledge workers*					
5.1.1	Knowledge-intensive employment, %	38.87	23.03	17.99	3.73	27.37
5.1.2	Firms offering formal training, % firms	40.37	38.43	32.05	28.41	35.00
5.1.3	GERD performed by business, % GDP[a]	1.06	0.28	0.10	0.04	0.63
5.1.4	GERD financed by business, %[a]	43.84	25.65	15.82	5.87	31.32
5.1.5	Females emp. w/adv. degrees, % tot. emp.[a]	18.81	13.01	10.02	2.27	14.54
5.2	*Innovation linkages*					
5.2.1	University/industry research collaboration[†a]	4.26	3.40	3.21	3.13	3.66
5.2.2	State of cluster development[†]	4.37	3.64	3.48	3.29	3.85
5.2.3	GERD financed by abroad, %	14.14	9.09	8.98	30.63	13.49
5.2.4	JV-strategic alliance deals/bn PPP$ GDP[a]	0.07	0.02	0.02	0.02	0.04
5.2.5	Patent families filed in 2+ offices/bn PPP$ GDP[a]	3.38	0.16	0.09	0.07	1.44
5.3	*Knowledge absorption*					
5.3.1	Intellectual property payments, % total trade[a]	1.90	0.69	0.44	0.13	1.00
5.3.2	High-tech imports less re-imports, % total trade	10.27	9.81	7.98	7.91	9.36
5.3.3	ICT services imports, % total trade	1.67	0.93	0.86	1.71	1.30
5.3.4	FDI net inflows, % GDP	5.32	3.94	3.18	5.32	4.49
5.3.5	Research talent, % in business enterprise	42.75	23.24	20.23	17.04	32.44

Note: (*) index, (†) survey question, (a) half weight, (b) higher values indicate worse outcomes. GERD = gross domestic expenditure on R&D.

business enterprise (GERD) as a percentage of GDP (i.e., GERD over GDP); and the percentage of total gross expenditure of R&D that is financed by business enterprise. In addition, the sub-pillar includes an indicator related to the percentage of females employed with advanced degrees. This indicator, in addition to providing a glimpse into the gender labour distributions of nations, offers more information about the degree of sophistication of the local human capital currently employed.

Innovation linkages and public/private/academic partnerships are essential to innovation. In emerging markets, pockets of wealth have developed around industrial or technological clusters and networks, in sharp contrast to the poverty that may prevail in the rest of the territory. The Innovation linkages sub-pillar draws on both qualitative and quantitative data regarding business/university collaboration on R&D, the prevalence of well-developed and deep clusters, the level of gross R&D expenditure financed by abroad, and the number of deals on joint ventures and strategic alliances. In addition, the total number of Patent Cooperation Treaty (PCT) and national office published patent family applications filed by residents in at least two offices proxies for international linkages.

In broad terms, pillar 4 on market sophistication makes the case that well-functioning markets contribute to the innovation environment through competitive pressure, efficiency gains, and economies of transaction and by allowing supply to meet demand. Markets that are open to foreign trade and investment have the additional effect of exposing domestic firms to best practices around the globe, which is critical to innovation through knowledge absorption and diffusion, which are considered in pillars 5 and 6. The rationale behind sub-pillars 5.3 on knowledge absorption (an enabler) and 6.3 on knowledge diffusion (a result)—two sub-pillars designed to be mirror images of each other—is precisely that together they will reveal how good economies are at absorbing and diffusing knowledge.

Sub-pillar 5.3 includes five metrics that are linked to sectors with high-tech content or are key to innovation: intellectual property payments as a percentage of total trade; high-tech net imports as a percentage of total imports; imports of communication, computer and information services as a percentage of total trade; and net inflows of foreign direct investment (FDI) as a percentage of GDP (three-year average). To strengthen the sub-pillar, the percentage of research talent in business was added in 2016 to provide a measurement of professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, including business management.

The Innovation Output Sub-Index

Innovation outputs are the results of innovative activities within the economy. Although the Output Sub-Index includes only two pillars, it has the same weight in calculating the overall GII scores as the Input Sub-Index. There are two output pillars: Knowledge and technology outputs and Creative outputs.

Pillar 6: Knowledge and technology outputs

This pillar covers all those variables that are traditionally thought to be the fruits of inventions and/or innovations (Table 1f). The first sub-pillar refers to the creation of knowledge. It includes five indicators that are the result of inventive and innovative activities: patent applications filed by residents both at the national patent office and at the international level through the PCT; utility model applications filed by residents at the national office; scientific and technical published articles in peer-reviewed journals;

and an economy's number of articles (H) that have received at least H citations.

The second sub-pillar, on knowledge impact, includes statistics representing the impact of innovation activities at the micro- and macroeconomic level or related proxies: increases in labour productivity, the entry density of new firms, spending on computer software, the number of certificates of conformity with standard ISO 9001 on quality management systems issued, and the measure of high- and medium-high-tech industrial output over total manufactures output.

The third sub-pillar, on knowledge diffusion, is the mirror image of the knowledge absorption sub-pillar of pillar 5, with the exception of indicator 5.3.5. It includes four statistics all linked to sectors with high-tech content or that are key to innovation: intellectual property receipts as a percentage of total trade; high-tech net exports as a percentage of total exports; exports of ICT services as a percentage of total trade; and net outflows of FDI as a percentage of GDP (three-year average).

Table 1f: Knowledge & technology outputs pillar

		Average value by income group				
	Indicator	High income	Upper-middle income	Lower-middle income	Low income	Mean
6	**Knowledge and technology outputs**					
6.1	*Knowledge creation*					
6.1.1	Patents by origin/bn PPP$ GDP[a]	7.65	3.02	1.27	0.25	4.10
6.1.2	PCT patent applications/bn PPP$ GDP[a]	2.50	0.23	0.10	0.06	1.17
6.1.3	Utility models by origin/bn PPP$ GDP	1.26	3.23	3.19	0.19	2.40
6.1.4	Scientific & technical articles/bn PPP$ GDP[a]	30.01	10.82	7.22	8.66	16.94
6.1.5	Citable documents H index*[a]	422.21	166.28	120.37	78.91	241.56
6.2	*Knowledge impact*					
6.2.1	Growth rate of PPP$ GDP/worker, %	0.70	0.69	1.19	2.32	0.97
6.2.2	New businesses/th pop. 15–64[a]	6.12	3.28	1.00	0.45	3.64
6.2.3	Computer software spending, % GDP[a]	0.42	0.21	0.19	0.07	0.26
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP[a]	14.69	9.35	2.73	1.33	8.89
6.2.5	High- & medium-high-tech manufactures, %[a]	33.74	21.97	15.83	8.68	25.05
6.3	*Knowledge diffusion*					
6.3.1	Intellectual property receipts, % total trade[a]	1.20	0.08	0.11	0.05	0.51
6.3.2	High-tech exports less re-exports, % total trade[a]	6.87	4.55	2.15	0.34	4.39
6.3.3	ICT services exports, % total trade[a]	2.99	1.73	2.34	2.34	2.42
6.3.4	FDI net outflows, % GDP	3.59	0.95	0.22	0.52	1.75

Note: (*) index, (†) survey question, (a) half weight, (b) higher values indicate worse outcomes.

Table 1g: Creative outputs pillar

		Average value by income group				
	Indicator	High income	Upper-middle income	Lower-middle income	Low income	Mean
7	**Creative outputs**					
7.1	*Intangible assets*					
7.1.1	Trademarks by origin/bn PPP$ GDP	56.96	56.80	45.97	16.72	49.60
7.1.2	Industrial designs by origin/bn PPP$ GDP[a]	5.3.5	3.09	4.48	1.26	4.10
7.1.3	ICTs & business model creation†	5.28	4.51	4.25	3.89	4.68
7.1.4	ICTs & organizational model creation†	4.93	4.04	3.87	3.40	4.28
7.2	*Creative goods and services*					
7.2.1	Cultural & creative services exp., % total trade[a]	0.85	0.58	0.08	0.23	0.54
7.2.2	National feature films/mn pop. 15–69[a]	9.35	3.30	2.90	1.30	5.52
7.2.3	Global ent. & media market/th pop. 15–69[a]	1.26	0.19	0.05	n/a	0.78
7.2.4	Printing & publishing manufactures, %	2.21	1.62	1.12	1.55	1.78
7.2.5	Creative goods exports, % total trade	1.90	1.70	0.86	0.07	1.39
7.3	*Online creativity*					
7.3.1	Generic TLDs/th pop. 15–69	33.42	5.79	1.37	0.32	14.56
7.3.2	Country-code TLDs/th pop. 15–69	31.69	6.52	0.91	0.77	14.07
7.3.3	Wikipedia yearly edits/mn pop. 15–69	60.37	46.09	33.69	9.93	44.01
7.3.4	Video uploads on YouTube/pop. 15–69	48.20	25.32	11.43	0.94	35.41

Note: (*) index, (†) survey question, (a) half weight, (b) higher values indicate worse outcomes. Scores rather than values are presented for indicators 7.3.1, 7.3.2, 7.3.3, and 7.3.4. TLDs = top-level domains.

Pillar 7: Creative outputs

The role of creativity for innovation is still largely underappreciated in innovation measurement and policy debates. Since its inception, the GII has always emphasized measuring creativity as part of its Innovation Output Sub-Index. The last pillar, on creative outputs, has three sub-pillars (Table 1g).

The first sub-pillar on intangible assets includes statistics on trademark applications by residents at the national office; industrial designs included in applications at a regional or national office, and two survey questions regarding the use of ICTs in business and organizational models, new areas that are increasingly linked to process innovations in the literature.

The second sub-pillar on creative goods and services includes proxies to get at creativity and the creative outputs of an economy. In 2014, in an attempt to include broader sectoral coverage, a global entertainment and media output composite was added. In addition, the indicator on audio-visual and related services exports was renamed 'Cultural and creative services exports' and expanded to include information services, advertising, market research and public opinion polling, and other personal, cultural, and recreational services (as a percentage of total trade). These two indicators complement the remainder of the sub-pillar, which measures national feature films produced in a given country (per capita count); printing and publishing output (as a percentage of total manufactures output); and creative goods exports (as a percentage of total trade), all of which are aimed at providing an overall sense of the international reach of creative activities in the country.

The third sub-pillar on online creativity includes four indicators, all scaled by population aged 15 through 69 years old: generic and country-code top level domains, average yearly edits to Wikipedia; and video uploads on YouTube. Attempts made to strengthen this sub-pillar with indicators in areas such as Internet and machine learning, blog posting, online gaming, and the development of applications have so far proved unsuccessful.

Notes

1 For a fuller introduction to the Global Innovation Index, see the GII 2011.

2 OECD and Eurostat, 2005.

3 OECD, 2010; INSEAD, 2011; and WIPO, 2011.

4 INSEAD, 2011; OECD Scoreboard, 2013; WIPO, 2011.

5 INSEAD, 2011; OECD, 2011; WIPO, 2011.

6 For completeness, 2.0% of data points are from 2012, 1.2% from 2011, 1.3% from 2010, 0.7% from 2009, 0.7% from 2008, 0.3% from 2007, and 0.1% from 2006. In addition, the GII is calculated on the basis of 9,225 data points (compared to 10,287 with complete series), implying that 10.3% of data points are missing. The Data Tables (Appendix II) include the reference year for each data point and mark missing data as not available (n/a).

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Adjustments to the Global Innovation Index Framework and Year-on-Year Comparability of Results

The Global Innovation Index (GII) is a cross-country performance assessment, compiled on an annual basis, which continuously seeks to update and improve the way innovation is measured. The GII report pays special attention to making accessible the statistics used in the Country/Economy Profiles and Data Tables, providing data sources and definitions, and detailing the computation methodology (Appendices I, II, III, and IV, respectively). This annex summarizes the changes made this year and provides an assessment of the impact of these changes on the comparability of rankings.

Table 1: Changes to the Global Innovation Index framework

GII 2016		Adjustment	GII 2017	
4.2.3	Total value of stocks traded, % GDP	Removed		
4.2.4	Venture capital deals/bn PPP$ GDP	Number changed	4.2.3	Venture capital deals/bn PPP$ GDP
5.3.4	Foreign direct investment net inflows	Name and methodology changed	5.3.4	Foreign direct investment net inflows (3-year avg.)
6.3.4	Foreign direct investment net outflows	Name and methodology changed	6.3.4	Foreign direct investment net outflows (3-year avg.)
7.3.3	Wikipedia monthly edits	Name and methodology changed	7.3.3	Wikipedia yearly edits

Note: Refer to Annex 1 and Appendix III for a detailed explanation of terminologies. Indicators whose name did not change but methodology at the source did are not part of this list. Refer to Appendix III for a detailed explanation of methodological changes at the source.

Adjustments to the Global Innovation Index framework

The GII model is revised every year in a transparent exercise. This year, no change was made at either the pillar or the sub-pillar level.

Beyond the use of World Intellectual Property Organization (WIPO) data, we collaborate with both public international bodies such as the International Energy Agency; the United Nations Educational, Scientific and Cultural Organization (UNESCO); the United Nations Industrial Development Organization (UNIDO); the International Telecommunication Union (ITU); and the Joint Research Centre of the European Commission (JRC) as well as with private organizations such as the International Organization for Standardization (ISO); IHS Global Insight; QS Quacquarelli Symonds Ltd; Bureau van Dijk (BvD); ZookNIC Inc; and Google to obtain the best available data on innovation measurement globally.

Table 1 provides a summary of adjustments to the GII 2017 framework for quick reference. A total of five indicators were modified this year: one indicator was removed, one indicator changed its number as a result, and three indicators underwent methodological and name changes. Indicators that retained the same name as last year but are derived from a source that changed its methodology are not identified in Table 1.

The statistical audit performed by the JRC (see Annex 3) provides a confidence interval for each ranking following a robustness and uncertainty analysis of the modelling assumptions.

Sources of changes in the rankings

The GII compares the performance of national innovation systems across economies, and it also presents changes in economy rankings over time.

Importantly, scores and rankings from one year to the next are not directly comparable (see Annex 2 of the GII 2013 for a full explanation). Making inferences about absolute or relative performance on the basis of year-on-year differences in rankings can be misleading. Each ranking reflects the relative positioning of that particular country/economy on the basis of the conceptual framework, the data coverage, and the sample of economies—elements that change from one year to another.

A few particular factors influence the year-on-year ranking of a country/economy:

- the actual performance of the economy in question;
- adjustments made to the GII framework;
- data updates, the treatment of outliers, and missing values; and
- the inclusion or exclusion of countries/economies in the sample.

Additionally, the following characteristics complicate the time-series analysis based on simple GII scores or rankings:

- **Missing values.** The GII produces relative index scores, which means that a missing value for one economy affects the index score of other economies. Because the number of missing values decreases every year, this problem is reduced over time.
- **Reference year.** The data underlying the GII do not refer to a single year but to several years, depending on the latest available year for any given variable. In addition, the reference years for different variables are not the same for each economy. The motivation for this approach is that it widens the set of data points for cross-economy comparability.
- **Normalization factor.** Most GII variables are normalized using either GDP or population. This approach is also intended to enable cross-economy comparability. Yet, again, year-on-year changes in individual variables may be driven either by the variable's numerator or by its denominator.
- **Consistent data collection.** Finally, measuring year-on-year performance changes relies on the consistent collection of data over time. Changes in the definition of variables or in the data collection process could create movements in the rankings that are unrelated to true performance.

A detailed economy study based on the GII database and the country/economy profile over time, coupled with analytical work on grounds that include innovation actors and decision makers, yields the best results in terms of grasping an economy's innovation performance over time as well as possible avenues for improvement.

Methodology and data

The revision of the computation methodology for certain individual indicators has caused shifts in the results for several countries.

For indicator 3.3.1, which measures energy use, the constant PPP$ per kg of oil equivalent was updated from 2005 PPP$ to 2010 PPP$.

The methodology underpinning indicators 4.2.3 and 5.2.4 expanded to use datasets from previous years to improve data coverage.

For indicators 5.3.4 and 6.3.4, the net inflows and outflows of foreign direct investment are now being measured as an average of the most recent three years to produce a more stable reflection of these indicators' datasets.

The underlying methodology for indicator 7.3.3 has also changed; it now measures edits within each economy by year rather than by month.

Missing values

Since its inception, the GII has had a positive influence on data availability, increasing awareness of the importance of submitting timely data. The number of data points submitted by economies to international data agencies has substantially increased in recent years. In the GII 2016, 12.8% of data points were missing; this year, in the GII 2017, coverage improved again, with only 10.3% of data points missing.

When it comes to country coverage, the objective is to include as many economies as possible. However, it is also important to maintain a good level of data coverage within each of these economies. Because the GII results are linked to data availability (see the JRC Statistical Audit presented in Annex 3 for more details), which affects the overall GII ranks, this year the minimum data coverage threshold rule was strengthened—on the recommendation of the JRC—to maintain the significance of both the GII results and the country sample. To be included in the GII 2017, an economy must have a minimum symmetric data coverage of 36 indicators in the Innovation Input Sub-Index (66%) and 18 indicators in the Innovation Output Sub-Index (66%), and it must have scores for at least two sub-pillars per pillar. Missing values are indicated with 'n/a' and are not considered in the sub-pillar score.

This adjustment derives from a sensitivity that is the result of the data availability, which is less satisfactory

Table 2: GII economies with the most missing values

Economy	Number of missing values	Economy	Number of missing values
Trinidad and Tobago	25	Brunei Darussalam	21
Togo	23	Burkina Faso	20
Burundi	22	Guinea	20
Niger	22	Nepal	20
Benin	21		

Table 3: GII economies with the fewest missing values

Economy	Number of missing values	Economy	Number of missing values
Colombia	0	Israel	3
Hungary	0	Kazakhstan	3
Mexico	0	Netherlands	3
Romania	0	Serbia	3
Bulgaria	1	Slovenia	3
Chile	1	Spain	3
Czech Republic	1	Sweden	3
Malaysia	1	Argentina	4
Poland	1	Croatia	4
Russian Federation	1	Egypt	4
Turkey	1	Latvia	4
Austria	2	Lithuania	4
Brazil	2	Malta	4
France	2	Morocco	4
Italy	2	New Zealand	4
Japan	2	Norway	4
Korea, Rep.	2	Philippines	4
Portugal	2	Switzerland	4
Slovakia	2	Tunisia	4
South Africa	2	United Kingdom	4
Thailand	2	Cyprus	5
Ukraine	2	Georgia	5
Australia	3	Greece	5
Belgium	3	India	5
Costa Rica	3	Ireland	5
Denmark	3	Luxembourg	5
Estonia	3	Moldova, Rep.	5
Finland	3	Panama	5
Germany	3	Singapore	5
Indonesia	3	United States of America	5

in the case of the Output Sub-Index: four countries that were part of the GII 2016 have data coverage below the 66% threshold in the 27 variables in the Output Sub-Index. In contrast, data coverage is satisfactory in all of these cases in the Input Sub-Index (all of these economies have indicator coverage of more than 66% over the 54 input variables). As a result, the following countries included in the GII 2016 dropped out this year: Bhutan, Ghana, Nicaragua, and the Bolivarian Republic of Venezuela.[1] The rules on missing data and the minimum coverage necessary per sub-pillar will be progressively tightened, leading to the exclusion of countries that fail to meet the desired minimum coverage in any sub-pillar (see Appendix I for more details).

Despite requiring minimum levels of coverage, for several economies the number of missing data points remains very high. Table 2 lists the countries that have the highest number of missing data points (20 or more), ranking them according to how many data points are missing.

Conversely, Table 3 lists those economies with the best data coverage, ranking them according to the least number of missed data points. These economies are missing at most only five data points; some are missing none at all.

Note

Conversely, Brunei Darussalam, Trinidad and Tobago, and Zimbabwe—which were not included in the GII 2016—enter the GII this year with the required coverage in both sub-indices and sufficient data availability per pillar.

Joint Research Centre Statistical Audit of the 2017 Global Innovation Index

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Conceptual and practical challenges are inevitable when trying to understand and model the fundamentals of innovation at the national level worldwide. In its 10th edition, the 2017 Global Innovation Index (GII) considers these conceptual challenges in Chapter 1 and deals with practical challenges—related to data quality and methodological choices—by grouping country-level data over 127 countries and across 81 indicators into 21 sub-pillars, 7 pillars, 2 sub-indices and, finally, an overall index. This annex offers detailed insights into the practical issues related to the construction of the GII, analysing in depth the statistical soundness of the calculations and assumptions made to arrive at the final index rankings. Statistical soundness should be regarded as a necessary but not sufficient condition for a sound GII, since the correlations underpinning the majority of the statistical analyses carried out herein 'need not necessarily represent the real influence of the individual indicators on the phenomenon being measured'.[1] Consequently, the development of the GII must be nurtured by a dynamic iterative dialogue between the principles of statistical and conceptual soundness or, to put it another way, between the theoretical understanding of innovation and the empirical observations of the data underlying the variables.

The European Commission's Competence Centre on Composite Indicators and Scoreboards at the Joint Research Centre (JRC) in Ispra has been invited for the seventh consecutive year to audit the GII. As in previous editions, the present JRC audit focuses on the statistical soundness of the multi-level structure of the index as well as on the impact of key modelling assumptions on the results.[2] The independent statistical assessment of the GII provided by the JRC guarantees the transparency and reliability of the index for both policy makers and other stakeholders, thus facilitating more accurate priority setting and policy formulation in this particular field.

As in past GII reports, the JRC analysis complements the country rankings with confidence intervals for the GII, the Innovation Input Sub-Index, and the Innovation Output Sub-Index in order to better appreciate the robustness of these ranks to the computation methodology. In addition, the JRC analysis includes an assessment of the added value of the GII and a measure of distance to the efficient frontier of innovation by using data envelopment analysis.

Conceptual and statistical coherence in the GII framework

An earlier version of the GII model was assessed by the JRC in April–May 2017. Fine-tuning suggestions were taken into account in the final computation of the rankings in an iterative process with the JRC aimed at setting the foundation for a balanced index. The entire process followed four steps (see Figure 1).

Step 1: Conceptual consistency

Eighty-one indicators were selected for their relevance to a specific innovation pillar on the basis of the literature review, expert opinion, country coverage, and timeliness. To represent a fair picture of country differences, indicators were scaled either at the source or by the GII team as appropriate and where needed.

Step 2: Data checks

The most recently released data within the period 2006–16 were used for each economy: 77% of the available data refer to 2015 or more recent years. In past editions, countries were included if data availability was at least 60% across all variables in the GII framework. A more stringent criterion was adopted this year, following the JRC recommendation of past GII audits. That is, countries were included if data availability was at least 66% within each of the two sub-indices (i.e., 36 out of 54 variables within the Input Sub-Index and 18 out of the 27 variables in the Output Sub-Index) and at least two of the three sub-pillars in each pillar could be computed. This more stringent criterion for a country's inclusion in the GII was introduced this year in order to ensure that country scores for the GII and for the two Input and Output Sub-Indices are

Figure 1: Conceptual and statistical coherence in the GII 2017 framework

Step 4. Qualitative review
- Internal qualitative review (INSEAD, WIPO, Cornell University)
- External qualitative review (JRC, international experts)

Step 3. Statistical coherence
- Treatment of highly collinear variables as a single indicator
- Assessment of grouping indicators into sub-pillars, pillars, sub-indices, and the GII
- Use of weights as scaling coefficients to ensure statistical coherence
- Assessment of arithmetic average assumption
- Assessment of potential redundancy of information in the overall GII

Step 2. Data checks
- Check for data recency (77% of available data refer to 2015–2016)
- Availability requirements per country: coverage ≥ 66% for the Input and the Output Sub-Indices separately and at least two sub-pillars per pillar
- Check for reporting errors (interquartile range)
- Outlier treatment (skewness and kurtosis)
- Direct contact with data providers

Step 1. Conceptual consistency
- Compatibility with existing literature on innovation and pillar definition
- Scaling factors per indicator to represent a fair picture of country differences (e.g., GDP, population)

Source: European Commission Joint Research Centre, 2017.

not particularly sensitive to the missing values (as it was the case for the Output Sub-Index scores of several countries in past editions). In practice, data availability for all countries included in the GII 2017 is very good: 80% data availability for 84% (107 out of 127) of the countries. Potentially problematic indicators that could bias the overall results were identified on the basis of two measures related to the shape of the distributions: skewness and kurtosis. In past editions since 2011, values were treated if the indicators had absolute skewness greater than 2.0 and kurtosis greater than 3.5.[3] These criteria were decided jointly with the JRC back in 2011. This year and after having analysed data in GII 2011–GII 2017, a less stringent criterion was adopted: an indicator was treated if the absolute skewness was greater than 2.25 and kurtosis greater than 3.5. These indicators were treated either by winsorization or by taking the natural logarithm (in case of more than five outliers; see Appendix IV Technical Notes in this report for details).

Step 3: Statistical Coherence

Weights as scaling coefficients

Weights of 0.5 or 1.0 were jointly decided between the JRC and the GII team in 2012 to be scaling coefficients and not importance coefficients, with the aim of arriving at sub-pillar and pillar scores that were balanced in their underlying components (i.e., that indicators and sub-pillars can explain a similar amount of variance in their respective sub-pillars/pillars). Becker et al. (2017) and Paruolo et al. (2013) show that, in weighted arithmetic averages, the ratio of two nominal weights gives the rate of substitutability between two indicators, and hence can be used to reveal the relative importance of individual indicators. This importance can then be compared with ex-post measures of variables' importance, such as the non-linear Pearson correlation ratio. As a result of this analysis, 35 out of 81 indicators and two sub-pillars—7.2 Creative goods and services and 7.3 Online creativity—were assigned half weight while all other indicators and sub-pillars were assigned a weight of 1.0. Nevertheless, for seven indicators with Pearson correlation coefficients less than 0.3 with the respective sub-pillars, some further reflection is needed because they seem to be non-influential (i.e., they behave as 'noise') at all aggregation levels in the GII 2017 framework, despite the fact that their inclusion was based on conceptual grounds or practical experience. This applies to 2.1.2 Government expenditure on education per pupil, secondary; 2.2.2 Graduates in science and engineering; 3.2.3 Gross capital formation; 5.2.3 GERD financed by abroad,

Table 1: Statistical coherence in the GII: Correlations between sub-pillars and pillars

	Sub-pillar	Institutions	Human capital and research	Infrastructure	Market sophistication	Business sophistication	Knowledge and technology outputs	Creative outputs
INPUT	Political environment	0.94	0.76	0.85	0.69	0.71	0.68	0.77
	Regulatory environment	0.93	0.68	0.71	0.60	0.68	0.60	0.67
	Business environment	0.89	0.73	0.77	0.69	0.66	0.66	0.71
	Education	0.57	0.78	0.56	0.45	0.50	0.51	0.55
	Tertiary education	0.67	0.80	0.73	0.58	0.48	0.54	0.60
	Research and development (R&D)	0.69	0.88	0.76	0.74	0.83	0.85	0.74
	Information and communication technologies (ICTs)	0.80	0.85	0.94	0.75	0.68	0.72	0.82
	General infrastructure	0.57	0.53	0.69	0.47	0.49	0.56	0.47
	Ecological sustainability	0.65	0.59	0.77	0.54	0.55	0.53	0.67
	Credit	0.63	0.58	0.58	0.87	0.53	0.56	0.60
	Investment	0.53	0.47	0.42	0.71	0.52	0.44	0.42
	Trade, competition, & market scale	0.48	0.66	0.73	0.71	0.52	0.62	0.62
	Knowledge workers	0.69	0.79	0.72	0.67	0.86	0.72	0.67
	Innovation linkages	0.52	0.42	0.40	0.38	0.74	0.51	0.45
	Knowledge absorption	0.56	0.60	0.58	0.55	0.81	0.77	0.61
OUTPUT	Knowledge creation	0.62	0.79	0.64	0.65	0.78	0.89	0.76
	Knowledge impact	0.50	0.55	0.61	0.48	0.54	0.76	0.62
	Knowledge diffusion	0.59	0.60	0.61	0.58	0.69	0.80	0.59
	Intangible assets	0.61	0.63	0.70	0.59	0.55	0.67	0.91
	Creative goods and services	0.69	0.66	0.69	0.61	0.68	0.71	0.85
	Online creativity	0.82	0.80	0.82	0.71	0.75	0.79	0.88

Source: European Commission Joint Research Centre, 2017..

5.3.4 Foreign direct investment net inflows; 6.2.1 Growth rate of GDP per person engaged; and 7.2.4 Printing and publishing output. For two out of the seven indicators listed above—2.1.2 and 7.2.4—this is the first time that they are found to be non-influential at all in the GII framework. Instead, the remaining five indicators were found to be non-influential also in the GII 2016. On the other hand, two indicators that were found to be non-influential last year—3.3.1 GDP per unit of energy use and 4.1.3 Microfinance institutions' gross loan portfolio—are instead found to be influential in this year's framework. It is suggested that the GII development team carefully assess how these variables behave in the coming releases of the index. If the 'noisy' behaviour persists, these variables could eventually be removed from the GII framework.

Principal components analysis and reliability item analysis

Principal component analysis (PCA) was used to assess to what extent the conceptual framework is confirmed by statistical approaches. PCA results confirm the presence of a single latent dimension in each of the seven pillars (one component with an eigenvalue greater than 1.0) that captures between close to 60% (pillar 4: Market sophistication) up to 85% (pillar 1: Institutions) of the total variance in the three underlying sub-pillars. These results reveal that the modest adjustments made to the 2017 GII framework have left unaffected the already good statistical coherence properties of the previous version. Furthermore, results confirm the expectation that the sub-pillars are more correlated to their own pillar than to any other pillar and that all correlation coefficients are close to or greater than 0.70. (see Table 1).

The five input pillars share a single statistical dimension that summarizes 80% of the total variance, and the five loadings (correlation coefficients) of these pillars are very similar to each other (0.86–0.92). This similarity suggests that the five pillars make roughly equal contributions to the variation of the Innovation Input Sub-Index scores, as envisaged by the developing team. The reliability of the Input Sub-Index, measured by the Cronbach alpha value, is very high at 0.94—well above the 0.70 threshold for a reliable aggregate.[4]

The two output pillars—Knowledge and technology outputs and Creative outputs—are strongly correlated to each other (0.81); they are also both strongly correlated with the Innovation Output Sub-Index (0.95). This result suggests that the

Table 2: Distribution of differences between pillar and GII rankings

	Innovation Input Sub-Index					Innovation Output Sub-Index	
Rank differences (positions)	Institutions (%)	Human capital and research (%)	Infrastructure (%)	Market sophistication (%)	Business sophistication (%)	Knowledge and technology outputs (%)	Creative outputs (%)
More than 30	14.8%	9.4%	3.9%	21.9%	17.2%	9.4%	3.1%
20–29	15.6%	14.8%	14.1%	10.2%	12.5%	11.7%	8.6%
10–19	23.4%	21.9%	28.1%	28.9%	18.8%	26.6%	30.5%
10 or more*	**53.9%**	**46.1%**	**46.1%**	**60.9%**	**48.4%**	**47.7%**	**42.2%**
5–9	21.1%	23.4%	25.8%	16.4%	22.7%	23.4%	19.5%
Less than 5	21.9%	26.6%	23.4%	18.8%	25.0%	25.8%	32.0%
Same rank	2.3%	3.1%	3.9%	3.1%	3.1%	2.3%	5.5%
Total†	**99.2%**	**99.2%**	**99.2%**	**99.2%**	**99.2%**	**99.2%**	**99.2%**
Pearson correlation coefficient with the GII	0.88	0.90	0.89	0.81	0.86	0.92	0.93

Source: European Commission Joint Research Centre, 2017.

* This column is the sum of the prior three rows.
† This column is the sum of all white rows.

Output Sub-Index is also well balanced in its two pillars. Furthermore, building the GII as the simple average of the Input Sub-Index and Output Sub-Index is also statistically justifiable because the Pearson correlation coefficient of either sub-index with the overall GII is 0.97; the two sub-indices have a correlation of 0.89.

Finally, an important part of the analysis relates to clarifying the importance of the Input and Output Sub-Indices with respect to the variation of the GII scores. The GII is built as the simple arithmetic average of the five Input sub-pillars and the two Output sub-pillars, which implies that the Input-related pillars have a weight of 5/7 versus a weight of 2/7 for the Output-related pillars. Yet this does not imply that the Input aspect is more important than the Output aspect in determining the variation of the GII scores. In fact, the Pearson correlation coefficient of either sub-index with the overall GII is 0.97 (and the two sub-indices have a correlation of 0.89), which suggests that the sub-indices are effectively placed on equal footing.

Overall, the tests so far show that the grouping of variables into sub-pillars, pillars, and an overall index is statistically coherent in the GII 2017 framework, and that the GII has a balanced structure at e`ach aggregation level.

The only recommendation for next year relates to a careful reflection of the seven indicators discussed above—2.1.2 Government expenditure on education per pupil, secondary; 2.2.2 Graduates in science and engineering; 3.2.3 Gross capital formation; 5.2.3 GERD financed by abroad; 5.3.4 Foreign direct investment net inflows; 6.2.1 Growth rate of GDP per person engaged; and 7.2.4 Printing and publishing output—because their information content is lost in the aggregation at the pillar level or higher (sub-index and overall GII). For five out of the seven indicators (2.2.2, 3.2.3, 5.2.3, 5.3.4, 6.2.1) this was also the case in last year's audit.

Added value of the GII

As already discussed, the Input and Output Sub-Indices correlate strongly with each other and with the overall GII. Furthermore, the five pillars in the Input Sub-Index have a very high statistical reliability. These results—the strong correlation between Input and Output Sub-Indices and the high statistical reliability of the five input pillars—may be interpreted by some as a sign of redundancy of information in the GII. The tests conducted by the JRC confirm that this is not the case. In fact, for more than 42% (up to 61%) of the 127 economies included in the GII 2017, the GII ranking and any of the seven pillar rankings differ by 10 positions or more (see Table 2). This is a desired outcome because it demonstrates the added value of the GII ranking, which helps to highlight other aspects of innovation that do not emerge directly by looking into the seven pillars separately. At the same time, this result points to the value of duly taking into account the GII pillars, sub-pillars, and individual indicators on their own merit. By doing so, country-specific strengths and bottlenecks on innovation can be identified and serve as an input for evidence-based policy making.

Step 4: Qualitative Review

Finally, the GII results—including overall country classifications and relative performances in terms of the Innovation Input or Output Sub-Indices—were evaluated to verify that the overall results are, to a great extent, consistent with current

Table 3: Uncertainty parameters: Missing values, aggregation, and weights

		Reference	Alternative
I. Uncertainty in the treatment of missing values		**No estimation of missing data**	**Expectation Maximization (EM)**
II. Uncertainty in the aggregation formula at pillar level		**Arithmetic average**	**Geometric average**
III. Uncertainty intervals for the GII pillar weights			
GII Sub-Index	Pillar	Reference value for the weight	Distribution assigned for robustness analysis
Innovation Input	Institutions	0.2	U[0.1, 0.3]
	Human capital and research	0.2	U[0.1, 0.3]
	Infrastructure	0.2	U[0.1, 0.3]
	Market sophistication	0.2	U[0.1, 0.3]
	Business sophistication	0.2	U[0.1, 0.3]
Innovation Output	Knowledge and technology outputs	0.5	U[0.4, 0.6]
	Creative outputs	0.5	U[0.4, 0.6]

Source: European Commission Joint Research Centre, 2017.

evidence, existing research, and prevailing theory. Notwithstanding these statistical tests and the positive outcomes on the statistical coherence of the GII structure, the GII model is and has to remain open for future improvements as better data, more comprehensive surveys and assessments, and new relevant research studies become available.

The impact of modelling assumptions on the GII results

Modelling assumptions with a direct impact on the GII scores and rankings relate to:

- setting up an underlying structure for the index based on a battery of pillars,
- choosing the individual variables to be used as indicators,
- deciding whether (and how) or not to impute missing data,
- deciding whether (and how) or not to treat outliers,
- selecting the normalization approach to be applied,
- choosing the weights to be assigned, and
- deciding on the aggregation rule to be implemented.

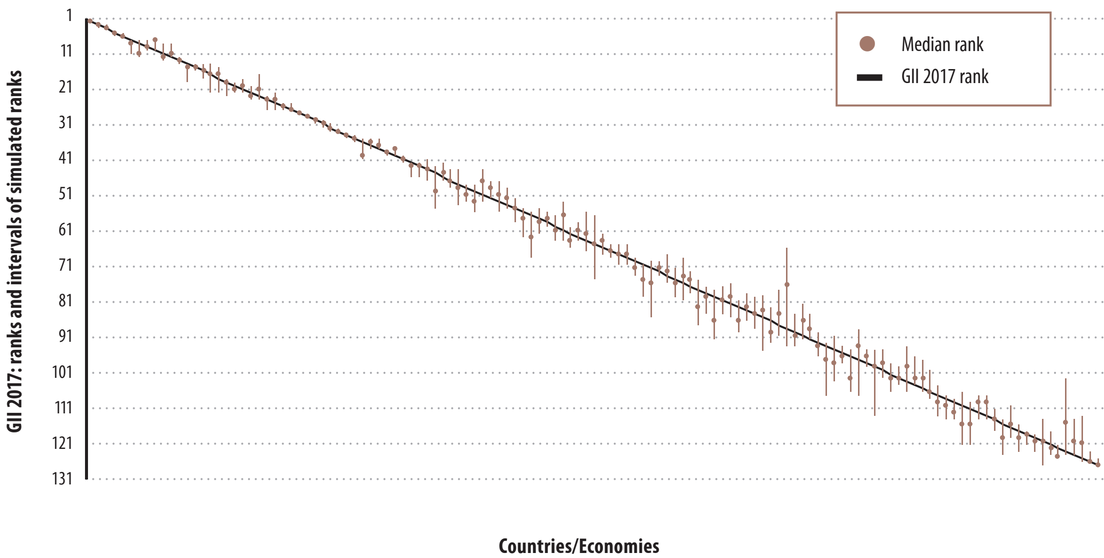
The rationale for these choices is manifold. For instance, expert opinion coupled with statistical analysis is behind the selection of the individual indicators, common practice and ease of interpretation suggests the use of a min-max normalization approach in the [0–100] range, the treatment of outliers is driven by statistical analysis, and simplicity and parsimony criteria seem to advocate for not imputing missing data. The unavoidable uncertainty stemming from the above-mentioned modelling choices is accounted for in the robustness assessment carried out by the JRC. More precisely, the methodology applied herein allows for the joint and simultaneous analysis of the impact of such choices on the aggregate scores, resulting in error estimates and confidence intervals calculated for the GII 2017 individual country rankings.

As suggested in the relevant literature on composite indicators,[5] the robustness assessment was based on Monte Carlo simulation and multi-modelling approaches, applied to 'error-free' data where potential outliers and eventual errors and typos have already been corrected in a preliminary stage. In particular, the three key modelling issues considered in the assessment of the GII were the treatment of missing data, the pillar weights, and the aggregation formula used at the pillar level.

Monte Carlo simulation comprised 1,000 runs of different sets of weights for the seven pillars in the GII. The weights were assigned to the pillars based on uniform continuous distributions centred in the reference values. The ranges of simulated weights were defined by taking into account both the need for a wide enough interval to allow for meaningful robustness checks and the need to respect the underlying principle of the GII that the Input and the Output Sub-Indices should be placed on equal footings. As a result of these considerations, the limit values of uncertainty for the five input pillars are 10%–30%; the limit values for the two output pillars are 40%–60% (see Table 3).

The GII developing team, for transparency and replicability, has always opted not to estimate missing data. The 'no imputation' choice, which is common in similar contexts, might encourage economies not to report low data values. Yet this is not the case for the GII. After 10 editions of the GII, the index-developing

Figure 2a: Robustness analysis (GII rank vs. median rank, 90% confidence intervals)



Source: European Commission Joint Research Centre, 2017.

Notes: Median ranks and intervals are calculated over 4,000 simulated scenarios combining random weights, imputed versus missing values, and geometric versus arithmetic average at the pillar level. The Spearman rank correlation between the median rank and the GII 2017 rank is 0.997.

team has not encountered any intentional no-reporting strategy. The consequence of the 'no imputation' choice in an arithmetic average is that it is equivalent to replacing an indicator's missing value for a given country with the respective sub-pillar score. Hence, the available data (indicators) in the incomplete pillar may dominate, sometimes biasing the ranks up or down. To test the impact of the 'no imputation' choice, the JRC estimated missing data using the Expectation Maximization (EM) algorithm.[6]

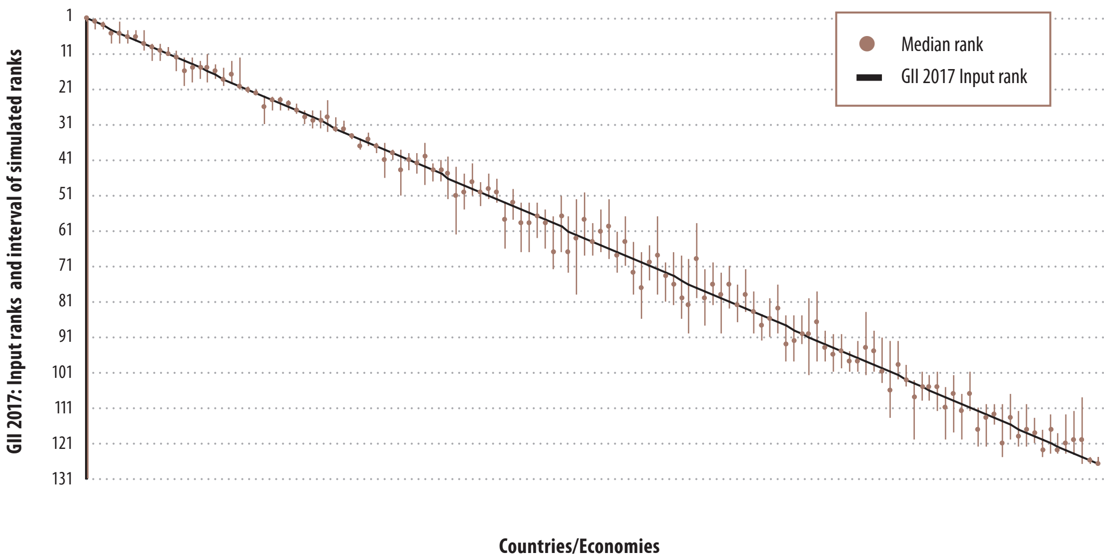
Regarding the aggregation formula, decision-theory practitioners challenge the use of simple arithmetic averages because of their fully compensatory nature, in which a comparative high advantage on a few indicators can compensate a comparative disadvantage on many indicators.[7] For example, one may argue that the United Kingdom and Germany, despite their similar performance at the Innovation Output Sub-Index—both close to 53.5 points (rank 6th and 7th respectively)—are very different if one considers how these countries perform within the sub-index. Germany ranks 8th in Knowledge and technology outputs and 7th in Creative outputs, while the United Kingdom is much more diverse: the country ranks 13th position in Knowledge and technology outputs, but it notably improves its overall position in the Output Sub-Index thanks to its 4th rank in Creative outputs. To assess the impact of this compensability issue, the JRC relaxed the strong perfect substitutability assumption inherent in the arithmetic average and considered instead the geometric average, which is a partially compensatory approach that rewards economies with balanced profiles and motivates economies to improve in the GII pillars in which they perform poorly, and not just in *any* GII pillar.[8]

Four models were tested based on the combination of no imputation versus EM imputation, and arithmetic versus geometric average, combined with 1,000 simulations per model (random weights versus fixed weights), for a total of 4,000 simulations for the GII and each of the two sub-indices (see Table 3 for a summary of the uncertainties considered).

Uncertainty analysis results

The main results of the robustness analysis are shown in Figure 2 with median ranks and 90% confidence intervals computed across the 4,000 Monte Carlo simulations for the GII and the two sub-indices. The figure orders economies from best to worst

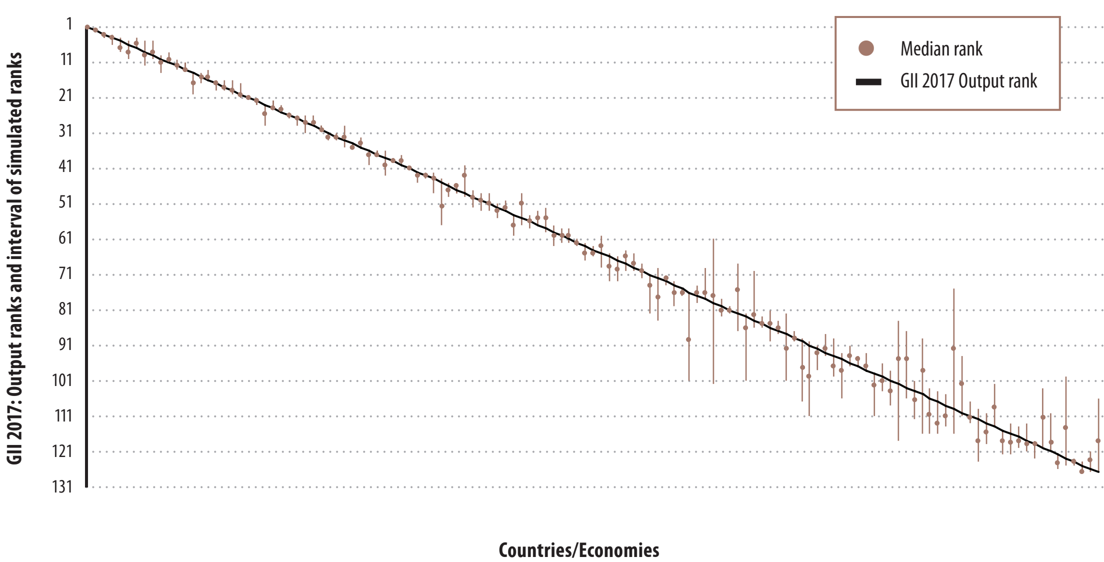
Figure 2b: Robustness analysis (Input rank vs. median rank, 90% confidence intervals)



Source: European Commission Joint Research Centre, 2017.

Notes: Median ranks and intervals are calculated over 4,000 simulated scenarios combining random weights, imputed versus missing values, and geometric versus arithmetic average at the pillar level. The Spearman rank correlation between the median rank and the Innovation Input 2017 rank is 0.997.

Figure 2c: Robustness analysis (Output rank vs. median rank, 90% confidence intervals)



Source: European Commission Joint Research Centre, 2017.

Notes: Median ranks and intervals are calculated over 4,000 simulated scenarios combining random weights, imputation versus no imputation of missing values, and geometric versus arithmetic average at the pillar level. The Spearman rank correlation between the median rank and the Innovation Output 2017 rank is 0.995.

Table 4: GII 2017 and Input/Output Sub-Indices: Ranks and 90% confidence intervals

	GII 2017		Input Sub-Index		Output Sub-Index	
Country/Economy	Rank	Interval	Rank	Interval	Rank	Interval
Switzerland	1	[1, 1]	3	[2, 4]	1	[1, 1]
Sweden	2	[2, 3]	2	[1, 4]	3	[3, 4]
Netherlands	3	[2, 3]	9	[8, 13]	2	[2, 2]
United States of America	4	[4, 5]	5	[2, 8]	5	[4, 8]
United Kingdom	5	[4, 5]	7	[4, 7]	6	[5, 10]
Denmark	6	[6, 10]	6	[4, 8]	12	[10, 13]
Singapore	7	[6, 11]	1	[1, 2]	17	[16, 19]
Finland	8	[6, 9]	4	[4, 8]	13	[11, 13]
Germany	9	[6, 9]	17	[14, 18]	7	[4, 7]
Ireland	10	[7, 12]	19	[13, 19]	8	[5, 12]
Korea, Republic of	11	[7, 11]	16	[11, 19]	9	[5, 10]
Luxembourg	12	[11, 13]	24	[23, 27]	4	[3, 6]
Iceland	13	[13, 18]	21	[20, 22]	10	[9, 14]
Japan	14	[13, 15]	11	[9, 11]	20	[17, 21]
France	15	[13, 17]	15	[13, 18]	18	[16, 19]
Hong Kong (China)	16	[13, 21]	8	[4, 10]	25	[23, 25]
Israel	17	[14, 21]	20	[12, 21]	14	[14, 20]
Canada	18	[17, 22]	10	[8, 13]	23	[23, 29]
Norway	19	[18, 21]	14	[12, 19]	22	[22, 23]
Austria	20	[17, 21]	18	[15, 20]	21	[20, 21]
New Zealand	21	[19, 23]	13	[12, 20]	24	[22, 24]
China	22	[16, 23]	31	[24, 33]	11	[8, 11]
Australia	23	[22, 26]	12	[10, 16]	30	[29, 30]
Czech Republic	24	[21, 26]	27	[25, 28]	16	[13, 16]
Estonia	25	[24, 26]	26	[24, 27]	19	[16, 20]
Malta	26	[24, 26]	28	[27, 31]	15	[14, 17]
Belgium	27	[27, 27]	22	[21, 22]	27	[26, 29]
Spain	28	[28, 28]	25	[23, 27]	26	[25, 27]
Italy	29	[29, 30]	29	[27, 32]	29	[26, 29]
Cyprus	30	[29, 31]	32	[29, 33]	28	[26, 31]
Portugal	31	[30, 32]	33	[30, 33]	31	[31, 33]
Slovenia	32	[31, 32]	30	[27, 32]	34	[34, 35]
Latvia	33	[33, 34]	35	[35, 38]	33	[29, 35]
Slovakia	34	[33, 35]	39	[38, 41]	35	[32, 35]
United Arab Emirates	35	[34, 40]	23	[23, 31]	56	[54, 58]
Bulgaria	36	[34, 37]	45	[41, 47]	32	[31, 33]
Malaysia	37	[34, 37]	36	[33, 37]	39	[38, 39]
Poland	38	[38, 39]	37	[36, 39]	41	[40, 41]
Hungary	39	[37, 39]	41	[39, 44]	37	[36, 37]
Lithuania	40	[39, 41]	34	[34, 35]	49	[47, 52]
Croatia	41	[41, 45]	44	[42, 47]	46	[45, 49]
Romania	42	[41, 45]	51	[45, 52]	44	[42, 48]
Turkey	43	[40, 46]	68	[57, 71]	36	[36, 40]
Greece	44	[42, 54]	38	[36, 46]	59	[57, 63]
Russian Federation	45	[41, 46]	43	[36, 48]	51	[48, 53]
Chile	46	[43, 48]	42	[39, 45]	53	[50, 53]
Viet Nam	47	[43, 53]	71	[65, 75]	38	[36, 43]
Montenegro	48	[47, 52]	50	[47, 54]	52	[51, 55]
Qatar	49	[47, 55]	48	[45, 55]	54	[54, 60]
Ukraine	50	[43, 52]	77	[59, 80]	40	[37, 40]
Thailand	51	[46, 51]	65	[55, 67]	43	[42, 44]
Mongolia	52	[46, 55]	67	[61, 73]	48	[40, 49]
Costa Rica	53	[48, 54]	57	[53, 63]	50	[48, 53]
Moldova, Republic of	54	[51, 58]	73	[70, 81]	42	[42, 45]
Saudi Arabia	55	[54, 62]	46	[40, 52]	66	[65, 73]
Kuwait	56	[55, 68]	80	[73, 90]	45	[44, 57]
South Africa	57	[54, 61]	49	[42, 51]	69	[65, 70]
Mexico	58	[55, 59]	54	[49, 58]	60	[58, 62]
Armenia	59	[56, 63]	82	[76, 87]	47	[46, 48]
India	60	[52, 63]	66	[52, 69]	58	[52, 59]
TFYR of Macedonia	61	[59, 65]	53	[53, 66]	63	[62, 67]
Serbia	62	[58, 63]	58	[55, 66]	61	[58, 62]
Panama	63	[55, 66]	74	[67, 82]	55	[48, 57]
Mauritius	64	[56, 74]	47	[43, 62]	82	[68, 87]

Table 4: GII 2017 and Input/Output Sub-Indices: Ranks and 90% confidence intervals *(continued)*

	GII 2017		Input Sub-Index		Output Sub-Index	
Country/Economy	Rank	Interval	Rank	Interval	Rank	Interval
Colombia	65	[61, 67]	52	[46, 53]	75	[75, 77]
Bahrain	66	[64, 68]	55	[53, 67]	67	[66, 73]
Uruguay	67	[64, 70]	61	[57, 73]	64	[63, 66]
Georgia	68	[64, 70]	69	[64, 79]	62	[61, 63]
Brazil	69	[68, 73]	60	[51, 67]	80	[78, 83]
Peru	70	[70, 79]	56	[53, 67]	85	[83, 86]
Brunei Darussalam	71	[69, 85]	40	[38, 51]	110	[94, 111]
Morocco	72	[69, 73]	79	[70, 82]	68	[64, 70]
Philippines	73	[67, 75]	83	[72, 84]	65	[60, 69]
Tunisia	74	[71, 79]	81	[71, 83]	71	[71, 82]
Iran, Islamic Republic of	75	[68, 80]	98	[84, 102]	57	[53, 57]
Argentina	76	[72, 78]	72	[57, 79]	81	[80, 82]
Oman	77	[74, 87]	62	[52, 79]	90	[89, 107]
Kazakhstan	78	[76, 84]	64	[59, 68]	93	[88, 94]
Dominican Republic	79	[77, 91]	88	[85, 98]	72	[69, 84]
Kenya	80	[76, 84]	91	[80, 102]	70	[68, 72]
Lebanon	81	[75, 85]	87	[76, 90]	78	[69, 78]
Azerbaijan	82	[80, 89]	78	[72, 88]	89	[87, 90]
Jordan	83	[78, 86]	92	[78, 98]	74	[73, 80]
Jamaica	84	[79, 88]	84	[78, 90]	84	[70, 86]
Paraguay	85	[79, 94]	90	[85, 93]	79	[61, 102]
Bosnia and Herzegovina	86	[82, 92]	75	[68, 86]	96	[91, 97]
Indonesia	87	[77, 90]	99	[89, 101]	73	[71, 74]
Belarus	88	[65, 93]	63	[50, 68]	109	[75, 116]
Botswana	89	[84, 93]	59	[57, 72]	111	[107, 113]
Sri Lanka	90	[81, 91]	94	[90, 101]	77	[74, 79]
Trinidad and Tobago	91	[84, 91]	85	[85, 92]	86	[81, 90]
Ecuador	92	[89, 96]	95	[90, 100]	83	[82, 101]
Albania	93	[92, 107]	70	[67, 86]	115	[115, 122]
Tajikistan	94	[90, 103]	100	[91, 104]	88	[82, 101]
Kyrgyzstan	95	[93, 98]	86	[80, 91]	104	[101, 112]
Tanzania, United Republic of	96	[94, 106]	109	[102, 118]	76	[76, 101]
Namibia	97	[88, 107]	89	[85, 98]	102	[84, 118]
Guatemala	98	[94, 99]	97	[92, 101]	92	[91, 98]
Rwanda	99	[94, 113]	76	[69, 90]	121	[110, 121]
Senegal	100	[94, 102]	102	[92, 103]	98	[93, 98]
Cambodia	101	[98, 106]	104	[103, 120]	87	[84, 88]
Uganda	102	[99, 104]	93	[89, 98]	106	[103, 116]
El Salvador	103	[93, 106]	96	[95, 101]	105	[89, 116]
Honduras	104	[96, 104]	103	[99, 105]	103	[87, 106]
Egypt	105	[97, 106]	106	[102, 109]	97	[94, 97]
Bolivia, Plurinational State of	106	[100, 108]	107	[101, 112]	99	[99, 111]
Mozambique	107	[104, 113]	114	[110, 116]	100	[96, 104]
Algeria	108	[107, 114]	105	[101, 109]	117	[114, 120]
Nepal	109	[108, 114]	108	[105, 120]	114	[102, 114]
Ethiopia	110	[106, 121]	122	[118, 124]	91	[90, 111]
Madagascar	111	[109, 121]	120	[117, 125]	95	[93, 106]
Côte d'Ivoire	112	[107, 114]	121	[113, 124]	94	[89, 100]
Pakistan	113	[107, 114]	116	[107, 120]	101	[98, 108]
Bangladesh	114	[111, 117]	113	[110, 122]	108	[105, 114]
Malawi	115	[114, 124]	112	[111, 122]	112	[109, 124]
Benin	116	[110, 119]	110	[107, 120]	120	[103, 120]
Cameroon	117	[115, 123]	117	[112, 122]	113	[110, 119]
Mali	118	[117, 121]	123	[113, 124]	107	[104, 116]
Nigeria	119	[118, 123]	118	[110, 122]	119	[118, 123]
Burkina Faso	120	[114, 127]	101	[92, 114]	126	[121, 127]
Zimbabwe	121	[117, 124]	124	[112, 124]	116	[113, 122]
Burundi	122	[121, 125]	115	[110, 125]	122	[122, 126]
Niger	123	[102, 124]	111	[101, 112]	123	[100, 125]
Zambia	124	[114, 124]	125	[108, 127]	118	[113, 121]
Togo	125	[113, 126]	119	[114, 121]	127	[106, 127]
Guinea	126	[123, 126]	126	[125, 127]	124	[123, 125]
Yemen	127	[125, 127]	127	[125, 127]	125	[124, 127]

Source: European Commission Joint Research Centre, 2017.

Table 5: Sensitivity analysis: Impact of modelling choices on economies with most sensitive ranks

Index or Sub-Index	Uncertainty tested (pillar level only)	Number of economies that *improve*		Number of economies that *deteriorate*	
		by 20 or more positions	between 10 and 19 positions	by 20 or more positions	between 10 and 19 positions
GII	Geometric vs. arithmetic average	0	1	0	3
	EM imputation vs. no imputation of missing data	0	3	0	3
	Geometric average and EM imputation vs. arithmetic average and missing values	1 (Belarus)	3	0	3
Input Sub-Index	Geometric vs. arithmetic average	0	0	0	1
	EM imputation vs. no imputation of missing data	0	2	0	2
	Geometric average and EM imputation vs. arithmetic average and missing values	0	5	0	7
Output Sub-Index	Geometric vs. arithmetic average	0	0	0	3
	EM imputation vs. no imputation of missing data	1 (Belarus)	10	1 (Tanzania, U. Rep.)	7
	Geometric average and EM imputation vs. arithmetic average and missing values	1 (Belarus)	9	1 (Tanzania, U. Rep.)	7

Source: European Commission Joint Research Centre, 2017.

according to their reference rank (black line), the dot being the median rank over the simulations.

All published GII 2017 ranks lay within the simulated 90% confidence intervals, and for most economies these intervals are narrow enough for meaningful inferences to be drawn: there is a shift of fewer than 10 positions for 105 of the 127 economies. However, it is also true that merely two country ranks vary significantly with changes in weights and aggregation formula and because of the estimation of missing data. These two countries—Niger and Belarus—have 90% confidence interval widths of 22 and 28, respectively; hence their GII ranks should be interpreted cautiously and certainly not taken at face value. This is a remarkable improvement compared to the GII 2015, where confidence interval widths for 32 economies lay between 20 and 29, for another 7 economies between 30 and 39, and for 2 economies the widths were 40 or greater. This improvement in the confidence one can attach to the GII 2017 ranks is the direct result of the developers' choice since 2016 to adopt a more stringent criterion for an economy's inclusion, which requires at least 62% data availability within each of the two sub-indices. Some caution is also warranted in the Input Sub-Index for 7 economies—Ukraine, Argentina, Oman, Kenya, Jordan, Rwanda, and Burkina Faso—that have 90% confidence interval widths over 20 (up to 27 for Oman). The Output Sub-Index is slightly more sensitive to the methodological choices: 8 countries—Paraguay, Belarus, the United Republic of Tanzania, Namibia, El Salvador, Ethiopia, Niger, and Togo—have 90% confidence interval widths over 20 (up to 41 for Paraguay and Belarus). This sensitivity is mostly the consequence of the estimation of missing data and the fact that there are only two pillars: this means that changes to the imputation method, weights, or aggregation formula have a more notable impact on the country ranks in the Innovation Output.

Although a few economy ranks, in the GII 2017 overall or in the two sub-indices, appear to be sensitive to the methodological choices, the published rankings for the vast majority can be considered as representative of the plurality of scenarios simulated herein. Taking the median rank as the yardstick for an economy's expected rank in the realm of the GII's unavoidable methodological uncertainties, 75% of the economies are found to shift fewer than three positions with respect to the median rank in the GII, or in the Input and Output Sub-Index.

For full transparency and information, Table 4 reports the GII 2017 Index and Input and Output Sub-Indices economy ranks together with the simulated 90% confidence intervals in order to better appreciate the robustness of the results to the choice of weights, of the aggregation formula and the impact of estimating missing data (where applicable).

Sensitivity analysis results

Complementary to the uncertainty analysis, sensitivity analysis has been used to identify which of the modelling assumptions have the highest impact on certain country ranks. Table 5 summarizes the impact of changes of the EM imputation method and/or the geometric aggregation formula, with fixed weights at their reference values (as in the original GII). Similar to last year's results, this year neither the GII nor the Input or Output Sub-Index are found to be heavily influenced by

Table 6: Pie shares (absolute terms) and efficiency scores for the top 25 economies in the GII 2017

	Input pillars					Output pillars						
Country/Economy	Institutions	Human capital and research	Infrastructure	Market sophistication	Business sophistication	Knowledge and technology outputs	Creative outputs	Efficient frontier rank (DEA)	GII rank	Difference	Efficiency ratio rank	Difference from GII rank
Switzerland	0.09	0.17	0.08	0.09	0.19	0.19	0.19	1	1	0	2	–1
Sweden	0.20	0.20	0.20	0.10	0.20	0.05	0.05	2	2	0	12	–10
Netherlands	0.20	0.05	0.20	0.05	0.20	0.10	0.20	5	3	–2	4	–1
United States of America	0.20	0.20	0.20	0.20	0.10	0.05	0.05	5	4	–1	21	–17
United Kingdom	0.20	0.20	0.20	0.20	0.05	0.05	0.10	4	5	1	20	–15
Denmark	0.20	0.20	0.20	0.20	0.05	0.05	0.10	5	6	1	34	–28
Singapore	0.20	0.20	0.20	0.20	0.10	0.05	0.05	2	7	5	63	–56
Finland	0.20	0.20	0.20	0.10	0.20	0.05	0.05	5	8	3	37	–29
Germany	0.20	0.20	0.20	0.10	0.05	0.05	0.20	9	9	0	7	2
Ireland	0.20	0.20	0.20	0.10	0.20	0.05	0.05	14	10	–4	6	4
Korea, Republic of	0.20	0.20	0.20	0.20	0.10	0.05	0.05	11	11	0	14	–3
Luxembourg	0.20	0.05	0.20	0.20	0.10	0.05	0.20	16	12	-4	1	11
Iceland	0.20	0.10	0.20	0.05	0.20	0.05	0.20	19	13	-6	5	8
Japan	0.20	0.20	0.20	0.20	0.10	0.05	0.05	9	14	5	49	–35
France	0.20	0.20	0.20	0.20	0.05	0.05	0.10	14	15	1	35	–20
Hong Kong (China)	0.20	0.10	0.20	0.20	0.20	0.05	0.05	11	16	5	73	–57
Israel	0.10	0.20	0.20	0.20	0.20	0.05	0.05	19	17	–2	23	–6
Canada	0.20	0.20	0.20	0.20	0.10	0.05	0.05	11	18	7	59	–41
Norway	0.20	0.20	0.20	0.20	0.10	0.05	0.05	19	19	0	51	–32
Austria	0.20	0.20	0.20	0.10	0.20	0.05	0.05	19	20	1	41	–21
New Zealand	0.20	0.20	0.20	0.20	0.05	0.05	0.10	16	21	5	56	–35
China	0.05	0.10	0.20	0.20	0.20	0.20	0.05	23	22	–1	3	19
Australia	0.20	0.20	0.20	0.20	0.05	0.05	0.10	16	23	7	76	–53
Czech Republic	0.20	0.20	0.20	0.10	0.05	0.05	0.20	28	24	–4	13	11
Estonia	0.20	0.05	0.20	0.20	0.10	0.05	0.20	23	25	2	19	6

Source: European Commission Joint Research Centre, 2017.

Notes: Pie shares are in absolute terms, bounded by 0.05 and 0.20. In the GII 2017, however, the five input pillars each have a fixed weight of 0.10; the two output pillars each have a fixed weight of 0.25.

the imputation of missing data or the aggregation formula. Depending on the combination of the choices made, only Belarus or the United Republic of Tanzania can change rank by 20 positions or more.

All in all, the published GII 2017 ranks are reliable and for the vast majority of countries the simulated 90% confidence intervals are narrow enough for meaningful inferences to be drawn. Nevertheless, the readers of the GII 2017 report should consider country ranks in the GII 2017 and in the Input and Output Sub-Indices not only at face value but also within the 90% confidence intervals in order to better appreciate to what degree a country's rank depends on the modelling choices. Since 2016, following the JRC recommendation in past GII audits, the developers' choice to apply the 66% indicator coverage threshold separately to the Input and Output Sub-Indices in the GII 2017 has led to a net increase in the reliability of country ranks for the GII and the two sub-indices. Furthermore, the adoption of less stringent criterion for the skewness and kurtosis (greater than 2.25 in absolute value and greater than 3.5, respectively) has not introduced any bias in the estimates.

Efficiency frontier in the GII by Data Envelopment Analysis

Is there a way to benchmark countries' multi-dimensional performance on innovation without imposing a fixed and common set of weights that may not be fair to a particular country?

Several innovation-related policy issues at the national level entail an intricate balance between global priorities and country-specific strategies. Comparing the multi-dimensional performance on innovation by subjecting countries to a fixed and common set of weights may prevent acceptance of an innovation index on grounds that a given

Figure 3: GII 2017 scores and DEA 'distance to the efficient frontier' scores

Source: European Commission Joint Research Centre, 2017.

Note: For comparison purposes, we have rescaled the GII scores by dividing them with the best performer in the overall GII 2017.

weighting scheme might not be fair to a particular country. An appealing feature of the Data Envelopment Analysis (DEA) literature applied in real decision-making settings is to determine endogenous weights that maximize the overall score of each decision-making unit given a set of other observations.

In this section, the assumption of fixed pillar weights common to all countries is relaxed once more; this time country-specific weights that maximize a country's score are determined endogenously by DEA.[9] In theory, each country is free to decide on the relative contribution of each pillar to its score, so as to achieve the best possible score in a computation that reflects its innovation strategy. In practice, the DEA method assigns a higher (lower) contribution to those pillars in which a country is relatively strong (weak). Reasonable constraints on the weights are applied to preclude the possibility of a country achieving a perfect score by assigning a zero weight to weak pillars: for each country, the share of each pillar score (i.e., the pillar score multiplied by the DEA weight over the total score) has upper and lower bounds of 5% and 20% respectively. The DEA score is then measured as the weighted average of all seven pillar scores, where the weights are the country-specific DEA weights, compared to the best performance among all other countries with those same weights. The DEA score can be interpreted as a measure of the 'distance to the efficient frontier'.

Table 6 presents the pie shares and DEA scores for the top 25 countries in the GII 2017, next to the GII 2017 ranks and efficiency ratio ranks. All pie shares are in accordance with the starting point of granting leeway to each country when assigning shares, while not violating the (relative) upper and lower bounds. The pie shares are quite diverse, reflecting the different national innovation strategies. These pie shares can also be seen to reflect countries' comparative advantage in certain GII pillars vis-à-vis all other countries and all pillars. For example, Switzerland is the only country this year that obtains a perfect DEA score of 1 by assigning 19% of its DEA score to Business sophistication, Knowledge and technology outputs, and Creative outputs, while merely 8% to 9% of its DEA score comes from Institutions, Infrastructure, and Market sophistication. Instead, countries including the United States of America, the United Kingdom, Denmark, and Singapore would assign 20% of their DEA scores to Market sophistication. Only Switzerland reaches a perfect DEA score of 1, closely followed by Sweden, the Netherlands, the United States of America, the United

Kingdom, Denmark, Singapore, and Finland, which score between 0.96 (Finland) and 0.99 (Sweden) in terms of efficiency. Figure 3 shows how close the DEA scores and the GII 2017 scores are for all 127 economies (correlation of 0.99).[10] Note that by construction, the version of DEA used herein is closer to the GII than to the efficiency ratio calculated as the Output Sub-Index score divided by the Input Sub-Index score (with a correlation of 0.63).

Conclusion

The JRC analysis suggests that the conceptualized multi-level structure of the GII 2017—with its 81 indicators, 21 sub-pillars, 7 pillars, 2 sub-indices, up to an overall index—is statistically sound and balanced: that is, each sub-pillar makes a similar contribution to the variation of its respective pillar. Nevertheless, a careful reflection by the GII team is needed for seven out of the 81 indicators because their capacity to distinguish countries' performance is lost in the aggregation at the pillar level or higher. Five indicators related to the inputs of innovation— 2.1.2 Government expenditure on education per pupil, secondary; 2.2.2 Graduates in science and engineering; 3.2.3 Gross capital formation; 5.2.3 GERD financed by abroad; 5.3.4 Foreign direct investment net inflows—and two indicators related to the outputs of innovation, 6.2.1 Growth rate of GDP per person engaged and 7.2.4 Printing and publishing output, need to be reviewed because their statistical relevance to the GII framework is very weak, unlike their strong conceptual relevance. The no-imputation choice for not treating missing values, common in relevant contexts and justified on grounds of transparency and replicability, can at times have an undesirable impact on some country scores, with the additional negative side-effect that it may encourage countries not to report low data values. The adoption, since 2016, by the GII team of a more stringent data coverage threshold (at least 66% for the input- and output-related indicators, separately) has notably improved the confidence in the country ranks for the GII and the two sub-indices. Additionally, the choice of the GII team, which was made in 2012, to use weights as scaling coefficients during the development of the index constitutes a significant departure from the traditional, yet erroneous, vision of weights as a reflection of indicators' importance in a weighted average. It is hoped that such a consideration will be made also by other developers of composite indicators to avoid situations where bias sneaks in when least expected.

The strong correlations between the GII components are proven not to be a sign of redundancy of information in the GII. For more than 42.2% (up to 60.9%) of the 127 economies included in the GII 2017, the GII ranking and the rankings of any of the seven pillars differ by 10 positions or more. This demonstrates the added value of the GII ranking, which helps to highlight other components of innovation that do not emerge directly by looking into the seven pillars separately. At the same time, this finding points to the value of duly taking into account the GII pillars, sub-pillars, and individual indicators on their own merit. By doing so, country-specific strengths and bottlenecks in innovation can be identified and serve as an input for evidence-based policy making.

All published GII 2017 ranks lie within the simulated 90% confidence intervals that take into account the unavoidable uncertainties in the estimation of missing data, the weights (fixed vs. simulated), and the aggregation formula (arithmetic vs. geometric average) at the pillar level. For the vast majority of countries these intervals are narrow enough for meaningful inferences to be drawn: the intervals comprise fewer than 10 positions for 83% (105 out of 127) of the economies. Some caution is needed mainly for two countries—Belarus and Niger—with ranks that are highly sensitive to the methodological choices. The Input and the Output Sub-Indices have the same modest degree of sensitivity to the methodological choices related to the imputation method, weights, or aggregation formula. Country ranks, either in the GII 2017 or in the two sub-indices, can be considered representative of the many possible scenarios: 75% of the countries shift fewer than three positions with respect to the median rank in the GII or either of the Input and Output Sub-Indices.

All things considered, the present JRC audit findings confirm that the GII 2017 meets international quality standards for statistical soundness, which indicates that the GII index is a reliable benchmarking tool for innovation practices at the country level around the world.

Finally, the 'distance to the efficient frontier' measure calculated with Data Envelopment Analysis could complement the Innovation Efficiency Ratio as a measure of efficiency, even if it is conceptually closer to the GII score than to the efficiency ratio.

The GII should not be seen as the ultimate and definitive ranking of countries with respect to innovation. On the contrary, the GII best represents an ongoing attempt by Cornell University, the business school INSEAD, and the World Intellectual Property Organization to find metrics and approaches that better capture the richness of innovation, continuously adapting the GII framework to reflect the improved availability of statistics and the theoretical advances in the field. In any case, the GII should be regarded as a sound attempt to pave the way for better and more informed innovation policies worldwide.

Notes

1 OECD/EC JRC, 2008, p. 26.

2 The JRC analysis was based on the recommendations of the OECD/EC JRC (2008) *Handbook on Composite Indicators* and on more recent research from the JRC. The JRC audits on composite indicators are conducted upon request of the index developers and are available at https://ec.europa.eu/jrc/en/coin.

3 Groeneveld and Meeden (1984) set the criteria for absolute skewness above 1 and kurtosis above 3.5. The skewness criterion was relaxed to account for the small sample (127 economies).

4 Nunnally, 1978.

5 Saisana et al., 2005; Saisana et al., 2011.

6 The Expectation-Maximization (EM) algorithm (Little and Rubin, 2002; Schneider, 2001) is an iterative procedure that finds the maximum likelihood estimates of the parameter vector by repeating two steps: (1) The expectation E-step: Given a set of parameter estimates, such as a mean vector and covariance matrix for a multivariate normal distribution, the E-step calculates the conditional expectation of the complete-data log likelihood given the observed data and the parameter estimates. (2) The maximization M-step: Given a complete-data log likelihood, the M-step finds the parameter estimates to maximize the complete-data log likelihood from the E-step. The two steps are iterated until the iterations converge.

7 Munda, 2008.

8 In the geometric average, pillars are multiplied as opposed to summed in the arithmetic average. Pillar weights appear as exponents in the multiplication. All pillar scores were greater than zero, hence there was no reason to rescale them to avoid zero values that would have led to zero geometric averages.

9 A question that arises from the GII approach is whether there is a way to benchmark countries' multi-dimensional performance on innovation without imposing a fixed and common set of weights that may not be fair to a particular country. The original question in the DEA literature was how to measure each unit's relative efficiency in production compared to a sample of peers, given observations on input and output quantities and, often, no reliable information on prices (Charnes and Cooper, 1985). A notable difference between the original DEA question and the one applied here is that no differentiation between inputs and outputs is made (Cherchye et al., 2008; Melyn and Moesen, 1991). To estimate DEA-based distance to the efficient frontier scores, we consider the $m = 7$ pillars in the GII 2017 for $n = 127$ countries, with y_{ij} the value of pillar j in country i. The objective is to combine the pillar scores per country into a single number, calculated as the weighted average of the m pillars, where w_i represents the weight of the i-th pillar. In absence of reliable information about the true weights, the weights that maximize the DEA-based scores are endogenously determined. This gives the following linear programming problem for each country j:

$$Y_i = \max_{w_{ij}} \frac{\sum_{j=1}^{7} y_{ij} w_{ij}}{\max\limits_{y_c \in \{\text{dataset}\}} \sum_{j=1}^{7} y_{cj} w_{ij}} \qquad \text{(bounding constraint)}$$

subject to

$$w_{ij} \geqq 0, \qquad \text{(non-negativity constraint)}$$

where

$j = 1, \ldots, 7,$
$i = 1, \ldots, 127$

In this basic programming problem, the weights are non-negative and a country's score is between 0 (worst) and 1 (best).

10 Instead, only Switzerland achieved a 1.0 score in the Innovation Efficiency Ratio, calculated as the ratio of the Output Sub-Index over the Input Sub-Index. The Efficiency Ratio and the DEA score embed very different concepts of efficiency, leading to completely different results and insights. A high score in the Innovation Efficiency Ratio is obtained by scoring more on the Output Sub-Index than on the Input Sub-Index, irrespective of the actual scores in these two sub-indices. Instead, a high score in the DEA score can be obtained by having comparative advantages on several GII pillars (irrespective of these being input or output pillars). The DEA scores are therefore closer to the GII scores than to the Innovation Efficiency Ratio.

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Measuring Innovation in Agriculture and Food Systems

Agriculture and food innovation systems are complex and constantly evolving. Today robotics and biotechnological and digital technologies are applied in agriculture and food systems. New actors enter the systems and traditional actors, such as farmers and food companies, grow into commercial farmers, bio/organic producers, and so on.

Agriculture and food systems also vary greatly across countries, reflecting each country's level of development as well as the role that agriculture and food sectors play.

Measuring agricultural innovation is challenging for several reasons:

First, agriculture and food systems span many different sectors, products, and service groups that are not easily grasped and that go far beyond the agriculture sector or agricultural farms alone. As Chapter 1 and the other substantive chapters of this report show, innovations occur along the value chain and involve (1) agricultural inputs such as fertilizers and seeds, at times coming from the chemical or the biotechnology sector; (2) product innovations coming from the capital goods sector; and (3) process or organizational innovations in the fields of payments, logistics, and distribution services coming from the banking, transport, and retail sectors.

Second, key innovation data sources such as the innovation surveys based on the *Oslo Manual* focus on the manufacturing and services sectors, thus excluding agriculture for the most part.[1] Although the agriculture sector is likely to be included in future revisions of the *Oslo Manual,* it is currently unclear whether the coverage of the business sector alone will satisfy the innovation data requirements of the agriculture sector.

Third, in developing countries, agricultural activities and related innovations often take place at the farm or household level (especially in case of subsistence farming), not in private-sector firms as captured by most data collections. Statistically, however, capturing activity in the informal sector or at the grassroots level is challenging.[2]

Clearly, the work of the African Union–New Partnership for Africa's Development (AU-NEPAD) on the African Innovation Outlook,[3] and application of innovation surveys, for example, is ongoing.[4] Yet the focus is currently not on the informal or the agriculture sector.

As a result of the complexities outlined above, and because of a lack of robust metrics (see Chapter 2), measuring innovation in agriculture and food systems is a difficult endeavour. This annex maps agriculture and food systems based on the GII framework.

Although incomplete, this mapping illustrates the above challenge and provides guidance to researchers and policy makers interested in benchmarking their agriculture and food systems. It also shows how the GII framework could be adapted to measuring innovation in specific systems and sectors, thereby laying the foundations for interesting future work.

Potential indicators to benchmark innovation in agriculture and food systems

Table 1 shows how the GII framework could be used to measure the characteristics of agriculture and food innovation systems. The table includes only the indicators that are relevant to measuring innovation in agriculture and food systems and that are available for a large number of economies.[5] The next sections look into some of these indicators and provide snapshots of top performing economies in each selected indicator.

Human capital and research

Education and research and development (R&D) investment are key to boosting productivity; they are also key for advancing the agriculture and food sector.[6,7] Various studies demonstrate that better-educated farmers have the skills to run their farms more efficiently and are more prone to embracing innovation.[8] Education has also proven to spill over, affecting the productivity of family members and neighbours.[9]

In spite of its role in agriculture and food systems, data on farmers' education are limited. This has led researchers to use other proxies, such

Table 1: Adapting the GII framework to agriculture and food systems

GII pillar	GII indicator	Are indicators available for agri-food?	Corresponding indicator in agri-food	Additional indicators
Human capital and research	Expenditure on education	For only a few economies	—	—
	Tertiary enrolment	Yes	Tertiary students in agriculture programmes	—
	Graduates in science & engineering	Yes	ODA for agricultural education/training	—
	Researchers	Yes	Agricultural researchers	—
	Gross expenditures on R&D	Yes	Agricultural R&D expenditures	ODA for agricultural research
	Global R&D companies, average expenditure	No	—	—
	QS university rankings	No	—	—
Market sophistication	Ease of getting credit	For only a few economies	—	—
	Domestic credit to private sector	Yes	Credit to agriculture	—
	Microfinance gross loans	For only a few economies	—	—
	Venture capital deals	No	—	—
	Applied tariff rate	Yes	Applied tariff rate for agriculture and food items	—
	Intensity of local competition	No	—	—
Business sophistication	Knowledge-intensive employment	—	—	—
	Firms offering formal training	Yes	Firms offering formal training in food-processing	—
	GERD performed by business	For only a few economies	—	—
	GERD financed by business	No	—	—
	Females employed w/ advanced degrees	No	—	—
	University/industry research collaborations	No	—	—
	State of cluster development	No	—	—
	GERD financed by abroad	No	—	—
	JV-strategic alliance deals	No	—	—
	Patent families in 2+ offices	Yes	Agri-food patent families in 2+ offices	—
	IP payments	No	—	—
	High-tech imports	Yes	High-tech imports for agri-food sector	Use of fertilizers; Machinery in use
	FDI net inflows	Yes	Agri-food FDI inflows	—
Knowledge and technology outputs	Patents by origin	Yes	Agri-food patents by origin	Plant varieties registered
	PCT patent applications	Yes	Agri-food PCT patent applications	—
	Utility models by origin	Yes	Agri-food utility models by origin	—
	Scientific and technical articles	Yes	Scientific and technical articles in agri-food	—
	Citable documents H index	Yes	Citable documents in agri-food	—
	Growth rate of PPP$ GDP/worker	Yes	Agriculture labour productivity growth	—
	New businesses	No	—	—
	ISO 9001 quality certificates	No	—	—
	IP receipts	No	—	—
	High-tech exports	Yes	Agri-food exports	—
	FDI net outflows	Yes	Agri-food FDI outflows	—
Creative outputs	Trademarks	Yes	Agri-food trademarks	Geographic indications registered
	Industrial designs	Yes	Agri-food industrial designs	—
	ICTs & business model creation	No	—	—
	ICTs & organizational model creation	No	—	—

Notes: The GII pillars Institutions and Infrastructure are not included in this table because the metrics in those pillars already capture the role of institutions and infrastructure in agriculture and food systems. ODA = official development assistance; — = data currently under review.

Table 2: Official development assistance for education and training: Top five economies

Economy	ODA in US$, millions
Afghanistan	8.2
Ethiopia	4.6
China	4.3
Indonesia	4.1
Uganda	3.4

Data source: FAOstats, February 2017. Available at http://www.fao.org/faostat/en/.

Note: Data refer to total disbursements from bilateral and multilateral donors for 2014.

Table 3: Agricultural R&D expenditures: Top five economies

Economy	US$, thousands	Economy	Share of agriculture value added
India	3,857	Singapore	1.48
Korea, Rep.	1,521	Qatar	0.11
China	1,149	Netherlands	0.10
Netherlands	1,145	Trinidad and Tobago	0.10
Australia	842	Denmark	0.06

Data source: UNESCO-UIS Science & Technology Data Center, February 2017. Available at http://data.uis.unesco.org/.

Notes: Where data are not available, data from previous years are used. R&D expenditures are in 2005 PPP$. Data are available for 73 economies. Many Organisation for Economic Co-operation and Development (OECD) economies, including the United States of America (USA), as well as other large economies such as Argentina and Brazil, are excluded because of a lack of data.

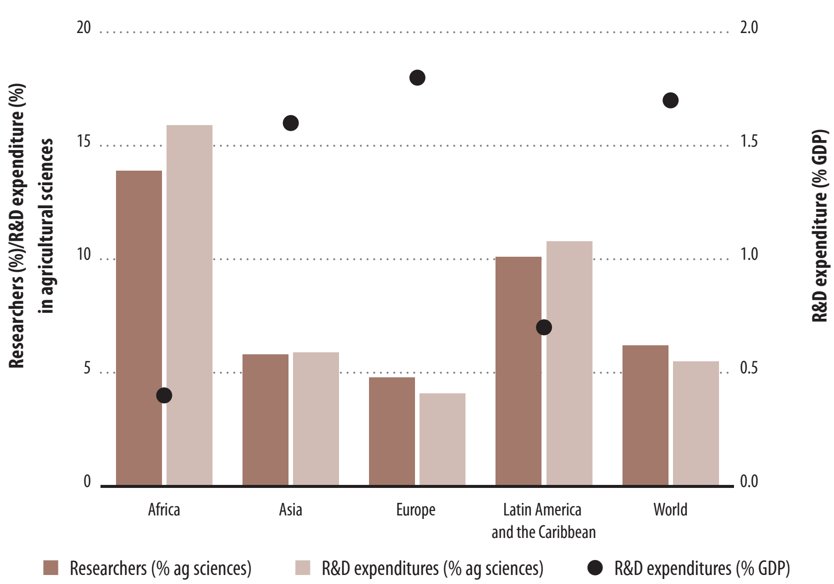
as official development assistance (ODA) for education and training (see Table 2). According to available data, Afghanistan, Ethiopia, China, Indonesia, and Uganda receive the highest amounts of aid in agricultural education and training. Other top recipients include Malawi, Myanmar, and Sierra Leone.

Lagging R&D expenditures in high-, middle-, and low-income economies affect productivity growth and innovation in agriculture. According to the data available, only about 6% of the world's R&D investments and researchers are devoted to agricultural sciences (see Figure 1).[10] Although advanced economies have historically been the leaders in agricultural R&D, research capacity has also reached high standards in several emerging economies—such as China, India, Brazil, Argentina, and South Africa.[11] In agriculture, R&D affects output with a long lag, but the impact lasts for a long time.[12] R&D spillovers tend to be geographically bounded because innovations produced in one part of the world require adaptations to work well in local soil and climate conditions. This makes indigenous R&D efforts essential. Developing countries, especially in Sub-Saharan Africa, have traditionally underspent in agricultural R&D (see Chapter 2). When they undertake R&D, poor (or lacking) extension services generally delay the adoption of innovation.[13] Indeed, research demonstrates that developing countries that invested the most in R&D while simultaneously investing in extension have had the strongest productivity leap.[14]

Overall, the top agricultural R&D spenders are India, the Republic of Korea (Korea), China, the Netherlands, and Australia (see Table 3), with India spending more than double than Korea. Singapore spends the most in relation to the size of its agriculture sector (as measured by value added), investing roughly 150% of its output in R&D. Qatar, the Netherlands, and Trinidad and Tobago follow, with roughly 10% of their agricultural output spent in R&D. Denmark spends 6% of its agricultural output in R&D.

Another way to look at R&D is through ODA disbursements to agricultural research. Nigeria, Argentina, India, Uganda, and Ethiopia are the largest recipients of ODA in this

Figure 1: Researchers and R&D expenditure in agriculture sciences



Data source: UNESCO-UIS Science & Technology Data Center, February 2017. Available at http://data.uis.unesco.org/.

Notes: Data on researchers in agricultural sciences are based on headcount (HC) measurement. Because of a lack of data, Northern America is missing. Data refer to 2014.

Table 4: ODA to agricultural research: Top five economies

Economy	ODA (US$, millions)
Nigeria	30.3
Argentina	28.2
India	24.0
Uganda	16.9
Ethiopia	16.9

Data source: FAOstats, February 2017. Available at http://www.fao.org/faostat/en/.

Note: Data refer to total disbursements from bilateral and multilateral donors for 2014.

Table 5: Tertiary students in agricultural studies: Top five economies

Economy	Share of tertiary students (%)
Ethiopia	8.0
Uzbekistan	7.5
Cambodia	6.8
Viet Nam	6.4
Albania	6.3

Data source: UNESCO-UIS Science & Technology Data Center, February 2017. Available at http://data.uis.unesco.org/.

Notes: When data for 2014 were not available, data points up to 2008 were used.

Table 6: Agricultural credit markets: Top five economies

Economy	US$, millions
United States of America	74,951
Germany	57,983
Australia	54,968
France	54,812
New Zealand	44,903

Economy	Share of total credit (%)
New Zealand	26
Uruguay	17
Kyrgyzstan	12
Tajikistan	12
Bolivia, Plurinational St	11

Data source: FAOstats, February 2017. Available at http://www.fao.org/faostat/en/.

Note: Data for 2014, available for 69 economies.

area. Argentina is the only top ODA recipient among upper-middle-income economies, while the others are mostly low- and lower-middle-income economies. Among the top 10 recipients are Kenya, the United Republic of Tanzania, and Indonesia, which each received more than US$10 million. Finally, ODA to agricultural research reaches much higher values than ODA to agricultural education and training (see Table 4).

Data on the share of tertiary students enrolled in agricultural studies indicate that agricultural studies are particularly relevant in the developing world. The top five highest shares of agricultural students in tertiary students are in Ethiopia, Uzbekistan, Cambodia, Viet Nam, and Albania (see Table 5). Other countries with high shares of agricultural students in total graduates include Malawi, Sierra Leone, Eritrea, and Kenya.

Market sophistication

Financial markets are important components of any innovation system. In agriculture, credit is essential to modernize farms and access high-quality inputs such as seeds and fertilizers. Given the size and nature of most farms, credit constraints can be often severe.[15] According to available data, the countries with the largest credit markets for agriculture are the USA, Germany, Australia, France, and New Zealand (see Table 6). It is worth recalling that these economies have very large credit markets. Indeed, in the GII, New Zealand, the USA, and Australia rank among the top five economies in the Credit sub-pillar. Still, New Zealand is the country that allocated the highest portion of its credit to agriculture (26%). Uruguay, Kyrgyzstan, Tajikistan, and the Plurinational State of Bolivia are the other top economies.

Business sophistication

The adoption of synthetic fertilizers, together with high-yield crop varieties, has been at the basis of the green revolution. Today, despite the growing demand for organic food, less than 1% of agricultural land is farmed using organic methods.[16] Although organic farming has a number of advantages, synthetic fertilizers are still widely used.[17]

Limited access to high-quality fertilizers is still an issue in many countries, most notably in Sub-Saharan Africa (see for example the case of Uganda, described in Chapter 11). Estimates indicate that, from 2009 to 2015, global demand for fertilizers grew by roughly 15%, and will grow at least 1.6% annually from 2015 to 2020. Sub-Saharan Africa will be responsible for most of this growth, reaching an average annual growth rate of 4.4%.[18]

Data on current fertilizer consumption show that global consumption is highly concentrated, with one single economy—China—consuming 31% of total world fertilizers (see Table 7). Although the gap in fertilizer consumption between China and other economies is considerable, according to available data, other top fertilizer consumers are India, the USA, Brazil, and Indonesia. By contrast, Sub-Saharan African countries together account for only 3% of total world consumption. Considered in relation to arable land, Qatar, Malaysia, Hong Kong (China), New Zealand, and Bahrain are the five top consumers; other important consumers include Singapore, Costa Rica, the United Arab Emirates, and Colombia.

Mechanization of agriculture has also contributed greatly to productivity growth in agriculture. Estimates indicate that the economies with the highest number of machines in their agricultural lands

Table 7: Fertilizer consumption: Top five economies

Economy	Share of world consumption (%)	Economy	Tonnes of nutrients per hectare of arable land
China	30.9	Qatar	12,111
India	13.4	Malaysia	2,064
United States of America	11.0	Hong Kong (China)	1,966
Brazil	7.3	New Zealand	1,491
Indonesia	2.6	Bahrain	1,319

Data source: FAOstats, February 2017. Available at http://www.fao.org/faostat/en/.

Notes: Data refer to 2014. Fertilizers include nitrogen, phosphate, and potash.

Table 8: Machinery in use: Top five economies

Economy	Machinery in use (number)
China	10,802,121
India	5,960,636
United States of America	4,351,616
Japan	2,112,822
Poland	1,539,059

Data source: U.S. Department of Agriculture (USDA), International Agricultural Productivity Data, February 2017. Available at https://www.ers.usda.gov/data-products/international-agricultural-productivity/.

Table 9: Agriculture and food FDI net inflows: Top five economies

Economy	Agri-food FDI (US$, millions)	Economy	Agriculture FDI (US$, millions)	Economy	Food FDI (US$, millions)
United Kingdom	19,186.1	China	1,112.1	United Kingdom	19,093.4
Italy	5,728.7	Brazil	426.7	Italy	5,746.7
Brazil	3,211.4	Ghana	348.8	Brazil	2,784.7
China	2,371.0	Argentina	259.4	Sweden	1,962.9
Sweden	1,962.9	Russian Federation	215.8	Turkey	1,700.5

Data source: FAOstats, February 2017. Available at http://www.fao.org/faostat/en/.

Notes: 'Agriculture' includes agriculture, forestry, and fishing. 'Food' includes food, beverages, and tobacco. Data refer to 2012; where data are missing, they refer to 2011, 2010, or 2009. FDI values are expressed in US$, 2005 prices.

are China, India, the USA, Japan, and Poland, with China and India respectively accounting for 25% and 14% of all world agricultural machinery in use (see Table 8). Italy, Thailand, France, Turkey, and Brazil also stand out in the use of machinery in agriculture.

Although these statistics are extremely interesting, in the future, metrics on the use of drones and other autonomous vehicles might also be useful in assessing the innovativeness of agriculture and food innovation systems. According to recent estimates, the market for drone-powered solutions in agriculture is US$32.4 billion—25% of the total drone application market.[19] Drones and robots can be integrated at every stage of the production cycle: they can be used for soil analysis, seed planting, spraying, and weed removal. They are more accurate and efficient than previous technologies such as satellite imagery and traditional tractors, allowing for productivity gains and cost savings.

The last indicator on business sophistication reviewed in this annex is foreign direct investment (FDI) net inflows. Some agricultural and food innovation systems prove to be well integrated in international knowledge networks, receiving considerable FDI. The United Kingdom, Italy, Brazil, China, and Sweden are the top five recipients of FDI inflows in food and agriculture, driven by FDI in food processing (except for China). Ghana, Argentina, and the Russian Federation are among the top five FDI recipients in the agriculture sector, while Turkey is the fifth FDI recipient in food processing (see Table 9).

Knowledge and technology outputs

This section looks at agricultural labour productivity growth, agriculture and food exports, and patents in technological fields related to agriculture and food.[20]

The top five economies in terms of agricultural labour productivity growth are Slovenia, Bahrain, Luxembourg, Armenia, and Belgium (see Table 10). Others that stand out include Bosnia and Herzegovina, Senegal, and Morocco.

Data on agricultural exports are widely available through the UN Comtrade database, which covers almost all economies in the world and allows for a highly disaggregated analysis. According to these data, a mix of high- and middle-income economies are among the top five exporters of agricultural and food products. The USA leads this ranking,

Table 10: Agricultural labour productivity growth: Top five economies

Economy	Growth rate of agriculture value added per worker
Slovenia	34.6
Bahrain	29.2
Luxembourg	19.9
Armenia	16.6
Belgium	15.8

Data source: World Bank's World Development Indicators, February 2017, available at http://data.worldbank.org/data-catalog/world-development-indicators.

Note: Data refer to agriculture value added per worker (constant 2010 US$).

Table 11: Agriculture and food exports: Top five economies

Economy	Share of agriculture and food exports (%)
United States of America	10.2
Netherlands	6.4
Germany	5.8
Brazil	5.4
China	5.0

Data source: UN Comtrade Database, February 2017. Available at https://comtrade.un.org/.

Note: Data refer to 2-digit commodities codes, and include commodities from 01 to 24.

Table 12: PCT applications in agriculture and food: Top five economies

Economy	Total applications
United States of America	4,821
Japan	2,142
China	1,418
Germany	948
Korea, Rep.	798

Data source: WIPO Statistics Database, May 2017.

Note: Data refer to 2016.

Table 13: Plant variety applications: Top five economies

Economy	Total applications
Netherlands	2,720
China	2,100
United States of America	2,027
France	1,038
Germany	942

Data source: WIPO, 2016.

accounting for 10% of total world agri-food exports. The Netherlands, Germany, Brazil, and China follow with shares of between 6% and 5% (see Table 11). Other European economies—namely France, Spain, Italy, and Belgium—follow. Among emerging economies, Argentina, India, and Indonesia stand out.

The top five economies in agri-food patent applications by origin are the USA, Japan, China, Germany, and Korea (see Table 12). Other important players in agri-food PCT patenting are Switzerland, the Netherlands, the United Kingdom, France, and Italy.

Early high-yielding varieties of wheat and rice led to the most significant improvements in crop yields in the 20th century (see Chapters 3 and 10). The green revolution enabled developing economies to import cheaper grains and grow high-yield seed varieties, which were responsive to fertilizers and resistant to diseases and insects. Productivity gains from high-yield varieties are not over. First, new innovations—for example, in genome-editing technologies—are expected to drive the development of ground-breaking crop varieties that could not be obtained by traditional breeding (see Chapter 8). Second, the diffusion of seeds and new plant varieties can still bring considerable advantages, as demonstrated in the case of Bt cotton cultivation in India (see Chapter 5), or in the case of soybeans, corn, and cotton in Latin America and the Caribbean (see Chapter 10).

Yet research shows that the knowledge accumulated in the development of new plant varieties is often tacit and difficult to appropriate.[21] Innovation in plant varieties tends to be cumulative, meaning that prior knowledge is needed to come up with new innovations. The adoption of new plant varieties also depends on the efforts to adapt innovation developed elsewhere to breed locally suitable varieties.[22] These characteristics may make intellectual property protection of new plant varieties a critical issue. The legislation on plant variety protection is increasingly being adopted in low-, middle-, and high-income countries.[23] WIPO data show that, since the early 2000s, plant variety application filings grew rapidly, with middle-income economies—especially in Asia—contributing to global figures more and more frequently.[24]

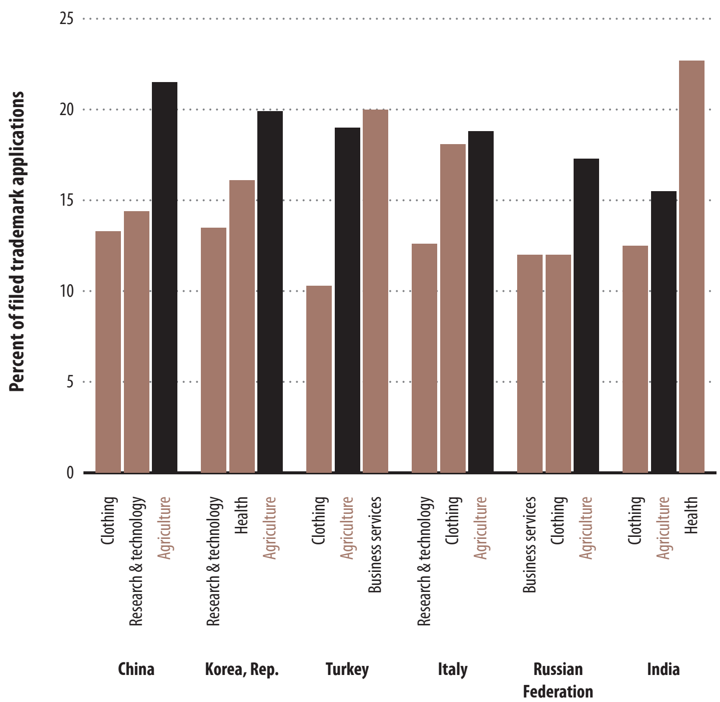
Top filers of plant variety applications are the Netherlands, China, and the USA, followed by France and Germany (see Table 13). Other important applicants are Japan, Korea, the Russian Federation, Ukraine, and Australia.

Creative outputs

The creative outputs of agriculture and food systems can be measured through trademarks and geographic indications.

Looking at trademarks, Nice classes 29, 30, 31, 32, 33, and 43 are typically associated with the agri-food sector.[25] Still, identifying the Nice classes that capture agriculture and food is a complex task because various other Nice classes can potentially contain agriculture- and food-relevant trademarks. For example, Nice class 1 includes genes of seeds for agricultural production and agricultural chemicals; Nice class 7 includes agricultural elevators and machines; and Nice class 44 includes

Figure 2: Trademark applications: Top three sectors by country origin



Data source: WIPO, 2016.

Notes: Data refer to 2015. The top three sectors and top origins were selected based on their 2015 totals.

agriculture, horticulture, and forestry services.

Data on trademark applications indicate that Nice class 30—which collects trademarks in coffee, tea, cocoa, rice, and other food products—is the 6th largest Nice class, comprising 4.6% of all trademark applications filed in 2015. Services for providing food and drink (Nice class 43) ranks 8th, with 3.8%. Finally, Nice class 29 (foodstuffs of animal origin and vegetables) ranks 10th, with 3.7% of all trademark applications. Overall, Nice classes 29, 30, 31, 32, 33, and 43 account for 17.3% of all trademark applications.[26] In China, Korea, Turkey, Italy, the Russian Federation, and India, the agriculture sector is in the top three sectors for trademark applications (see Figure 2).

Notes

1 OECD and Eurostat, 2005.

2 Charmes et al., 2016.

3 AU-NEPAD, 2010; NPCA, 2014.

4 For example, NEPAD's African Science Technology and Innovation Indicators (ASTII) contribute to the development and use of science, technology, and innovation indicators in African countries.

5 Agriculture and food innovation systems rely on nation-wide regulations, infrastructures, and education systems that are common for the economy and are therefore captured by the GII. These indicators are not reported in Table 1.

6 This section has benefited from contributions from our colleagues from the UNESCO Institute for Statistics (UIS) Martin Schaaper, Rohan Pathirage, and Luciana Marins.

7 Alston et al., 2000; Alston, 2010; Hayami and Ruttan, 1970; Kawagoe et al., 1985; Lau and Yotopoulos, 1989; Reimers and Klasen, 2013.

8 Adrian et al., 2005; Knight et al., 2003; Wheeler, 2008.

9 Knight et al., 2003; Weir and Knight, 2004.

10 Africa stands out as the region with the highest proportion of resources committed to agricultural sciences (16% of the region's total R&D expenditure). This is followed by Latin America and the Caribbean (11%), ahead of Asia (6%) and Europe (4%), indicating that middle- and low-income economies allocate more resources to agricultural sciences, whereas high-income focus more on other fields—notably natural sciences and engineering. These figures, however, should be taken with caution because of numerous data gaps.

11 Ruttan, 2002.

12 Alston, 2010.

13 Alston, 2010.

14 Fuglie, 2012. In developing countries, the public sector is still the main source of extension services, although they are plagued by limited funding, insufficient technologies and skills, weak links with research institutes, and limited farmer participation (World Bank, 2005).

15 FAO, 2016.

16 Data from FAOstats, available at http://www.fao.org/faostat/en/.

17 Moreover, modern technologies are optimizing their usage, thus reducing their environmental consequences (see Chapter 4).

18 FAO, 2016.

19 PwC, 2016.

20 Technological fields are selected following Lippoldt (2015).

21 Olmstead and Rhode, 2008.

22 Evenson and Gollin, 2003.

23 Campi and Nuvolari, 2015.

24 WIPO, 2016. See also FAO et al., 2009. On plant variety protection, see http://www.upov.int.

25 WIPO, 2016. The Nice Classification, established by the Nice Agreement (1957), is an international classification of goods and services applied for the registration of trademarks.

26 WIPO, 2016.

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The Potential of a Global Diagnostic Tool for Agricultural Innovation Systems

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Eradicating hunger and malnutrition, improving rural livelihoods, and protecting the environment in the context of the global trends and challenges (e.g., population growth, climate change, land degradation) that shape agriculture and food systems worldwide will require creative solutions. Innovative responses to complex issues are needed to accelerate progress towards achieving the UN Sustainable Development Goals (SDGs). Innovation, be it technological, institutional, or social, emerges from collective thinking, iterative learning, and action. It is a process by which multiple actors and stakeholders collectively put knowledge to use.[1] Innovation outcomes—such as poverty reduction, increases in agricultural productivity, and resource use efficiency—are determined by the properties and capacities of the system in which organizations or individuals operate and engage with each other. Effective and dynamic systems are likely to generate more effective and relevant innovation outcomes. In addition to enhanced investments, policies, and technologies, a balanced strategy for sustainable agricultural productivity growth in developing countries involves strengthening agricultural innovation systems (AIS).[2]

Agricultural innovation systems

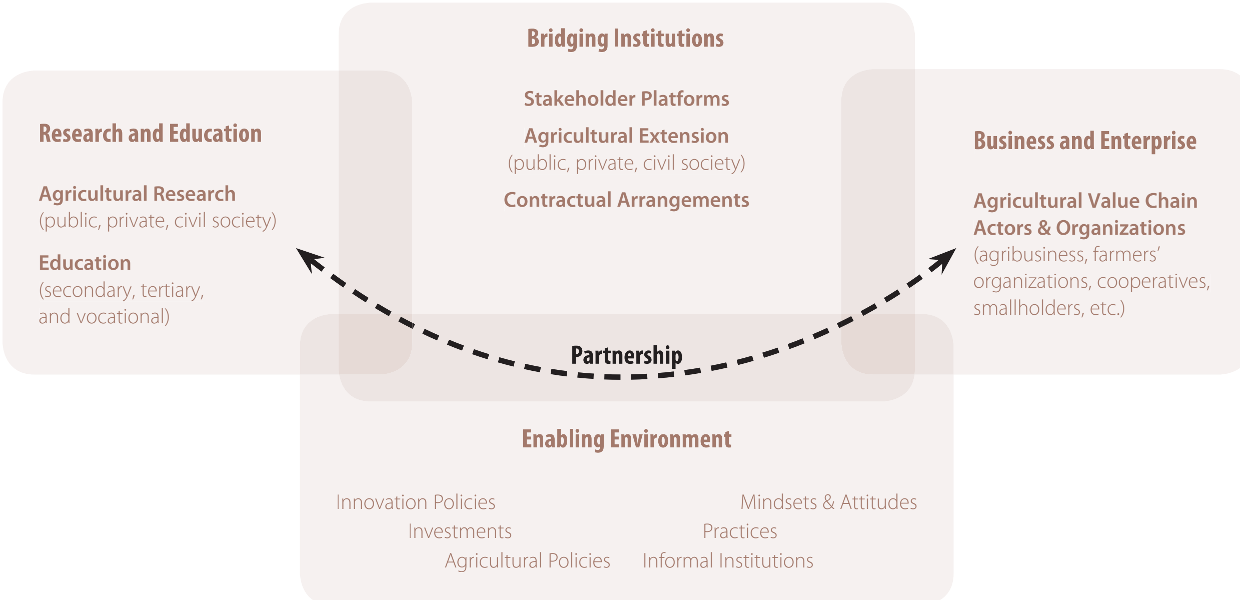
AIS can be understood as a network of actors (organizations and individuals), together with supporting institutions (formal and informal) and policies in the agricultural and related sectors that brings existing or new products, processes, and forms of organization into social and economic use.[3] System thinking is firmly established in the agriculture and rural development disciplines, and the AIS concept is widely recognized among researchers.[4] Adopting an AIS perspective for agricultural development issues is also becoming more commonplace beyond academia in international agencies and fora, donor organizations, and government outfits.[5]

Based on a conceptual model proposed by Arnold and Bell (2001) and further refined by Spielman and Birner (2008) and Spielman and Kelemework (2009), four primary AIS domains comprising public, civil society, and private-sector actors are proposed: (1) research and education, involving research institutes, universities, and vocational training centres; (2) business and enterprise, involving various value chain actors, agribusiness, producers, and consumers; (3) bridging institutions, involving stakeholder platforms, contractual arrangements, and various types of rural advisory services; and (4) an enabling environment, involving governance and policies as well as behaviours, mindsets, and attitudes (Figure 1). The actors in the system engage in collective action at various levels, from local to global, and with various objectives, be it a product, process, or any other type of innovation.

Requirements for a robust AIS assessment

Assessing agricultural innovation system properties and performance is not a straightforward exercise. Whereas much emphasis has been put on analysing and assessing the overall role of agricultural research and of extension and rural advisory services, relatively little attention has been paid to the system-wide analysis (e.g., understanding AIS actors' linkages and relationships and how these shape AIS performance), or to developing a broader diagnostic tool for assessing national agricultural innovation systems. AIS assessment has the potential to inform decision-makers about strengths, gaps, and opportunities in capacity development and investment. It can also be instrumental in meeting monitoring and evaluation requirements. A transition towards

Figure 1: Representation of the agricultural innovation system



Source: Adapted from TAP, 2016, with permission from CAB International 2016.

sustainable growth in the food and agriculture sectors needs evidence on what works and what does not.[6]

In recent years, countries have started to recognize the critical role that innovation plays and will continue to play in achieving the SDGs. During the 25th Session of the Committee on Agriculture (COAG) of the Food and Agriculture Organization of the United Nations (FAO),[7] countries explicitly requested support for the assessment of their innovation systems, in particular through the development of a diagnostic tool.

Data related to different aspects of AIS are available from a wide range of sources. These include FAO, the International Food Policy Research Institute (IFPRI), the Organisation for Economic Co-operation and Development (OECD), the World Bank, the World Economic Forum (WEF), and the World Intellectual Property Organization (WIPO). Existing datasets include information, for example, on public spending and foreign aid for agricultural research and extension, ease of access to loans, and costs associated with agricultural policies. For a more comprehensive assessment, macro-level indicators measuring rather static properties and performance can be complemented by indicators that capture systems dynamics.[8] These can help to understand how far a system is integrated, heterogeneous, and demand-driven.

The AIS concept puts great emphasis on understanding the nature of relationships and interactions between actors and the knowledge, attitudes, and practices that shape these relationships. However, such information is not readily available.

This chapter explores the potential for a diagnostic tool to assess national agricultural innovation systems. Such a diagnostic tool needs to be geared towards identifying enabling and hindering factors that affect the performance of the system, with the aim of improving its overall performance to respond to the needs of its actors and stakeholders. More specifically, the chapter provides insights into data availability and discusses options for additional data gathering and validation.

Data considerations

Underpinning all these elements is the availability of good and up-to-date data. Good data are both essential and difficult to identify.

Overview of available information

The complexity of the AIS concept poses challenges in terms of methods and data. The literature on innovation systems in agriculture has been making valuable contributions to the understanding of the role of AIS, mostly through the use of descriptive and case study methods,[9] while usually avoiding the use of more formal models and macro-level analysis.

More systematic assessment approaches are, however, gaining traction.[10] A quantitative diagnostic of AIS at the country level or across a set of countries has been proposed by Spielman and Kelemework (2009) and Mekonnen et al. (2015). For their study of the determinants of technical efficiency in agriculture, Mekonnen et al. (2015) collected a dataset on innovation system properties covering 85 low- and middle-income countries from 2004 to 2011. The results illustrate how a global analysis of AIS can contribute to a better understanding of key agricultural development challenges. At the same time, the study shed light on some of the difficulties related to obtaining meaningful and comprehensive aggregate data on agriculture-specific innovation system properties. In terms of the explained variable, Mekonnen et al. decided to resort to technical efficiency. They point out that the innovation system properties selected for their study are expected to have a positive influence on the efficiency of agricultural production. The quality of institutions and legal systems as well as factors enabling business and enterprise influence the nature and performance of public- and private-sector innovation processes.

Table 1 on page 84 compiles available information that is of potential use for global AIS analysis. These are indicators that have already been used in the literature. As shown in the bottom part of the table, a range of AIS outcome indicators other than technical efficiency are available—for example, eco-efficiency and total factor productivity (TFP)—or simpler metrics, such as the value of agricultural production or agricultural exports. This wide range of indicators demonstrates the need to draw on records from a variety of sources to create a comprehensive database. The compilation reveals that several indicators pertain to innovation at large and are not specific to the agricultural sector. In the absence of more accurate data, these are considered proxies for AIS characteristics. At the same time, they represent spillovers from what shapes innovation in general to the agricultural innovation system, which are important to take into account. Several of the indicators shown in Table 1 have been used in the studies by Spielman and Kelemework (2009) and Mekonnen et al. (2015), while other variables—such as public spending on extension and research-extension collaboration—were not considered previously but have been added here, as deemed relevant. The IFPRI/ASTI database records numbers of researchers and public spending on research in agriculture but falls short of providing any indicators on the relevance and demand-orientation of agricultural research.[11]

Three criteria were applied for selecting variables: (1) the indicator must be a potential parameter to assess innovation processes in agriculture; (2) the data must be openly accessible; (3) the level of data coverage across countries and years must be high (for most countries less than 20% of data are missing between 2000 and 2014). For any assessment of AIS on the basis of the data presented here, it is crucial to take into account issues regarding the quality and informative value of the data. Rather than focusing the analysis on single years or averages, data trends as well as variability, especially in the case of financial flows, should be at the core of an innovation system diagnostic.

AIS properties

Although a range of useful indicators has been identified, it becomes clear that many gaps exist—for example, gaps in data on rural advisory services and farmer organizations. Some indicators capture generic innovation system properties but lack precision in the context of analysing AIS. In Table 2 on page 85, additional indicators are proposed that would be desirable for a more accurate and in-depth diagnosis of AIS. The indicators listed here by no means present an exhaustive list but serve to draw attention to how some important gaps could potentially be filled. Data on these indicators exist but are available only for a limited number of countries. Furthermore, data from national sources or surveys exist for selected countries but require considerable effort to make them comparable cross-country.

In Tables 1 and 2, the AIS properties variables were attributed to one of the four AIS domains to reflect how they capture the education and research levels, business and enterprise development, bridging institutions, and enabling environment aspects of the assessment. This categorization, however, falls short of making an important distinction that is of great relevance for any AIS analysis. Indicators can represent either more actor-oriented and static AIS characteristics or more system- and action-oriented properties. In addition, a distinction can be made in terms of specificity. While some indicators can be considered more generic, applying to innovation systems in general, others are more specific to innovation systems in the agricultural sector.

The following indicators can be classified as representing mostly static and generic properties: health expenditures, foreign aid received, total tax rate, patent applications, scientific and technical journal articles, domestic credit to the private sector, and the credit information index.

A range of indicators can be classified as representing mostly static but fairly agriculture-specific properties: farmer organization membership, extension service providers, extension

Table 1: Selected easily accessible variables of relevance for global AIS analysis

Domain	Indicators	Analytical focus	Unit	Sources
AIS PROPERTIES				
Research and education	Quality of the education system	Trend	1 (low) to 7 (high)	WEF, GCR data
	Foreign aid for agricultural education/ training	Trend, variability	% of agriculture GDP	OECD, DAC data
	Quality of scientific research institutions	Trend	1 (low) to 7 (high)	WEF, GCR data
	Agricultural researchers	Trend	FTEs per 100,000 farmers	IFPRI, ASTI data
	Agricultural research spending	Trend, variability	% of agriculture GDP	IFPRI, ASTI data
	Foreign aid for agricultural research	Trend, variability	% of agriculture GDP	OECD, DAC data
	Patent applications	Trend	Number per 1,000,000 people	WIPO data
	Scientific and technical journal articles	Trend, variability	Number per 100 researchers	WB, WDI data
Bridging institutions	University-industry collaboration in R&D	Trend, variability	1 (minimal) to 7 (intensive)	WEF, GCR data
	Foreign aid for extension	Trend, variability	% of agriculture GDP	OECD, DAC data
Business and enterprise	Start-up procedures to register a business	Trend	Number	WB, WDI data
	Time required to start a business	Trend	Days	WB, WDI data
	Total tax rate	Trend	% of commercial profits	WB, WDI data
	Ease of accessing loans	Trend	1 (low) to 7 (high)	WEF, GCR data
	Domestic credit to private sectors	Trend, variability	% of GDP	WB, WDI data
Enabling environment	Credit information index	Trend	0 (low) to 8 (high)	WB, WDI data
	Credit to agriculture	Trend, variability	% of total credit	FAOSTAT data
	Government expenditure on agriculture	Trend, variability	% of total outlays	FAOSTAT data
	Agricultural policy costs	Trend	1 (low) to 7 (high)	WEF, GCR data
	Foreign aid received	Trend, variability	Current international US$ per capita	OECD, DAC data
	Foreign aid for agriculture	Trend, variability	% of agriculture GDP	OECD, DAC data
	Gross capital formation	Trend	% of GDP	WB, WDI data
	Health expenditures	Trend, variability	% of GDP	WB, WDI data
AIS OUTCOMES				
Domain	Indicators	Analytical focus	Unit	Sources
Results	Agricultural output	Level, growth	Tons per hectare / %	FAOSTAT data
	Value of agricultural output	Level, growth	Current international US$ per hectare / %	FAOSTAT data
	Value of agricultural exports	Level, growth	% of agricultural output	FAOSTAT data
	Total factor productivity [a]	Growth	Index	FAOSTAT data (calculation required); USDA, ERS
	Eco-efficiency	Level, growth	0 (low) to (1high) / %	FAOSTAT data (calculation required)
	Rural poverty	Trend	% of rural population	WB, WDI data

Note: FAOSTAT data = FAO Statistical Databases, available at http://www.fao.org/faostat/en/#home; IFPRI, ASTI data = International Food Policy Research Institute, Agriculture Science and Technology Indicators, available at https://www.asti.cgiar.org/; OECD, DAC data = Organisation for Economic Co-operation and Development, Development Assistance Committee, available at http://www.oecd.org/development/stats/idsonline.htm; USDA, ERS = United States Department of Agriculture, Economic Research Service, available at https://www.ers.usda.gov/data-products/international-agricultural-productivity/; WB, WDI data = World Bank, World Development Indicators, available at http://data.worldbank.org/data-catalog/world-development-indicators; WEF, GCR = World Economic Forum, Global Competitiveness Report 2016–2017, available at https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1; and World Intellectual Property Organization (WIPO), Global Brand Database, available at http://www.wipo.int/branddb/en/.

a Environmentally adjusted total factor productivity has been suggested as an alternative measure by the OECD.

Table 2: Proposed indicators for in-depth diagnosis of AIS

AIS PROPERTIES				
Domain	Indicators	Analytical focus	Unit	Possible sources
Research and education	Vocational training graduates	Trend	Number per 100,000 farmers	National data
	Quality of university education in agriculture	Trend	1 (low) to 10 (high)	Survey data
	Quality of vocational training in agriculture	Trend	1 (low) to 10 (high)	Survey data
	Demand-orientation of agricultural Research	Trend	1 (low) to 10 (high)	Survey data
	Research-extension collaborations		1 (low) to 10 (high)	Survey data
Bridging institutions	Extension service providers	Trend	Number	National data
	Extension agents	Trend	Number per 100,000 farmers	National data
	Public spending on extension	Trend, variability	% of agriculture GDP	National data
	Demand-orientation of extension	Trend	1 (low) to 10 (high)	Survey data
Business and enterprise	Farmer organization membership	Trend	% of total farmers	National data
	Adoption of certification standards	Trend	1 (low) to 10 (high)	Survey data
	Seed regulation	Trend	0 (poor) to 100 (good practice)	WB, EBA data
	Fertiliser regulation	Trend	0 (poor) to 100 (good practice)	WB, EBA data
	Access to finance in agriculture	Trend	0 (poor) to 100 (good practice)	WB, EBA data
Enabling environment	Market regulation in agriculture	Trend	0 (poor) to 100 (good practice)	WB, EBA data
	Transport regulation in agriculture	Trend	0 (poor) to 100 (good practice)	WB, EBA data
	Research-policy collaborations	Trend	1 (low) to 10 (high)	Survey data

Note: WB, EBA data = World Bank, Enabling the Business of Agriculture, available at http://eba.worldbank.org/; national data = national government statistical data; survey data = data collected through key informant/expert opinion interviews.

agents, agricultural researchers, credit to agriculture, government expenditure on agriculture, public spending on agricultural research, public spending on extension, foreign aid for agriculture, foreign aid for agricultural education/training, foreign aid for extension, and foreign aid for agricultural research.

Several of the indicators can be classified as representing mostly dynamic and generic properties: quality of the education system, quality of scientific research institutions, university-industry collaboration in R&D, start-up procedures to register a business, time required to start a business, ease of accessing loans, and gross capital formation.

The remaining indicators can be classified as representing mostly dynamic and agriculture-specific properties: quality of university education in agriculture, quality of vocational training in agriculture, demand-orientation of agricultural research, research-extension collaborations, demand-orientation of extension, research-policy collaborations, agricultural policy costs, adoption of certification standards, seed regulation, fertilizer regulation, access to finance in agriculture, market regulation in agriculture, and transport regulation in agriculture.

It should be noted that the above classification is not conceived of as a clear-cut typology, but rather an aid for reflection.

AIS outcomes

For the AIS outcome indicators shown at the bottom of Table 1, data on agricultural output for all major crops and the value of agricultural production are readily available through FAOSTAT. Outcomes measured through TFP growth or eco-efficiency entail calculations that can be performed using existing FAOSTAT data but require knowledge of appropriate methods.

TFP denotes the ratio between total outputs and total inputs. It has been used to broaden the focus on land or labour productivity, improving understanding of technical change in agriculture. Growth in TFP is interpreted as increased efficiency of input use.[12] Fuglie (2015) explains the use of growth accounting to construct TFP indices for agriculture worldwide.[13] Using FAO data and the growth accounting methodology, internationally consistent and comparable agricultural TFP growth rates can be computed, for which a complete dataset is accessible through the USDA website.[14] TFP rarely accounts for quality improvements in inputs or changes in natural resource stocks.

'Eco-efficiency' is defined as the ratio between economic value added and a composite variable of environmental pressures.[15] It must be stressed that measures used for computing eco-efficiency scores do not attempt to represent the environmental impact of agricultural production but rather the environmental pressures associated with it. Following the eco-efficiency definition, a country can be considered eco-efficient if it is impossible to decrease any environmental pressure without simultaneously increasing another pressure or decreasing the economic value added. For calculation purposes, data envelopment analysis is commonly used,[16] solving linear programming problems to trace a global eco-efficiency frontier and determine the distance of countries from that frontier. Data on environmental pressures from agriculture are available through FAOSTAT to a steadily increasing extent.

Conclusions

The precise representation of AIS properties constitutes the most important constraint in any attempt of a diagnostic and/or assessment, where agriculture-specific data are by and large missing. As this chapter shows, some key data for characterizing and assessing national AIS covering a wide range of countries and periods are available and accessible from various sources. These include *inter-alia* data from FAO, IFPRI, the International Fund for Agricultural Development (IFAD), World Bank, OECD, WEF, WIPO, and so on. However, other crucial data are missing or are not readily available. These include data on extension and civil society (non-governmental organizations and farmers' organizations), public spending on extension services, the responsiveness of research to the needs of producers, and regulatory procedures in agriculture. A lack of structured data at the country level is particularly apparent for extension and other institutional arrangements that fulfil the bridging function between education and research actors and value chain actors. For these reasons, any AIS diagnostic tool remains exploratory rather than one that allows for precise analysis and definite answers. Despite limitations arising from the nature and scope of the data used, interesting results can emerge from AIS measurements and assessments. The information and knowledge generated can provide pointers to policy and investment gaps and innovation opportunities.

There is potential for a comprehensive diagnostic tool for AIS assessment, but data availability and accessibility at the county level remain a daunting challenge. For a thorough analysis of national AIS, it is important to identify available and accessible data and then fill gaps through additional data gathering. Equally important is to focus on trends and to rely on additional qualitative data sources and validation to interpret results. A sizeable set of indicators has been presented in Table 2. Selecting key indicators characterizing actors and actions/interactions, linkages, and relationships in the AIS will allow for a meaningful analysis of the system in terms of strengths and weaknesses. A multi-criteria AIS diagnosis can thus generate the sound evidence required to formulate global, regional, and national agricultural innovation strategies. In order to draw meaningful results from the diagnosis, it is of paramount importance to define upstream its purpose and the information expected to be generated through the analysis of the diagnostic outputs. This requires the definition of information and knowledge needs by national actors and stakeholders that will guide data collection processes and the diagnostic process. Once the specific context is known, the selection of core indicators from the original set can then facilitate the data collection. The involvement of key AIS actors and stakeholders from the outset is therefore critical to ensure that the diagnosis responds to their information and knowledge requirements and needs.

Notes

1 TAP, 2016.

2 World Bank, 2012; FAO, 2014.

3 TAP, 2016.

4 Klerkx et al., 2012.

5 OECD, 2010; OECD, 2012; World Bank, 2012; FAO, 2014.

6 OECD, 2011.

7 FAO, 2016.

8 For example, public researchers per $100 million of agricultural GDP (ASTI indicator); university-industry research collaboration (WEF indicator); and external assistance to agriculture (FAO indicator). See Spielman and Kelemework, 2009.

9 For example, Hall and Clark, 1995; Klerkx et al., 2010.

10 Schut et al., 2015.

11 IFPRI, 2015.

12 Fuglie and Wang, 2012.

13 Fuglie, 2015.

14 USDA, 2016.

15 Kuosmanen and Kortelainen, 2005.

16 Kuosmanen and Kortelainen, 2005.

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The Role of Private-Sector R&D in Agricultural Innovation: Improving Yields, Equipment Productivity, and Sustainability

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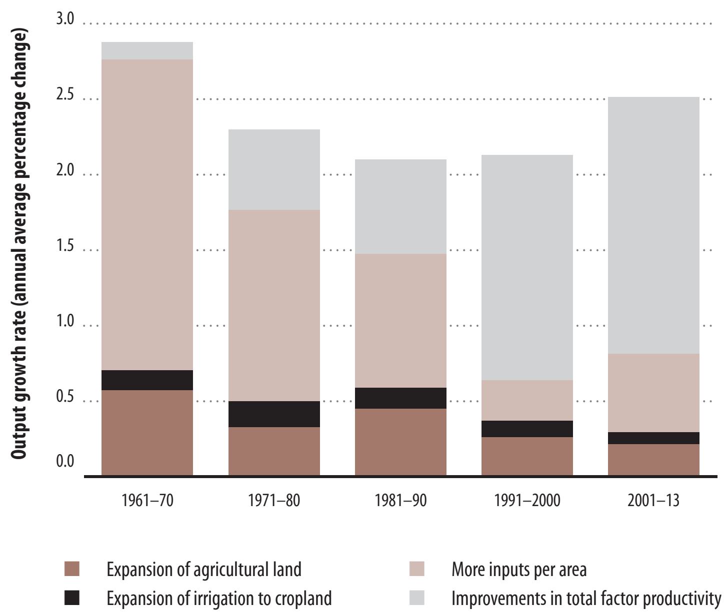
Tom Johnson, PwC

By 2050, according to the United Nations, the world's population is estimated to reach 9.7 billion.[1] This presents the global agriculture sector with a daunting challenge, especially when combined with the effects of climate change and resource scarcity. The stage has been set for a potential global food crisis if policy makers and other stakeholders fail to act: Ensuring adequate supplies of food will require a 70% increase in agricultural production over the next 30 years.[2]

The pace of agricultural innovation has increased over the last 10 to 15 years, with advances in genomics, software, communications, logistics, and technology. The public sector has traditionally been the driving force behind these advances and represented the lion's share of agricultural research and development (R&D) expenditures, with global public-sector R&D accounting for 55% of the US$69 billion total in 2011 (the most recent year for which global data are available).[3] But more recently, constrained fiscal policies in many countries have slowed public-sector R&D growth. The private sector has increasingly filled the gap: Private investment in agricultural innovation has resulted in new technologies and production techniques with significant promise to boost productivity.

Figure 1: Sources of growth in global agricultural output, 1961–2013



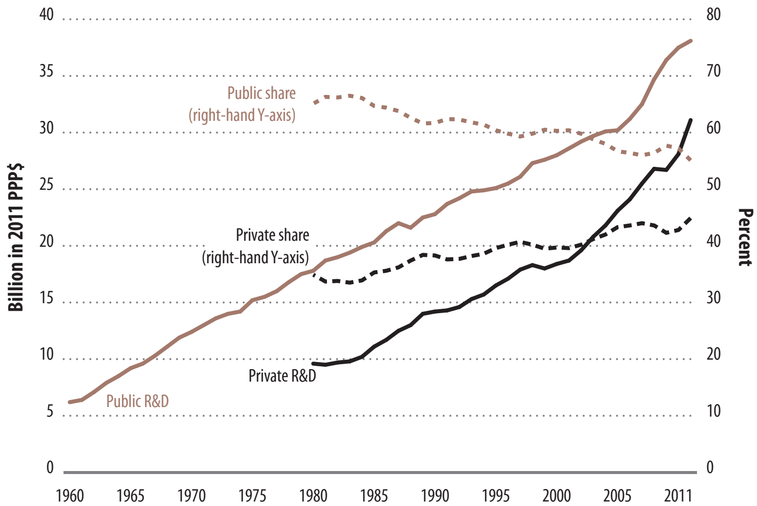
Source: USDA Economic Research Service, 2017.

Output and productivity

Before 1970, the expansion of land under cultivation and other inputs—such as labour and capital per acre—accounted for the vast majority of the growth in global agricultural output. Since 1990, however, the rate of growth in land, labour, capital, and other material inputs has dramatically slowed, and increasing total factor productivity (TFP)—which measures the efficiency with which all agricultural inputs are transformed into outputs—has become the main driver of agricultural productivity growth. From 2001 to 2013, TFP accounted for more than two-thirds of the overall growth in output (see Figure 1).[4]

However, the 2016 *Global Agricultural Productivity Report,* a benchmark that analyses agricultural productivity growth (compiled by the private-sector group Global Harvest

Figure 2: Public and private agricultural R&D



Source: Pardey et al. (University of Minnesota, InSTePP International Innovation Accounts, 2016).

Initiative), has found that global TFP is not growing fast enough to meet projected population-driven increases in food demand by 2050. This inadequate growth is mostly the result of lagging TFP growth in low-income countries, where the current average growth rate is 25% lower than the global average.[5] In these countries, the bulk of output growth still comes from increasing agricultural inputs and land under cultivation—creating even greater need for productivity gains.

Driving further growth in TFP rates demands greater investment in agricultural R&D. Unfortunately, the growth of public-sector investment has slowed in many high-income countries, including those of Western Europe, and has declined sharply in the United States of America (USA) in recent years (falling more than 20% in real terms from 2008 to 2013). R&D spending in low-income countries is also lagging, particularly when measured on a per capita basis. In 2011, high-income countries spent US$17.73 per person, compared to US$1.51 in low-income countries.[6]

At the same time, public-sector spending has been increasing in middle-income countries, including Brazil, India, and especially China; the last-mentioned has accounted for a majority of the net growth in global public-sector agricultural R&D in recent years. From 2008 to 2013, China increased its spending nearly 70%.[7]

Private-sector R&D spending, meanwhile, has been growing robustly in recent years, especially in high-income countries (see Figure 2).[8] In the USA, private- and public-sector spending were roughly equal in the 1980s and 1990s; in 2000, for example, each sector contributed 50%. But by 2013, the public share had declined and private investment had risen; the private sector now accounts for 75% of total US R&D.

Such growth can be traced to advances in genetic engineering in the mid-1980s, which gave rise to a wave of technological innovation that boosted returns on private investment, and to the increasing marketization of the agricultural supply chain in many regions. Over the past 10 years, investment in agricultural innovation has been fuelled by an unprecedented convergence of advances in biology, agronomy, plant and animal science, digitization, and robotics. These technologies—often referred to collectively as 'digital agriculture',[9] precision farming', or 'smart farming'—are creating the foundation for a new, more productive and sustainable future of agriculture. Farm ownership patterns are also changing, creating a multiplier effect because farmers who automate are able to manage larger fields and greater numbers of animals.

Much of this new wave of innovation is enabled by the shift in corporate R&D towards software, advanced hardware, and service offerings. The integration of embedded software and sensors in farm equipment, in the soil, and on the animals—as well as the ability to reliably and inexpensively connect and network agricultural producers, suppliers, products, and customers using cloud-based systems and shared analytics—has significant potential to increase output.[10] Such innovations are enabling major gains in yields, asset productivity, and sustainability that will be key factors in meeting the escalating demand for food (see Figure 3).

Increasing yields

The development and widespread adoption of hybrid seeds led to the most significant improvements in crop yields in the 20th century. For example, the adoption of hybrid corn (maize) in the USA—aided by improvements in tillage practices, herbicides, and equipment—increased yields by a factor of five from the 1940s to the present.[11] In the 1990s, genetically modified crops (GMCs) launched a new wave of major yield improvements; today more than 90% of the planted area of soybeans, cotton, and corn in the USA are genetically modified varieties. These hybrids are also in wide use in South America and Asia—most notably in China and in India. Adoption of GMCs has been controversial, however, and health fears have limited their penetration in Europe.[12]

The latest advances in genomics promise to increase crop yields while avoiding some of the features that have caused concern about GMCs. A technology under development known as CRISPR (which stands for 'clustered regularly interspaced short palindromic repeats') for example, which is now being adapted for crop and animal science, uses the immune system of bacteria to edit specific genes in organisms. Unlike processes used for traditional GMCs, CRISPR does not introduce genes from other organisms into plants but instead edits the genome of the plant itself. Scientists believe the CRISPR outcomes could improve the natural characteristics of crops to make them more resistant to drought, pests, and weeds, and could boost their photosynthetic efficiency to make them grow faster. Companies are already developing applications of the technology to improve drought resistance for crops and to improve livestock resistance to diseases, such as African swine fever.[13]

R&D in sensor technology, geo-positioning, and big data will also enable significant increases in crop and livestock yields. The Climate Corporation, a subsidiary of Monsanto, launched its Climate FieldView platform in 2015. This platform, backed by a powerful data science engine and an extensive field research network, uses sensors and satellite imagery to provide farmers with real-time data to maximize crop yields. It enables precision application of fertilizers and can also identify and prevent disease vulnerability. FieldView is already in operation on more than 100 million acres in the USA and Brazil. The Climate Corporation has recently expanded into the European market, and plans to also offer the platform in South Africa, Australia, and Argentina over the next few years.[14] More and more big-data solutions of this nature are expected both from start-ups and from legacy agribusiness organizations that serve growers around the world.

Figure 3: Three imperatives driving future investments across agribusiness markets

INCREASING YIELDS	IMPROVING ASSET PRODUCTIVITY	ENHANCING SUSTAINABILITY
Precision agriculture solutions	Enterprise resource planning (ERP) systems for the farm	Land use mapping
Integrated equipment	Telematics	Managing water
Data collection and data entry	Autonomous equipment	Energy management
Image management	Drones	Waste tracking
Consultative support	Sensory networks	Input traceability
Access to season trends and facts	Services enablement	Farm/field performance reporting
	Predictive analytics	Harvest tractability

Source: PwC, 2016b.
Note: Farmers who deliver profitability across all three objectives will likely expand their acreage and become enterprise agribusiness leaders in their markets.

Another example of the implementation of new technology is happening at My Dairy Dashboard, a joint venture of Virtus Nutrition and Dairy.com in the USA, announced in May 2017. Virtus had previously acquired Farmeron, a Croatian startup that developed a cloud-based software platform for data management and agricultural production performance optimized for dairy farmers. My Dairy Dashboard will provide data aggregation for the dairy farm industry, to help enhance production and streamline operations.[15]

Innovations in drone technology will also enable increases in yields. Companies are adapting drones to produce precise three-dimensional maps for soil analysis and to optimize irrigation and nitrogen-level management. Start-ups are developing drone systems for planting that shoot pods with seeds and nutrients into the soil. Drones are also being developed to spray crops far more precisely and efficiently than current tractor-based technologies. Drones with thermal sensors are well suited for monitoring crop health and growth.[16]

Some African countries are pursuing R&D in aquaculture to develop inland fish farming as a potentially large future source of protein. In the United Republic of Tanzania, the National Aquaculture Development Centre is working with a consortium of local and global educational and nonprofit organizations to identify and optimize the best species of native tilapia for farming, and to adopt best practices from aquaculture experience around the world. The Tanzanian government aims to triple the contribution of aquaculture to the nation's GDP from its current 1.4% to 4.2% by 2025.[17]

Not all promising innovations for raising yields rely on cutting-edge science; some leverage older technologies. AgroStar, a start-up based in Pune, India, has developed a mobile-commerce platform that helps small farmers access raw materials, seed, fertilizer, and other agricultural inputs in rural areas that are often plagued by product unavailability, unfair prices, substandard quality, and limited information. AgroStar enables its customers to order using a mobile app or via the 'missed call' technique (dialling a number and disconnecting before the call is picked up, thus signalling the recipient that the caller wants to order or communicate while avoiding cell-phone usage charges). The company, which launched in 2012, has partnered with more than 150 brands, including multinationals such as Syngenta, and has served 7 million farmers in the states of Maharashtra, Gujarat, and Rajasthan.[18]

Improving asset productivity

One of the most notable innovations in improving asset productivity was the invention of the cotton gin in 1793. The new machine could process 1,000 pounds of cotton in the time it took an individual to process five pounds by hand.[19] Over the past decade, major agricultural equipment manufacturers have been attempting another dramatic transformation by building increasingly sophisticated digital features into farm equipment to boost productivity.

The latest models of tractors, planters, harvesters, and other equipment from companies such as Case IH, John Deere, and Kubota feature monitors, sensors, and software that optimize farming processes and generate detailed computerized data—enabling farmers to maximize their productivity and increase their yields while gaining a wealth of information to help them manage their operations more efficiently. Manufacturers have also been developing sophisticated autonomous tractors and other vehicles over the last several years, and have prototypes in operation today.

Case IH, for example, unveiled an autonomous tractor concept in 2016—the Case IH Autonomous Concept Vehicle—built with a fully interactive interface that allows remote monitoring of pre-programmed operations. These include automatically accounting for implement widths, and plotting the most efficient paths in a field depending on terrain, obstructions, and other machines in use in the same field. A remote operator can monitor and control the tractor from a computer or tablet. Such vehicles can operate around the clock, and can provide the farmer with predictive information on maintenance.[20]

Equipment manufacturers and third-party vendors are also offering software and Global Positioning System (GPS) packages that can track and map an agricultural producer's mechanized equipment. This enables farmers to monitor their machines on a tablet or smart phone and direct them to where they are needed—when, for example, a storm is coming—and to re-route support vehicles carrying fuel, seed, and fertilizer. Similar tracking and mapping software is also available for livestock. Collars or tags placed on the animals can send real-time data to farmers and ranchers not only on livestock location, but also on weather conditions, health, and mating patterns.[21]

Finally, companies are developing innovative technologies for offshore aquaculture operations that can grow and harvest different varieties of seafood in oceans, including smart floating farms and submersible cages that can be located near cities or out at sea.[22] Ocean Farming, for example, a subsidiary of the Norwegian fish farming company SalMar, is adapting deep-water petroleum technology to develop offshore salmon farms that would anchor 100-metre steel cages that float below the surface to the ocean floor and adapt to the motion of waves and currents. The company estimates these could be eight times as productive as traditional inshore fish farms.[23]

Enhancing sustainability

The introduction of sustainable techniques such as contour farming—the practice of planting crops in rows running parallel, rather than perpendicular, to the contours of the land—reduced topsoil loss by 65% within five years during the environmental and humanitarian crisis known as the Dust Bowl in the USA during the 1930s.[24] In recent decades, many key innovations in sustainability have focused on more efficient irrigation techniques. In most parts of the world where irrigation is necessary, variations of field flooding—the least efficient method—are still used. More efficient methods, such as central pivot systems, which use wheeled booms to apply water to crops more precisely, have been in use in high-income countries since the 1950s.

T-L Irrigation, a leading producer of centre wheel systems, introduced a new system for arid farming areas in 2014 that combines the central pivot and drip irrigation approaches. Drip hoses, spaced a few feet apart, apply water directly to crops, minimizing evaporation, and can reach water efficiency levels of 95%.[25] By adding sensors to these types of irrigation equipment to optimize water application, water use could be reduced by as much as 50% and yields could be increased by 10% or more.[26]

Access to fresh water is another focus of sustainability efforts, especially in arid climates.

In 2012, the World Bank reported that 14 of the 20 most water-scarce countries in the world were located in the Middle East and North Africa (MENA) region.[27] Desalination currently plays a critical role in supplying water to the populations of MENA countries, and will continue to do so moving forward as these populations continue to grow. But desalination plants are energy and resource intensive, and for that reason many MENA countries are investing in concentrating solar power (CSP) plants, which use large mirrors to generate thermal energy for desalination. Given the high costs associated with CSP, the public and private sectors will need to work together to ensure broader adoption.[28]

In addition to improving sustainability, players across the agricultural supply chain are also keenly interested in creating transparency and trust about their sustainability efforts. For example, major food companies and retailers are making public sustainability commitments to improve their environmental footprints. Land O'Lakes, a farmer-owned cooperative with more than 4,300 members based in Minnesota, USA, created a new business unit named SUSTAIN to align its environmental sustainability efforts across its enterprise, which operates in all 50 US states and more than 50 other countries.[29] The SUSTAIN programme focuses on sustainable crop production by delivering products, services, and insights; enhancing sustainability within the dairy foods and feed businesses; and partnering with other entities, including governments, to improve efficiency and collaboration on water conservation and sustainability. The programme also offers tracking, reporting, and aggregated results that enable farmers to communicate their sustainability results to their customers and retailers to document and communicate the sustainability of their products to end consumers.

The R&D challenges in agriculture

The imperative to raise the productivity of agricultural R&D by up to 70% over the next three decades will require the public and private sector to address several critical challenges.

Speeding R&D cycles and furthering the widespread adoption of promising innovations—particularly in low-income countries—are a precursor to improving outputs. The lags between successful R&D efforts and the widespread adoption of agricultural innovations tend to be long; at least 15 to 25 years before peak impacts, with further adoption lags that can continue for decades. In the USA, for example, the earliest research on hybrid corn technology began as early as the 1890s, and focused research did not begin until 1918. Commercial adoption, however, began only in the 1930s and was uneven. And not until 1960 was almost all US corn acreage in hybrids. Thus the total adoption cycle took over 40 years—or arguably longer.[30]

Another challenge is that many of the most promising agricultural innovations are capital-intensive, and agriculture has historically been dominated by small businesses with low profitability and limited access to capital. Several trends offer promise in overcoming such obstacles, however. For one, consolidation in agriculture will boost efficiency, with fewer farmers and ranchers managing larger fields. In addition, more widespread use of crop insurance is an example of a financial innovation that could provide farmers and ranchers with more financial security. Agricultural insurance lowers risks as well as improving access to credit. At present, in higher-income counties, 1.99% of agricultural GDP is spent on agricultural insurance, but that falls to 0.29% in upper-middle-income countries, 0.16% in lower-middle-income countries, and 0.01% in low-income countries.[31]

Some scientists and researchers also note that economic and environmental changes, such as changes in weather patterns and crop pests and diseases, could undermine past patterns of productivity growth. This is a particular concern in low-income countries, where the demand for food is growing the fastest. Low levels of public-sector R&D investment, which is best suited to creating solutions to these kinds of problems, could slow productivity improvements and put these countries at risk.

Conclusions: Feeding the World

The public sector needs to reverse the negative trend in R&D spending growth in many high-income countries, and increase R&D spending in low-income countries—making investments in basic scientific research in agriculture and supporting technologies. But governments can also foster an attractive environment for venture capital funds and corporate ventures focusing on agricultural innovation, and help ensure that the investments being made by the private sector can make a greater impact, by taking the following steps:

- Support agricultural extension efforts to disseminate knowledge about new technologies and techniques and to demonstrate their business case. Publicly funded agricultural extension has been a key historical link between agricultural R&D and farmers and ranchers in high-income countries. Governments and supra-national organizations should prioritize implementing such programmes in low-income countries.
- Streamline regulation to reduce lag times, provide targeted tax relief to enhance farmers' incomes and financial security, and offer preferential access to land and market support for promising agricultural techniques and technologies.
- Create public-private partnerships, which governments can use to leverage public-sector investment, enhance private-sector involvement in agriculture infrastructure, and fill gaps in the delivery and adoption of innovation by public- and private-sector entities acting independently.[32]
- Maintain and expand regional and international trade in agriculture outputs. Many of the gains in productivity in recent decades have been enabled by globalization and the rise of extended agricultural value chains.

The rise of commercial R&D in agriculture underway today—and the resulting innovations in improving yields, asset productivity, and sustainability—provide the means for meeting the food needs of the world's growing population by 2050. But to reach that goal, both the public and private sectors will need to keep the R&D pipeline flowing and make investments and commitments to ensure that innovative technologies and techniques are widely and rapidly adopted by countries across the income spectrum.

Notes

1 See http://www.un.org/en/development/desa/news/population/2015-report.html for more on population growth estimates.

2 PwC, 2015.

3 Pardey et al., 2016a.

4 USDA Economic Research Service, 2017

5 Global Harvest Initiative, 2016.

6 Pardey et al., 2016b.

7 Pardey et al., 2016b.

8 Pardey et al., 2016a.

9 See Chapter 4 of this report.

10 Jaruzelski et al., 2016.

11 Russell and Sandall, 2017.

12 See http://www.isaaa.org/resources/publications/pocketk/16/ for more information on biotech crop adaptation.

13 Montenegro, 2016.

14 See https://climate.com/?gclid=CKvDi5qVtNECFZWLswodSusK_A for more information on The Climate Corporation's FieldView platform.

15 See http://mydairydashboard.com/index.html for more on the joint venture between Virtus Nutrition and Dairy.com.

16 PwC, 2016a.

17 Earlham Institute, 2017.

18 ET Bureau, 2016.

19 See https://www.eliwhitney.org/7/museum/eli-whitney/cotton-gin and http://www.farmcollector.com/equipment/ten-agricultural-inventions-in-farming-history for more on the invention of the cotton gin.

20 See https://www.caseih.com/northamerica/en-us/Pages/campaigns/autonomous-concept-vehicle.aspx for more on the Case IH autonomous concept vehicle.

21 See https://www.theintelligenceofthings.com/article/connected-farm-big-data-agriculture/ for more on connected farm solutions.

22 Kearnes, 2016.

23 Nortrade, 2015.

24 The Nature Conservancy, No date.

25 See http://tlirr.com/products/precision_mobile_drip_irrigation/ for information about T-L Precision Mobile Drip Irrigation.

26 Goldman Sachs, 2016.

27 The convention in the GII is to refer to UN regions. In this chapter, the 'Middle East and North Africa (MENA) region' refers to the region as defined by the World Bank; for a list of these countries, see http://www.worldbank.org/en/region/mena.

28 World Bank, 2012.

29 See https://www.landolakesinc.com/Blog/December-2016/Land-O-Lakes-SUSTAIN-gears-up for more on Land O'Lakes' SUSTAIN programme.

30 Pardey and Alston, 2010.

31 Villalobos, 2013.

32 Moreddu, 2016.

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Innovation in Agriculture and Food Systems in the Digital Age

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Agriculture and the worldwide food system are challenged to feed an estimated global population of 9.7 billion people by 2050 with diminishing land and water resources.[1] Agricultural land areas can no longer be expanded because most global arable lands have already been put into production. The remaining lands are increasingly lost to urbanization or need to be preserved for habitat conservation, biodiversity, and climate buffers.[2] Moreover, the unsustainable overuse of freshwater resources from irrigation is making less water available for future crops, and food security is being affected by increased risk from climate change and an uncertain geopolitical landscape.

Concerns with diminishing resources and expanding populations are exacerbated by changing diets in many developing countries (which are now using more animal-based protein and fresh produce). This will ultimately require higher global production levels of the primary source of protein, carbohydrates, and nutrients: crops. An effective strategy for gaining enhanced agricultural production levels should focus on sustainable improvements in five major areas:

- further optimization of resources in currently productive agricultural regions;
- intensification of production in areas that have good basic agricultural resources but are currently low-producing (e.g., West Africa and Southeast Europe);[3]
- expansion of local and controlled environment production systems such as urban farms, greenhouses, and indoor growing systems that provide high-value crops to local and regional markets;
- improved crop and animal genetics that facilitate higher production levels and result in less susceptibility to yield-depressing agents such as diseases and insects; and
- greater efficiencies and less waste in the food supply chain.

Digital agriculture

Digital data will be getting collected at a rate of 40 zettabytes (ZB—the equivalent of 40 trillion gigabytes, or GB) per year by 2020.[4] Increased storage and computational capacity, coupled with high-resolution environmental and remotely sensed data, have created unprecedented opportunities for data-driven discovery in agriculture and food systems.[5] Many agricultural improvements can be facilitated by these digital innovations.

This chapter defines 'digital agriculture' as the deployment of computational and information technologies in farming, which will play a key role in achieving innovation goals. It is a new direction for 'precision agriculture', a more established concept that is historically aimed at crop production. Digital agriculture offers new opportunities through the ubiquitous availability of highly interconnected and data-intensive computational technologies as part of the so-called Fourth Industrial Revolution.[6] It can be applied to all aspects of agricultural production systems, and it reflects a shift from generalized management of farm resources towards highly optimized, individualized, real-time, hyper-connected and data-driven management. For example, instead of treating all farm fields uniformly, small field zones may each receive their own highly optimized management prescriptions; animals may be monitored and managed individually rather than as a whole herd. The desired outcomes of digital agriculture are more productive, profitable, and sustainable systems.

Digital agriculture can leverage the smart use of data and communication to achieve system optimization. The tools that enable digital agriculture are multiple and varied, and include cross-cutting technologies such as computational decision and analytics tools, the cloud, sensors, robots, and digital communication tools (Table 1). In addition, field-based activities are enabled by geo-locationing technologies such as Global Positioning Systems (GPS), geographical information systems, yield monitors, precision soil sampling, proximal and remote spectroscopic sensing, unmanned aerial vehicles, auto-steered and guided equipment and variable rate technologies. Animal-focused technologies include radio frequency identification (RFID chips) and automated (robotic) milking and feeding systems, among others. Controlled-environment agriculture (greenhouses, indoor farms, etc.) is also increasingly enabled by digital technologies such as sensors and robots.

Digital agriculture can potentially accumulate large amounts of data, and analytical capabilities that

Table 1: Enabling technologies for digital agriculture

Production environment	Type of technology	Purpose and benefits
Cross-cutting technologies	Computational decision tools	Use data to develop recommendations for management and optimize multitudes of farm tasks
	The cloud	Provide efficient, inexpensive, and centralized data storage, computation, and communication to support farm management
	Sensors	Gather information on the functioning of equipment and farm resources to support management decisions
	Robots	Implement tasks with efficiency and minimal human labour
	Digital communication tools (mobile, broadband, LPWAN)	Allow frequent, real-time communication between farm resources, workers, managers, and computational resources in support of management
Field	Geo-locationing (GPS, RTK)	Provide precise location of farm resources (field equipment, animals, etc.), often combined with measurements (yield, etc.), or used to steer equipment to locations
	Geographic information systems	Use computerized mapping to aid inventory management and to make geographical crop input prescriptions (fertilizer, etc.)
	Yield monitors	Employ sensors and GPS on harvesters to continually measure harvest rate and make yield maps that allow for identification of local yield variability
	Precision soil sampling	Sample soil at high spatial resolution (in zones) to detect and manage fertility patterns in fields
	Unmanned aerial systems (UAS, or drones)	Use small, readily deployed remote-control aerial vehicles to monitor farm resources using imaging UAS
	Spectral reflectance sensing (proximal and remote)	Measure light reflectance of soil or crop using satellite, airplane, or UAS, imaging, or field equipment–mounted sensors, to make determinations on soil patterns, crop, or animal performance, or on nutrient/pest problems
	Auto-steering and guidance	Reduce labour or fatigue with self-driving technology for farm equipment (including robots); can also precisely guide equipment in fields to enable highly accurate crop input placement and management
	Variable rate technology	Allow continuous adjustment of application rates to precisely match localized crop needs in field areas with field applicators for crop inputs (chemicals, seed, etc.)
	On-board computers	Collect and process field data with specialized computer hardware and software on tractors, harvesters, etc., often connected to sensors or controllers
Livestock	Radio frequency ID	Transmit identity data with tags attached to production units (mostly animals) that allow data collection on performance as well as individualized management
	Automated milking, feeding, and monitoring systems	Perform milking or feeding operations automatically with robotic systems, often combined with sensors that collect basic biometric data on animals, thereby reducing labour needs and facilitating individualized animal management

Note: GPS = global positioning system; LPWAN = low-power wide-area networks; RTK = Real Time Kinematic high-accuracy positioning system.

facilitate the effective employment of these data are key implementation factors. The development of computational tools that address system dynamics and optimization are similarly critical; they require a deep understanding of the biological, physical, chemical, and socioeconomic processes that together make agricultural production possible. Therefore digital agriculture technologies require talent in science and entrepreneurship.

Production efficiencies can be gained both from the integration of data associated with multiple technologies and from the real-time transfer of data between field equipment, barn, office, and the cloud. The recent surge in digital agriculture technologies has led to the accumulation of large amounts of data. High-resolution soil data, site-specific weather maps, aerial imagery, nutrient applications, and milking and animal health records are being continuously generated by farms. Much of that information can be sent via broadband or mobile connections to cloud-based services, but inadequate telematics (the long-distance transfer of digital information) often constrains the potential benefits from these technologies. In addition, farmers and researchers are finding it difficult to manage, interpret, or make use of their data as a result of their volume and complexity.[7] Growth in hybrid fields such as computational agriculture, computational sustainability, and data science that aim to use farm data are partial responses to these needs.[8]

In the end, agriculture will follow other industrial sectors in that the benefits from digital technologies will materialize and become a source of increased production efficiencies once ubiquitously available data are effectively employed. In a global economic environment, a nation's agricultural competiveness and ability to sustain critical natural resources will be strongly tied to its ability to innovate in these aspects of the production system. The question is not whether the global agricultural industry should adopt digital technologies, but how this adoption process can occur in an environment that encourages it to fully capitalize on the potential production gains.

Types of innovation

At the farm enterprise level, different types of technology investments may be distinguished:

1. **Capital investments** that promote efficiencies (computer hardware/software, robotic systems, variable-rate technology, sensors, high-precision GPS, etc.). These are invariably offered by established equipment companies that have made significant technology investments and typically compete in global markets.

2. **Service investments** that provide actionable information (remote sensing, cloud-based decision models, etc.). These services are offered by companies ranging from global corporations to small tech companies.

3. **Farm knowledge and human capital investments** that involve the development of highly localized actionable knowledge for a specific farm, herd, or crop-growing environment (optimized seeding, nutrient and pest management, animal feeding, etc.). These investments involve the collection of data—often from investments discussed under (1) and (2)—that are analysed to generate farm-specific recommendations. These knowledge investments are made at the local level, with consultants working in partnership with farm managers.

The above investments each require somewhat different support infrastructures. Large capital investments not only require educated farmers to use the equipment effectively, but also need dealership networks with competent staff and operational farm credit systems. Digital services such as remote sensing and decision models are highly scalable technologies that generally do not involve upfront financial or knowledge investments on the part of farm owners or managers, but are generally pay-as-you-go arrangements. However, in order to effectively incorporate digital technologies, a farm-specific knowledge base that involves a more sustained commitment to technology investments and analytics is still required, and it demands both educated farmers and local consultants who are trained in digital agriculture technologies.

Where does innovation in digital agriculture occur?

Digital agriculture innovation is both knowledge- and skills-intensive because agricultural production systems are complex and multifaceted and solutions require knowledge ranging from broad to specific. For example, tools that optimize nitrogen dynamics (see below) need to consider soil, weather, and crop-related processes that all have interacting physical, biological, and chemical components. These in turn need to be considered in the context of a wide diversity of practices, production environments, and socioeconomic conditions on farms. Solutions are often more complex and less scalable than optimization processes in manufacturing industries or communications. This is arguably the primary reason why digital innovation in agriculture has been relatively slow and the leading global digital technology companies have made few inroads into agriculture.

Currently most digital innovations in agriculture are led by 'Big Ag' companies, smaller innovative agricultural technology (ag-tech) companies, and top agricultural universities. Where are they located? Corporate innovation in digital agriculture technologies is mostly associated with a few global-scale companies that offer durable (farm equipment) and consumable (seed, chemicals, etc.) goods and services. These industries have in recent years consolidated to the point where most major farm purchases are controlled by a small number of companies in a highly competitive global market. These corporate leaders are primarily headquartered in Northern America and Western Europe and increasingly differentiate themselves in the marketplace by their ability to innovate with digital technologies. Yet smaller companies, typically based in the same countries, also offer innovative technology solutions.

University innovations are typically associated with the internationally prominent agricultural institutions in developed countries (mostly in Northern America and Western Europe). A constraint on university-based innovation in many developing countries is the common institutional separation of agriculture from other relevant disciplines—basic sciences, engineering, and medicine—that is, separate agricultural universities cultivate intellectual isolationism at a time when collaboration with other disciplines is critical for innovation. Not unrelated, agricultural universities in developing countries also generally do not attract the most talented students and professors because the profession is considered less prestigious and offers lower remuneration. In all, the primary innovations in digital agriculture occur in a limited set of countries in part because of structural, institutional, and economic barriers.

Issues with digital agriculture adoption

A recent report based on surveys and literature analyses identified a number of concerns and opportunities associated with the penetration of advanced technologies into agriculture.[9] Factors related to infrastructure (e.g., reliable mobile data access), research and development, technical information, and relevant educational resources were all cited in that report as important factors in a recent survey of farmers in New York State, United States of America (USA). Some of those factors are described below.

Farm size: Large farms tend to engage in digital agriculture more readily because capital investments provide earlier returns on investment as a result of scale efficiencies, but the technology competence of farmers is also an important adoption factor.[10] Some digital agriculture technologies are attractive to medium and small farms because they are less scale-dependent or are highly compelling for a specific production environment. For example, organic vegetable growers can benefit greatly from precision planting and equipment guidance systems because they rely on mechanical weed cultivation that risks crop damage if done without precision technologies. Similarly, medium-size farms may be attracted to robotic milking and feeding systems or automated greenhouses because of farm labour shortages.

Data: As farmers adopt digital agriculture technologies they accumulate large amounts of data, increasingly through cloud-based services. They are concerned with data privacy and ownership issues because legal concerns around agricultural data are unresolved at this time. Farmers are generally more comfortable sharing data with trusted partners such as universities and local cooperatives than with large companies that may repurpose the data for corporate interests.[11] Farm data are generally not protected in current statutes, but nonprofit initiatives (e.g., Ag Data Transparency) offer third-party certification on data ownership and privacy issues.[12]

A second, and related, data issue revolves around availability. As data are increasingly accumulated by large corporate entities, concerns arise about their availability for aggregated analytics and the development of next-generation management recommendations. Public-sector and scientific communities do not have universal access to valuable private-sector data, and ventures for community data sharing infrastructure are generally absent in agricultural and economics realms.

A third issue is government agency attitudes towards agricultural research data and associated priority areas. Results of a recent survey of agricultural researchers suggest that widespread data management practices fall short of generally accepted best practices.[13] In this context, legislative proposals calling for greater data sharing among public-sector agencies have been put forward,[14] but, so far, with very little effect.[15] Public-private partnerships such as Socrata, CyVerse, and the Health Data Consortium have emerged to coordinate and increase data sharing and access, which are important steps for data gathered under public auspices.

Analytics and management gap: Production environments (soil, climate, crops, animals, etc.) vary greatly in agriculture. The effective employment of digital technologies therefore requires locally appropriate analytics and management responses. In general, the engineering innovations by means of sensors, robotics, and software are rapidly advancing, but the ability to make the technology smart and applicable to local production environments lags behind.

Education and research gaps: The engagement of digital agriculture requires knowledgeable and skilled farm managers and labourers, as well as a cadre of well-educated consultants and service providers. Most educational institutions are inadequate in offering such instruction, and professional talent tends to favour urban over rural living. In addition, few institutions have the capacity or resources to answer the research questions that advanced farmers ask.

Connectivity and digital divide: Agriculture by its very nature is mostly conducted in rural areas that are poorly connected, even in the most developed countries. The industry is therefore highly impacted by the so-called digital divide. This current state of inadequate connectivity limits the full deployment of digital agriculture technologies in most rural areas, including broadband access for information communication; mobile (cellular) coverage and data transmission speeds for uploading and downloading data from field equipment or remote farm buildings; universal access to precision equipment guidance technology that requires reliable relay stations and mobile connections; and low-power wide-area networks that offer opportunities for the widespread use of sensor technology and equipment communications. Advanced connectivity investments in rural areas are generally expensive because of low customer density and are often not regarded as economically justified by communications companies.

Business development and employment: Many farmers and ag-professionals agree that digital agriculture has a bright future, offers good business and employment opportunities, and will result in environmental benefits and efficiencies.[16] But it may also profoundly impact businesses and employment in rural areas around the globe. In high-wage countries, farmers are eager to employ automation and digital technologies to reduce challenges with their farm labour force—which often depends on migrant workers and therefore poses legal and management challenges. Digital technologies will also facilitate those management farm enterprises that are larger than would otherwise be possible, and may intensify the global trend of farm consolidation. In developing countries where wages are lower and farms generally smaller, digital technologies will help advance improved management practices and better access to markets (e.g., through mobile technologies), but will also impact employment opportunities in rural areas.

Examples of digital agriculture technology implementation

Implementing digital agriculture technology can take different forms. Three of these are considered below.

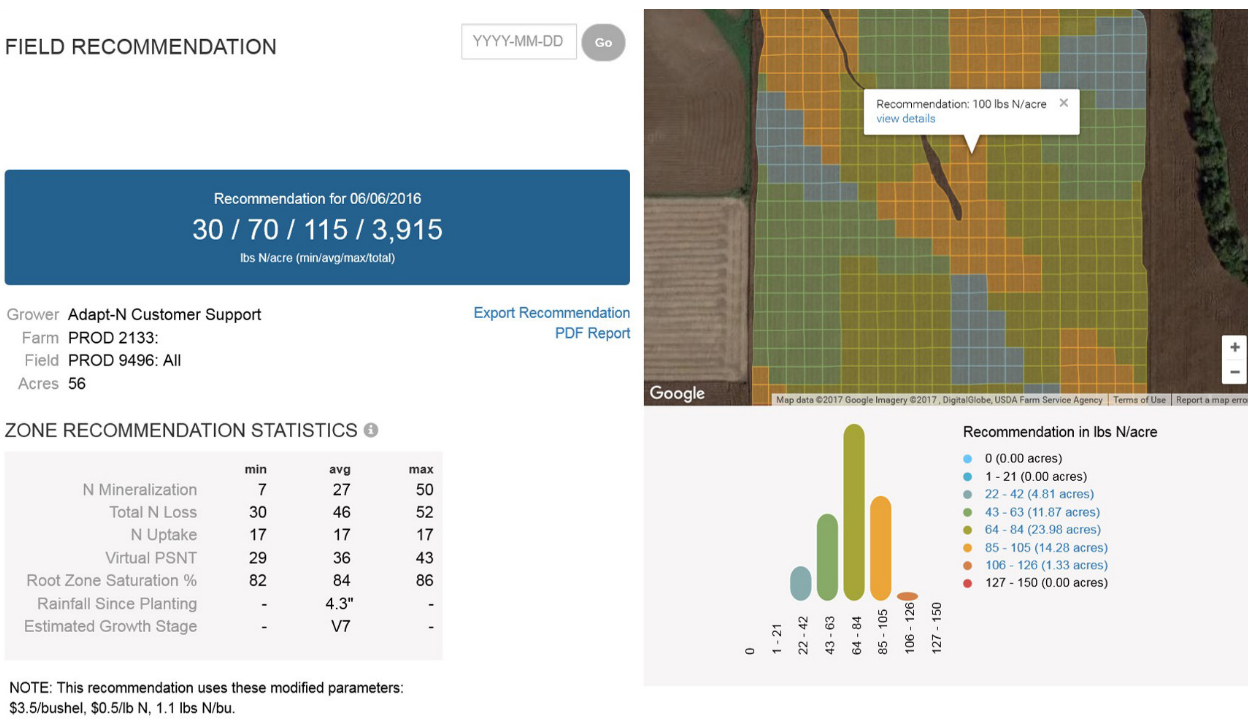
Cloud-based nitrogen advisors

Agriculture includes some 'wicked problems', including the use of nitrogen fertilizer that is needed to grow many of the world's crops at high production levels. The widespread adoption of nitrogen fertilizer use after World War II and especially during the Green Revolution has greatly enhanced food production and reduced malnutrition. But it has also led to serious environmental concerns, including high energy use, greenhouse gas emissions (through nitrous oxide), and water quality degradation. Notably many of the world's estuaries (Gulf of Mexico, Baltic Sea, etc.) experience low oxygen levels (hypoxia) from nitrogen inflows, which in turn result in the high mortality of critical fish species.

These concerns are in large part related to excessive nitrogen use, where more fertilizer is applied than is needed for the crop. This appears wasteful, but where farmers are uncertain about the 'right' amount of fertilizer needed they actually respond in an economically rational manner to the realities of their production environments, avoiding the high risk of under-nourishing their crops and incurring yield losses. Most of the uncertainties are associated with (1) variable production environments (soil, crop, management), and (2) weather variability.

Recent technological developments have proven that data and model computations can address these uncertainties and offer more reliable nitrogen management advice to farmers through cloud-based services. This technology offers real-time nitrogen fertilizer advice, based on weather conditions, that is specific to field zones and thereby allows farmers to more precisely match nutrient additions

Figure 1: Real-time nitrogen field advice through a cloud service



Source: Adapt-N.com.

with crop needs (Figure 1). In on-farm field evaluations, this technology has proven to offer a win-win opportunity: it increases farmers' profits while reducing negative environmental impacts.[17] Similar technologies can be employed for irrigation and pest management, among others.

Some of the main advantages of employing such cloud-based services are:

- the high scalability such services provide allows the technology to be rapidly employed in many growing environments,
- employment at scale allows for dramatic reductions in per-unit (hectare) expense and can drive down adoption costs, and
- cloud-based and mobile communications allow for continuous access and real-time monitoring of the status of farm resources.

The next phase of technology deployment will likely be the integration of highly computational, data-intensive tools with low-cost field sensor technologies offering management advice based on ensemble technologies.

Precision farming services in Bulgaria

Prior to Bulgaria's political and economic reforms of 1989, the country's agriculture was relatively efficient by Eastern European standards, and included large cooperative farms and highly consolidated production units (fields and livestock facilities). After the reforms, Bulgaria liquidated many of the former collective farms, and the associated land privatization resulted in a subdivision of fields into smaller plots with a great number of heirs—that is, large fields are often owned by multiple absentee landowners (82% of holdings are comprised of fewer than two hectares).[18] But through lease agreements with many individual landowners, private farmers can still cultivate the vast majority of the land through large-scale agriculture, with wheat, sunflower, and maize as primary crops. Furthermore, since its European Union accession in 2007, the EU Common Agricultural Policy invested around US$4 billion in Bulgaria's agriculture, much of it through direct payments intended to support farms, rural employment, good management practices, and stable food supplies.

These developments have resulted in viable large-scale farming in Bulgaria, and also created exceptional opportunities for the adoption of precision farming methods. Many farmers are purchasing advanced field equipment, and regional technical service providers are offering associated products and services. For example, NIK is a company that works with farmers to implement modern precision technologies in

Bulgaria.[19] These technologies are offered through (1) strategic partnerships with Northern American and European technology leaders that allow for capital and service investments (farm management software, mapping and navigation hardware and software, precision application equipment, auto-steering and guidance systems, weather and satellite monitoring, irrigation equipment, etc.), and (2) skilled field professionals who implement technologies on farms and help develop local knowledge. In summary, the rapid adoption of digital farming technology in Bulgaria can be attributed to a combination of:

- large-scale production units that are a result of land reforms under socialist governments prior to 1989,
- a workable land lease system that allows private farmers to manage large land tracks with multitudes of small land owners,
- farm payments from the European Union, and
- strategic partnerships with leading technology providers.

Remote sensing and financial risk management to alleviate poverty

The USA has long had major government programmes in place to facilitate risk management for farmers in various forms. Today the bulk of that funding is allocated to risk management and insurance programmes with great success. However, uptake has been slower in the developing world. This is in part the result of the fact that the programmes are not as well funded in developing countries; furthermore, verifying yields and losses is much more difficult in remote areas of the developing world, despite the fact that those agricultural producers face risk all the same. Several programmes have emerged recently to address these issues using index-based insurance schemes.[20] Initially, pilot programmes in the developing country context relied heavily on station-level weather data. However, these data are often sparse and are themselves difficult to verify. In recent years there has been a movement towards a different solution: using remotely sensed data to determine losses. The Index Based Livestock Insurance programme (IBLI) in Kenya and Ethiopia was one of the earlier adopters of this approach.[21] As newer remote sensing platforms come online, as well as lower-cost custom options (e.g., nano-satellites, unmanned aerial systems, etc.), there will likely be a large movement towards designing the risk management programmes of the future around these sensing technologies to indicate both when losses occur and the extent of those losses.

Conclusions

The penetration of advanced digital technologies into the agricultural industry is progressing rapidly in advanced economies, and is increasingly impacting developing countries. Because of several unique characteristics of agriculture (involving its highly localized and variable resources, poor connectedness in rural areas, education and research gaps, support businesses, and global players), digital agriculture requires special consideration from governments and industry leaders. This will be well worth the effort because it is a primary path towards a sustainable food supply.

Notes

1 UN DESA, 2015.

2 Montgomery, 2007.

3 Foley, 2011.

4 Tien, 2013; Song et al., 2016.

5 Woodard, 2016a.

6 Schwab, 2016.

7 van Es et al., 2016.

8 Woodard, 2016a, 2016b.

9 van Es et al., 2016.

10 Castle et al., 2015.

11 Castle et al., 2015.

12 Further information about Ag Data Transparency is available at http://www.fb.org/ag-data.

13 Fernandez et al., 2016.

14 Murray, 2015.

15 Woodard, 2016a.

16 van Es et al., 2016.

17 Sela et al., 2016; Sela et al. 2017.

18 European Commission, 2015.

19 More information about NIK is available at http://www.nik.bg/en.

20 Woodard et al., 2016.

21 Woodard et al., 2016.

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Digital Technologies Transforming Indian Agriculture

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India is the world's largest sourcing destination for the information technology (IT) industry, accounting for approximately 67% of the US$124–130 billion market.[1] However, the emergence of farm technologies integrated with a robust information and communication technology (ICT) framework is still evolving in India, and it holds tremendous potential to both positively impact agricultural performance and enhance farmers' income. The impact of technology in unlocking value for the people at the bottom of the pyramid and improving access to critical services is well demonstrated in the healthcare sector in India, as observed in the case of mobile technology–enabled telemedicine and low-cost devices that can address health conditions such as anaemia in a large section of the population. Technology has powered Indian agriculture time and again by helping overcome productivity stagnation, strengthening market linkages, and enhancing farm management. In the past, Indian agriculture faced a formidable challenge to grow more food, but it faces an even more difficult challenge today and for the future: to grow more sustainably and inclusively. Major challenges confronting Indian agriculture include declining total productivity, diminishing and degrading natural resources, a rapidly growing demand for food (not just for quantity but also for quality), stagnating farm incomes, fragmented land holdings, and unprecedented climate change. It has been established that technology adoption modernizes farmers' production practices and leads to uniform annual returns for farmers, reduced risk of crop failure, and increased yields.[2]

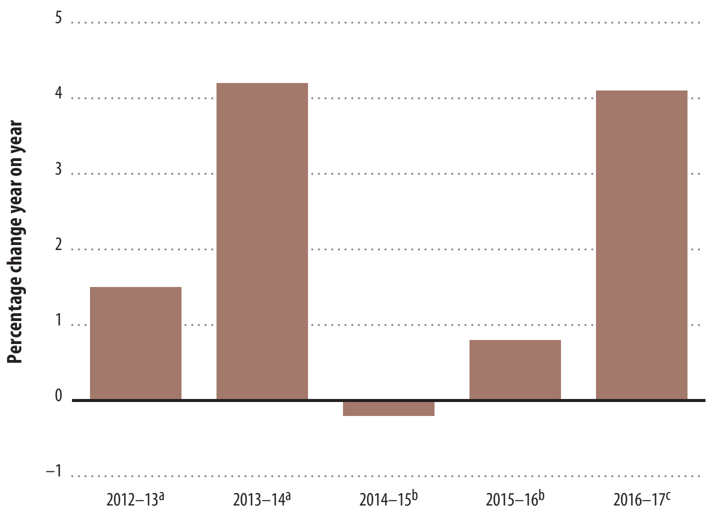
Direct applications of digital technology include remote sensing (via satellites), geographic information systems, crop and soil health monitoring, and livestock and farm management, among other applications. At the pre-harvest stage, digital technology can recommend crop and input selection and assist in obtaining credit and insurance. At the on-farm stage, there is need for weather advisories and disease- and pest-related assistance; and at the post-harvest stage, real-time data on both domestic and export markets are needed. The growth of competitive markets and demand for consistent food quality is making the adoption of such tech-based solutions imperative for the Indian farmer. Much of the scope for application and innovation remains to be exploited. The application of digital technology in agriculture has been instrumental in promoting data generation as well as the advanced analytics that allow farmers to make smart decisions about farming and to benefit from an economical use of inputs and labour.

Technology: A key driver for sustainable agriculture

India is one of the leading contributors to the global food basket. The country's food grain production stood at 252.23 million tonnes in 2015–16, and has a record production of 271.98 million tonnes in 2016–17.[3] India's horticulture output—comprising fruits and vegetables, floriculture, honey, plantation crops, medicinal plants, and spices—was around 283.4 million tonnes in 2015–16, surpassing food grains and making India the second largest fruit and vegetable producer in the world. India is also the world's largest producer of milk (155.5 million tonnes in 2015–16) and second largest producer of sugar, and the leading country in coconut production per government estimates. In 2016–17, after two successive years of sub-par monsoons, the growth of agriculture and allied sectors in India improved significantly (Figure 1). This growth is being primarily driven by the livestock and fisheries sectors, contributing to the diversification of the production basket towards high-value foods. Although fluctuating, the agricultural growth rate over the years reflects the increasing resilience of the sector to natural shocks and market volatility, an increase that also demonstrates the impact of favourable investments, technology uptake, and strategic policy efforts.

India's population has nearly doubled since the 1970s; it is currently estimated at over 1.2 billion and is

Figure 1: Growth rate of gross value added in agriculture and allied sectors, 2011–12 base prices



Source: Government of India, 2017b; 2017c.
Note: Data are government estimates: [a] second revised estimate; [b] first advance estimate; [c] first revised estimate.

growing at 1.4% annually, putting pressure on natural resources such as land and water to produce enough food. Moreover, with rising incomes, a structural change in the dietary patterns of an average Indian is diversifying the country's food demand to include high-value foods. According to the National Sample Survey estimates for 2011–12, although cereals account for 26% (20%) of the total food consumption expenditure in rural (urban) India, high-value foods (milk, meat, eggs, fish, fruits, and vegetables) account for 42% (46%) in rural (urban) India.[4]

Sustaining food security in India holds a larger implication for global markets.[5] India's agricultural export value growth rate was the highest in the world for the decade ending 2013 (Figure 2), at 21.3%—more than the average annual percent increase in agricultural export value in countries such as Indonesia (17.6%), Brazil (14.9%), and China (11.8%).[6]

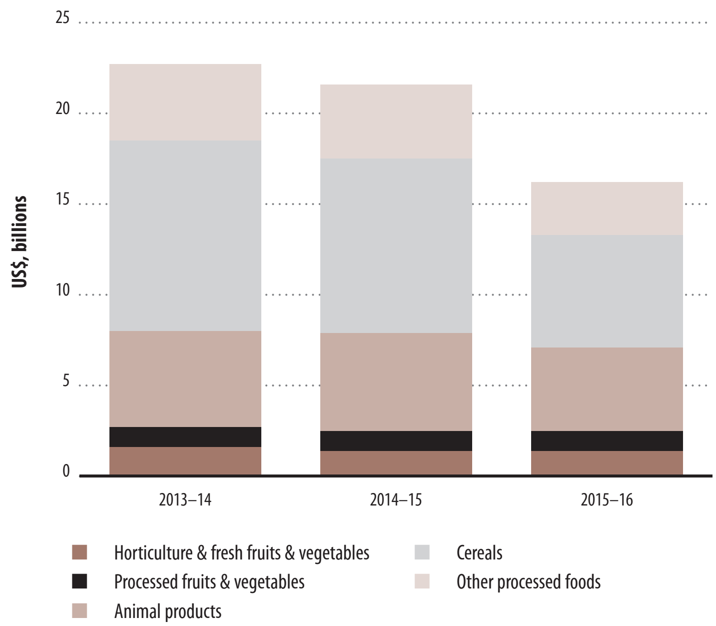
To respond successfully to the growing food demand both domestically and globally, India will have to produce more. Yields of major crops are low in India compared with those in other countries. For instance, the rice yield in India is 2.6 tonnes per hectare—far lower than the 4.7 in China, 3.7 in Brazil, 5.9 in the United States of America (USA), or 9.5 in Australia; that of wheat is 3.0 tonnes per hectare in India, 5.3 in China, and 3.1 in the USA; and the maize and soybean yields are 2.5 and 0.75 tonnes per hectare in India compared with 5.9 and 1.8 tonnes, respectively, in China.[7]

Leveraging technology to achieve higher and sustainable agricultural growth is not novel for farmers and other relevant stakeholders in India. Noteworthy are the green revolution (1966–67), the white revolution (1970–96), and the gene revolution (in cotton) in early 2000. The green revolution, which relied on extensive cultivation of high-yielding varieties of wheat, led to a fivefold increase in production and, as a result, also led to rising farmers' incomes.[8] The three decades from 1973 to 1999 can be regarded as the highlight in the timeline of agriculture productivity in India, when the food grain production nearly doubled.[9] It is interesting to note that the increase in production was more a result of an increase in the yield rather than an expansion of cultivated area. Similarly, the white revolution led to record milk production in India and enabled higher returns for dairy farmers. It established a national milk grid and introduced the crossbreeding of indigenous cows with high-milk-yielding European breeds, pasteurization of milk for long-duration storage, and refrigerated transport systems to distribute milk across the country. During the same period, agriculture machines were introduced on Indian farms; these primarily consisted of tractors and seed drills to improve productivity per unit of land and water. Following the successful adoption of Bacillus thuringiensis (Bt) cotton, India's cotton production increased from 14.0 million bales in 2000–01 to 38.6 million bales in 2014–15; it is estimated to be 35.1 million bales in 2016–17. India became the largest cotton producer in the world, accounting for 26% of the global production. Yield levels also increased from 278 kilograms (kg) per hectare to 511 kg per hectare to 568 kg per hectare during the above periods.[10] In 2015, India continued to have the largest area being cultivated with Bt cotton in the world—11.6 million hectares sowed by 7.7 million small farmers and an adoption rate of 95%. According to estimates, India enhanced farm income from Bt cotton by US$18.3 billion between 2002 and 2014 and US$1.6 billion in 2014.[11]

In the wake of concerns that intensive farming adversely impacts environmental balance, India will need to adopt sustainable farming practices that include employing efficient irrigation methods with a simultaneous focus on groundwater regeneration, monitoring soil degradation, and adopting energy-efficient production methods. Adopting advanced technology has helped small countries, including the Netherlands and Israel. Notably, these countries, have augmented the production of high-value crops through enormous productivity breakthroughs and, even more importantly, by ensuring the optimal utilization of resources and maintaining the environmental balance.

Currently technologies that cater to the optimal utilization of resources (particularly those that are linked to natural resource availability and environmental impact), effective market linkages for improved service delivery, and the discovery of the highest price possible as observed in the case of India through the country's electronic National Agricultural Market (e-NAM)—a technology-driven unified market platform—have a brighter future in India. The success of technology adoption lies in customizing to address particular challenges at the local level, supporting institutions and policies to create an enabling ecosystem, and harnessing the potential of these technologies to scale and commercialize within a defined time period.

Figure 2: Key agricultural exports from India, US$ billions



Source: APEDA 2017, statistical data on agricultural exports, available at http://agriexchange.apeda.gov.in/indexp/exportstatement.aspx.

An emerging ecosystem of digital technologies in Indian agriculture: The rise of start-ups and young entrepreneurial firms

The agriculture sector has attracted large conglomerates, leading IT companies, investors, and young innovators in India; the ecosystem for technology and digital solutions is expanding at an impressive pace. The global market for precision agriculture is expected to grow at an annual growth rate of 13.09% to reach a market size of over US$6.34 billion by 2022.[12] Although Northern America will maintain its dominance in the sector, the fastest growth is projected for India and China, which are expected to see an annual growth rate of 18.29% until 2022.[13]

The agro-tech start-up ecosystem in India has also been receiving renewed interest from investors, and an estimated 34 ventures received US$295 million in investments in 2016 in the country—the highest investment amount recorded in India in the past three years.[14] In Asia, China had 10 deals totalling US$427 million, while 53 Indian start-ups raised US$313 million and four Japanese companies raised US$8.9 million. The most active geographies—those countries with the highest number of agriculture start-ups—remained consistent year-over-year, with the USA, India, Canada, the United Kingdom, Israel, and France remaining the top six by number of deals.[15]

Among the prominent ventures backed by large conglomerates in India is ITC's e-Choupal, a comprehensive digital knowledge hub for farmers, which has 6,100 installations covering over 35,000 villages and serving over 4 million farmers.[16] Launched in 2000, the first-of-its-kind initiative not only benefited the farmers doing business through their network, but this model also led to a ripple effect on the public sector–managed food grain management systems that resulted in an upgrade.

Mahindra & Mahindra (M&M), one of India's leading producers of tractors and farm equipment, is innovating alongside expanding its core business. M&M's Trringo, a mobile-based app enabling farmers to rent tractors, is a unique example of leveraging technology to help farmers use machinery without having to make the large investment (US$7,500) of buying tractors.[17] Through Trringo, the farmers benefit from available latest machines, freeing labour as well as raising productivity and product quality. In addition, the farmers are required to pay only for the services they use without locking any money in as capital. This is particularly revolutionary in a country such as India, where agriculture is characterized by smallholders (who operate on less than 2 hectares of land) and who are often resource poor and lack access to formal channels of credit. The 'uberization' of tractors and farm machines (as some have coined it—a concept similar to uber taxis, which is a platform aggregating demand and supply of taxi services and connecting both through a mobile app) has the potential to fast-track farm mechanization and take it to regions within India where farm sizes are really small, yet abundant in water and exhibit suitable soil and climate conditions that could produce much more than their current output.

In another example, Tata Consultancy Services (TCS), India's leading IT firm, offers personalized advisory services in voice and visual formats using communication devices such as mobile phones through its mKRISHI platform. The growing penetration of mobile phones in rural regions of India is driving the development of several mobile-based applications by government departments, entrepreneurs, and the private sector.[18] The rural subscriber base in India for mobile services has been growing at steady pace, reaching approximately 342 million subscribers in 2012–13, 378 million in 2013–14, and 414 million at the end of 2014–15.[19] With easier access to mobile phones, farmers can connect with traders and other farmers. Small farmers can also utilize their mobile phones to seek information on input availability or market prices, thereby reducing costs—both because they do not have spend the time needed to get into town to find this information, and because it allows them to get competing prices and choose the best one. Other benefits that have been recorded are improved access to information about selecting seed varieties appropriate to a particular farm; and how to identify best cultivation practices, protect from weather-related damage, and get a better handle on plant diseases.[20]

Digital technology in Indian agriculture is not about big box solutions only. A large number of young entrepreneurs have ventured into this sector to tackle specific challenges. The technology thrust of these ventures has been on reducing the time duration of crop cycles, saving on water and energy, reducing the usage of agro-chemicals, automating for efficient farm management, strengthening farmer market linkages, and improving cold chain logistics for higher value addition.

Examples of these leading start-ups include Stellapps Technologies, which is providing dairy farm optimization and monitoring services with a special focus on small- and medium-herd farms. Their applications and tools leverage the Internet of Things, big data, the cloud, mobility, and data analytics to improve milk production, milk procurement, and the cold chain, and to boost animal insurance and farmer payments.[21] Ekgaon Technologies, an IT-based network integrator, offers a range of services to farmers, rural businesses, and women. The ekgaon OneVillageOneWorld Network is leveraging mobile communication technology to encourage the sustainable development of women-self-help-groups (SHGs) and small farmers across India. The platform has over 900,000 women and 300,000 farmers spread across villages in India.[22]

Drones and robotics are also increasingly used in Indian agriculture, although the ventures in this area are still budding and there is a long way to go before these technologies are scaled up in any major way. Agnext, an Indian start-up, has developed drones among other digital technologies with the objective of creating an integrated hyperlocal farm data collection and crop analytics platform.

A number of new start-ups are developing solutions to tackle climate change challenges. For example, Skymet Weather Services is involved in monitoring and predicting weather and providing agri-risk solutions.[23] Skymet can measure and predict yield at the village level for any crop with a high level of accuracy and can also accurately forecast the weather in the short, medium, and long term. Ecozen Solutions has developed state-of-the-art solar-powered products for irrigation and cold storage, with the aim of catering to smallholder farms and regions with limited or no electricity.[24] Barrix Agro Sciences offers eco-friendly crop protection methods that have the potential to minimize a significant proportion of the damage caused by pests and diseases without overdosing crops and plants with chemicals, thus preventing soil and water contamination.[25]

There are also ventures that started out as agri-tech start-ups in India but, owing to their innovative solutions, are now operating as medium-scale businesses. EM3 AgriServices, founded in 2014, has quickly risen to become a pioneer in the farming-as-a-service (FaaS) model. EM3's *Samadhan techno kheti centres* offer machines needed to perform all critical farm operations on a pay-for-use basis.[26] At their centres, the organization employs agri-professionals who are well versed in the agronomy of the target area. Another such noteworthy venture, eKutir Global, offers an online and mobile-based platform to connect marginal farmers with stakeholders across the value chain such as soil-testing labs, suppliers of seeds and fertilizers, banks, exporters, food-processing units, and branded retailers. Agri Suite by eKutir offers a one-stop solution for all the needs of a farmer; their field partners also train farmers to use their application.[27] Over time, services that go beyond merely selling a product but that also provide training about how to use, maintain, and repair that product, as well as supplementary components such as advisory and marketing services, have become an increasingly important and integral part of any product offering. Technology is playing an important role in bringing these elements together.

Despite the tremendous gains achieved, the long-term impact of the earlier technology revolutions was limited to selected agricultural pockets in the country, and further efforts to advance these revolutions lost momentum over time. In the context of start-ups, the common barriers to commercialization and the scaling up of technology are related to access to finance, which is in turn related to operational finance, funding/capital deficiencies, and cash flow management; gaps in technology infrastructure; and issues concerned with cyber security. Furthermore, limited access to farmer networks for effective piloting of the products is seen to impede the commercialization plans of start-ups. For innovation and entrepreneurship to be effective in transforming agriculture in India, it will be important to address these issues and create an enabling environment in which they can grow and flourish. To a large extent, the effort towards this transformation has been catalysed by the government's special programme on start-ups, Startup India.[28] Moreover, large companies with knowledge about the diversity of Indian agriculture could also support these start-ups by mentoring, which would help them pilot and scale up their activities for potential commercialization.

Policy and institutions: Key enablers for scaling up digital technologies in India

India's present public policy with regard to agriculture is focused on encouraging innovation and entrepreneurship, and out-of-box thinking towards achieving sustainable higher growth and income security in the farm sector. Because more than 50% of the working population is in agriculture and farm size is shrinking, the per capita output is small. Thus it is true and desirable that people move out of agriculture and bring the current percentage of the workforce employed in agriculture from 54.6 % down many fold. New forms of engagement have emerged in this sector that could make agriculture more remunerative and exciting for the new generation. The government—through its flagship programme Startup India, launched in 2016—aims to boost start-ups across sectors by providing hand-holding services, access to funding, and incubation. This programme is of immense significance for the agriculture sector. The other flagship programme—Digital India, which seeks to empower people through access to digital technology riding an increasingly robust infrastructure and service platform—has equally immense potential to positively impact agriculture. The government has also launched the Custom Hiring Centre, a rental model for using tractors and other farm equipment with the twin objective of encouraging rural entrepreneurship and fast-tracking the mechanization of Indian agriculture.

The budget for 2016–17 announced by the central government confirms its commitment to modernize agriculture systems in India through a slew of measures such as setting up a dedicated micro-irrigation fund, establishing new mini labs in the Krishi Vigyan Kendras (KVKs) agricultural extension centre, ensuring 100% coverage of all 648 KVKs in the country for soil sample testing, and expanding the coverage of the e-NAM from 250 markets to 585 markets.[29]

According to the Department of Industrial Policy and Promotion (DIPP) of the Ministry of Commerce and Industry, the Indian agricultural services and machinery sectors have cumulatively attracted foreign direct investment equity inflow of about US$2,278.3 million from April 2000 to March 2016.[30] This reveals the trend of global and domestic partnerships being forged across the value chain to keep agriculture on a path of fast-track growth. Some notable developments include the launch of an Agritech laboratory with a focus on agri-biotech in Hyderabad by the Intertek Group, a UK-based total quality assurance provider; Mahindra and Mahindra Ltd acquisition of a 35% stake in a Finnish combine harvesters manufacturer, Sampo Roselnew Oy; ICRISAT's plan to set up a Rs.100 crore (US$14.67 million) fund in a year to help small entrepreneurs in the agribusiness space; and the Indian Farmers Fertiliser Cooperative (IFFCO)'s joint venture with Japanese firm Mitsubishi Corp for manufacturing agrochemicals in India.

Conclusions

A successful future growth strategy for agriculture will need to perceive agriculture as a business enterprise involving constant innovation and catering to dynamic market demand. Although agricultural technologies are fast evolving in India and a mix of business models are driving the ecosystem, there is a need to design the pathway to successful commercialization and to scale it up by utilizing the right incentives and policy support. Technology will continue to play an important role while the dynamics of the agriculture sector changes and produces new challenges. With the private sector playing an increasingly important role in investments, operations, and expertise, agriculture will gain immensely as the public sector catalyses these efforts. The IT revolution in India was brought forward by the private sector, with the public sector creating an enabling environment.

Uptake of technologies at market prices in a sector that has traditionally been heavily subsidized remains challenging, but farmers are prompt to identify what works in their interest and are ready to pay for it. Digital technologies offer the potential to achieve the necessary conditions for scale, with distributed low cost and customized delivery, creating a unique opportunity for private enterprise and innovation to thrive. The challenge before India lies in balancing high growth with inclusive growth; leveraging technology to achieve these twin goals will be a fascinating journey to track.

A developed agriculture system is based on three key pillars: knowledge, infrastructure, and a robust delivery mechanism. Supporting the research and development ecosystem in agriculture directly contributes to creating knowledge and preparing for the future. To strengthen the supporting framework for growth, it will be important to focus on creating new physical markets, improving storage and transport facilities, making better roads, and ensuring a continued electricity and water supply. These system components also facilitate efficient mechanisms for delivery and the monitoring of relevant government schemes and extension services that will accelerate the pace of development. The public policy regime in India has been supporting technology-led agricultural growth and has been increasingly developing new institutions to ease access and affordability of technology adoption among farmers.

Notes

1 IBEF, 2017.

2 Emerick et al., 2016.

3 Government of India, 2017a.

4 Government of India, 2013.

5 If India has to depend on imports, it will be difficult to supply enough because the volume of the need is so high. If India is able to grow more than it needs, it can be a global exporter. Both import and export impact price in different ways.

6 USDA-FAS, 2014.

7 OECD, 2017.

8 Dastagiri et al., 2014.

9 Government of India, 2017d.

10 The Cotton Corporation of India Ltd, 2017.

11 ISAAA, 2015.

12 BIS Research 2015.

13 Tech Mahindra, No date.

14 Shashwati, 2017.

15 Agfunder, 2017.

16 Information on ITC's e-Choupal is available at http://www.itcportal.com/businesses/agri-business/agri-commodities-and-rural-services.aspx, accessed 11 February 2017.

17 Information on M&M's Trringo comes from https://www.trringo.com/about-us/, accessed 11 February 2017.

18 For more information about TATA Consultancy Services, see https://www.tcs.com/.

19 TRAI, various issues.

20 Mittal and Mehar, 2013.

21 This information on Stellapps comes from http://www.stellapps.com/index.php/about-stellapps/, accessed 11 February 2017.

22 Information about ekgaon and its OneVillageOneWorld Network can be found at http://ekgaon.co.in/ekg/index.php, accessed 11 February 2017.

23 Information about Skymet Weather Services comes from http://www.skymetweather.com/, accessed 11 February 2017.

24 Information about Ecozen Solutions can be found at http://www.ecozensolutions.com/about-us, accessed 11 February 2017.

25 Information about Barrix Agro Sciences can be found at http://www.barrix.in/About-Us, accessed 11 February 2017.

26 Information about EM3 AgriServices is available at http://www.em3agri.com/, accessed 11 February 2017.

27 Information about eKutir Global is available at http://www.ekutirsb.com/, accessed 11 February 2017.

28 Information about Startup India is available at http://www.startupindia.gov.in/.

29 Key features of the budget can be found at the Government of India's Union Budget 2017–18, available at http://indiabudget.nic.in/ub2017-18/bh/bh1.pdf.

30 GBV, 2017.

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Innovations in Food Distribution: Food Value Chain Transformations in Developing Countries and their Implications for Nutrition

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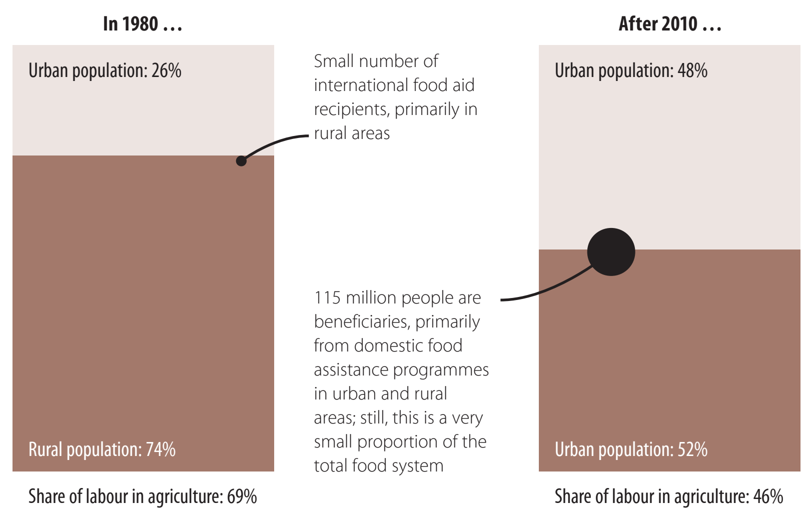
Millions of individuals are affected by malnutrition globally. Malnutrition in developing countries is characterized as a triple burden,[1] which includes undernourishment (insufficient calorie and protein intake), micronutrient malnutrition (hidden hunger), and over-nutrition (excess calories leading to overweight and obesity). In 2010, undernourishment and micronutrient malnutrition affected about 900 million and 2 billion people, respectively, in developing countries.[2] Meanwhile, over-nutrition—reflected in escalating overweight and obesity rates along with higher incidence of chronic diseases such as diabetes—continues to expand in developing countries.[3] The causes of this triple burden are multiple, but the availability, variety, and composition of foods that make up peoples' diets play a major role.

This chapter explains how food value chain (FVC) innovations in recent years are influencing the triple burden of malnutrition in developing countries. These chains are changing fast as a result of population and income growth; technological progress in food production and distributions; urbanization; and the expansion of modern food retailing, distribution, and wholesaling firms.[4] As a result, today's developing-country FVCs exhibit great diversity, because modern food sector firms either establish their own food chains or interact with traditional FVC actors, such as smallholder farmers and traders, wet markets (which sell fresh meat and produce), corner stores, and street vendors. A deeper understanding of the drivers of emerging FVC arrangements, the interactions of businesses that participate in them, the products offered, and the markets targeted can provide valuable insights into strategies to curb malnutrition.

Figure 1: Developing-country food systems: Key differences between 1980 and 2010



Source: Based on Gómez et al., 2013.
Note: The trend of people moving to urban areas and working in less physically demanding jobs continues in 2017. Updated data would show an even higher percentage of urban dwellers and beneficiaries of food assistance programmes.

Food system transformation

Figure 1 highlights key differences between a representative food system in 1980 and 2010.[5] In 1980, about 74% of people in low- and middle-income countries resided in rural areas. The share of food sold in local rural wet markets and grown for household consumption was relatively high, while the share sold in supermarkets out of total food consumed was very small.[6] In the same year, the share of low- and middle-income countries' total labour force in agriculture was approximately 69%;[7] these workers expended considerable energy in manual labour. In addition, domestic public food-based safety nets to provide food assistance to those missed by the commercial sector were practically non-existent

This chapter is based on the article by M. I. Gómez and K. D. Ricketts, 'Food Value Chain Transformations in Developing Countries: Selected Hypotheses on Nutritional Implications'. *Food Policy* 42 (2013): 139–50.

Table 1: Food value chain typologies and their influence on nutrition

Type	Participants	Implications for food access	Nutritional impacts
Traditional	Traditional traders buy primarily from smallholder farmers and sell to consumers and traders in wet, mostly local, markets.	• **Affordability:** A local clearing-house for products, with flexible prices, product volumes, and quality standards. • **Availability:** Food hub for consumers and local 'mom and pop' stores to access directly from traders and smallholder farmers; market offerings are highly dependent on production seasonality.	• Traditional FVCs help reduce micronutrient deficiencies and undernourishment by offering low-priced fruits, vegetables, livestock products, and staples, particularly in rural areas and in poor neighbourhoods of urban areas. • Production seasonality, combined with lack of post-harvest and distribution infrastructure, increase FVC intermediation costs and limit the ability of traditional FVCs to reduce micronutrient deficiencies and undernourishment.
Modern	Domestic and multinational food manufacturers procure primarily from commercial farms and sell through modern supermarket outlets.	• **Affordability:** Economies of scale enable the production, marketing, and distribution of packaged/processed foods at low per-unit prices. • **Availability:** Modern supermarkets provide year round, wide product assortment, primarily in urban areas; supermarkets are successfully expanding the market for processed and packaged foods.	• Modern FVCs may contribute to alleviate micronutrient deficiencies by offering a wide assortment of products year round, but supermarkets' physical locations and quality standards may imply higher retail prices, missing the poor. • Modern FVCs may contribute to obesity/overweight malnutrition by expanding the reach of inexpensive, calorie-dense processed/packaged foods, primarily in urban areas.
Modern-to-traditional	Domestic and multinational food manufacturers sell through the network of traditional traders and retailers (e.g., mom and pop stores).	• **Affordability:** Food manufacturers benefit from economies of scale to connect with traditional distributors and retailers, offering low-priced processed foods to reach low-income consumers. • **Availability:** By linking with traditional retailers, food manufacturers develop intense distribution strategies in urban areas and in rural, isolated markets.	• Expansion of processed/packaged foods into isolated, rural regions may alleviate undernourishment, but it can result in over-nutrition among urban consumers. • Food fortification initiatives focusing on modern-to-traditional FVCs may help reduce micronutrient malnutrition.
Traditional-to-modern	Supermarkets and food manufacturers source food from smallholder farmers and traders.	• **Affordability:** Increased income opportunities in high-value crop and livestock production for smallholder farmers and traders can expand food budgets because most are net food buyers. • **Availability:** Increased production and crop diversification may increase food available for local consumption.	• Traditional-to-modern FVCs may reduce micronutrient deficiencies and undernourishment of smallholder farmers and traders through higher incomes leading to diet diversification. • Opportunities for smallholder farmers and traders to benefit directly from participation appear limited and may miss asset-poor farmers; substantial benefits are generated through off-farm employment opportunities.

Source: Gómez and Ricketts, 2013.

in developing countries, other than those programmes supported by foreign food aid shipments from high-income countries.[8]

Developing-country food systems became dramatically different by 2010. A larger portion of people in developing countries lived in urban areas by then and depended on commercial FVCs to deliver their food, while they typically worked in less physically demanding jobs than agriculture, expending far fewer calories in daily labour. In 2011, only about 52% of low- and middle-income country people resided in rural areas and the share of agricultural labour had fallen to about 46%.[9] Thus the share of food sold in local rural markets and grown for household consumption after 2010 was significantly smaller than it was in 1980. The percentage of people residing in rural areas and the share of agriculture in total labour continue falling today. Meanwhile, modern food retail and wholesale and the foreign direct investment of global food manufacturers have expanded rapidly.[10] Another key feature of today's food systems is that many developing countries are establishing food-based safety nets—'food assistance programmes' (FAPs)—for those individuals who are at risk of experiencing macronutrient and micronutrient deficiencies. The World Bank (2013) estimates that, on average, nearly 115 million people benefited annually from safety nets in developing countries during 2011–14.

Emerging food value chain typologies: Implications for nutrition

Table 1 offers a typology that assigns FVCs into four broad categories to reflect ongoing FVC transformations in developing countries. For each FVC category, the table describes its primary characteristics and participants, explains the essential mechanisms affecting food access (availability and affordability), and describes its impact on elements of the triple malnutrition burden. The typology recognizes the existence of a modern sector (e.g., large commercial farms, agribusinesses, multinational food manufacturers, and modern supermarkets), a traditional sector (e.g., smallholder farmers and traders, wet markets, and 'mom and pop' stores), and the interaction between modern and traditional actors at different FVC stages. A discussion of the implications of each FVC type on nutrition follows.

Traditional food value chains

Consumers in traditional FVCs follow long-established patterns and most often purchase food directly from smallholder farmers and traders in regional/local wet markets, or from a network of traditional retailers that includes independently owned mom and pop corner stores, street vendors, or roadside stands.[11] Wet markets, in turn, can include large, regional markets that function like distribution hubs, or smaller, local, weekly markets with more limited product assortment. Product availability in these FVCs tends to be seasonal. Traditional FVCs are common in small rural markets located relatively close to production regions. Products delivered by traditional FVCs travel longer distances to reach urban consumers, primarily in lower-income neighbourhoods.[12]

Despite the expansion of modern supermarkets and food manufacturers, evidence suggests that food categories that are important sources of micronutrients continue to be accessed primarily through traditional FVCs in developing countries.[13] For example, over 90% of all fruits and vegetables are purchased in traditional FVC retail outlets in Kenya, Nicaragua, and Zambia,[14] and 90% of households in Ethiopia buy their beef through a local butcher in wet markets.[15] These large market shares are mainly the result of three advantages accruing to traditional FVCs, particularly with respect to perishable products: (1) their ability to offer products at low prices, (2) their considerable flexibility in product quality standards, and (3) their convenience for consumers as a result of their flexible retail market locations.[16]

Food products rich in micronutrients (e.g., fruits and vegetables) and staple foods rich in calories (e.g., pulses, grains) tend to be more affordable in traditional FVCs than in modern supermarkets. These marketing channels often deliver nutritional benefits to rural residents who are largely missed by modern FVCs. Additionally, important nutritional benefits accrue to low-income people in urban areas, where traditional FVC retailers enjoy cost and location advantages. Moreover, traditional FVCs offer relatively more flexibility to target consumers who are willing to settle for lower food standards. This is reflected in significant retail price differences between modern and traditional FVCs.

Nevertheless, the post-harvest and distribution infrastructure requirements of perishable foods are more expensive and more technologically advanced than they are for other food types. Traditional FVC infrastructure is typically lacking in developing countries and may imply higher price variability and limited year-round availability in traditional FVCs, imposing higher distribution costs and high post-harvest losses, as well as less quantity and lower quality.[17] Lack of access to adequate post-harvest processing and distribution infrastructure may limit the ability of traditional FVCs to contribute to year-round availability of micronutrient-rich foods, resulting in high intermediation costs that may offset, to some extent, the cost advantages in retailing.

Modern food value chains

These FVCs are largely driven by the expansion of modern retail enterprises in developing countries, primarily in urban areas with a large consumer base. They generally involve domestic and multinational food manufacturers and wholesalers, as well as commercial agribusinesses and farms.[18] In general, modern FVC participants coordinate the supply chain through formal, well-documented contractual arrangements that feature predetermined product standards, volume requirements, and purchase prices.[19] Such tight coordination, together with access to a network of global and domestic suppliers, allows modern FVCs to offer a wide year-round assortment of fresh and processed/packaged food products. These chains also generally benefit from economies of size in the production, marketing, and distribution of shelf-stable packaged/processed foods.

Modern FVCs are changing the dietary landscape in the developing world. Overall, research suggests that modern FVCs help alleviate micronutrient deficiencies by offering a wide assortment of products year round for a diverse diet, but often only for urban households with relatively high incomes.[20] Higher retail prices of foods rich in micronutrients (produce, dairy products, meats) resulting from stricter product standards may limit the ability of lower-income consumers to afford a diet with an adequate micronutrient intake.[21]

A number of studies suggest that the expansion of modern FVCs is associated with an increased market for processed/packaged foods, with at least two implications for nutrition.[22] First, modern FVCs may be contributing to obesity/overweight malnutrition by expanding the reach of inexpensive, calorie-dense processed/packaged foods, primarily in urban areas. There is evidence that dietary changes in developing countries, along with other factors (e.g., change in lifestyles, reduced manual labour), are associated with the emergent global epidemic of obesity, particularly among younger people.[23] Although there are no studies showing causality between the expansion of processed/packaged food categories and obesity, it is plausible that this is a primary contributing factor driving the increase in the number of overweight and obese people in developing countries. Second, there may be demand substitution effects, such that low-priced packaged/processed foods substitute for fresh produce and livestock products, further worsening nutritional outcomes.

Modern-to-traditional food value chains

These FVCs consist of food manufacturers utilizing traditional wholesale and retail networks to market primarily processed/packaged foods. Two key characteristics of these FVCs are that food manufacturers often benefit from economies of scale in production and distribution, and from an increased ability to coordinate the downstream supply chain (as opposed to having to negotiate with large, powerful supermarkets). These two characteristics allow modern-to-traditional FVCs to implement intensive, year-round distribution strategies for processed/packaged foods, targeting lower-income consumers in urban areas as well as consumers who get their food from smaller, remote markets in rural areas.

The market for processed/packaged foods has been growing substantially more quickly in developing countries than in their developed counterparts.[24] Much of this growth is being fuelled by food manufacturers selling products through traditional FVC retailers in urban and rural areas. For example, in India, small independent grocers (*'kirana'* stores) are ubiquitous in urban and rural areas and represented over 53% of processed/packaged food retail sales in that country in 2010.[25] Similarly in Brazil, small corner stores (called *'mercadinhos'*) represented over 21% of processed/packaged food retailing in 2010.[26]

Moreover, processed/packaged foods sold through modern-to-traditional FVCs may help alleviate (and prevent) undernourishment in remote rural areas. These products can be made available to consumers year round at stable prices in remote rural areas, which often experience high food price variability as a result of production seasonality and production risk (e.g., adverse weather during the cropping cycle). The influence of modern-to-traditional FVCs on the nutrition of urban consumers with relatively low incomes appears to be negative because, similar to the case of modern FVCs, the ongoing market expansion of processed/packaged foods through modern-to-traditional FVCs may be associated with excess weight and obesity, mirroring long-established over-nutrition trends in developed countries.[27]

Although expanded sales of processed/packaged foods may be associated with over-nutrition in urban areas, fortification of these foods may provide an avenue for alleviating micronutrient deficiencies with modern-to-traditional FVCs. The World Economic Forum (2009) suggests that innovative public-private partnerships can create incentives to develop business models targeting micronutrient concerns among the poor. These partnerships are being established at three distinct levels:

1. *Investing in new product development of fortified foods*—for example, nutritious yogurt fortified with essential micronutrients is distributed by Grameen-Ladies at affordable prices to address vitamin A deficiency in Bangladesh and elsewhere in South Asia, where over 8 million children are affected.[28]
2. *Expanding distribution networks for existing fortified foods*—for example, in Mozambique, the National Committee for Food Fortification is a government-food industry partnership aiming at expanding distribution of fortified products such as vegetable oil with vitamin A, and wheat flour with zinc, iron, B-complex vitamins, and folic acid.[20]
3. *Strengthening consumer demand for micronutrient-rich processed/packaged foods*—examples of public-private collaborations expanding education and distribution of fortified foods include a partnership between GAIN and nutrition/supplement companies such as Herbalife.[30]

These private-public partnerships necessarily include the network of traditional FVC retailers and traders because these entities offer the primary point of sales employed by the poor to access food.

Increasing business partnerships between large food manufacturers and traditional retailers is (and will continue) expanding the affordability and availability of processed/packaged foods in developing countries. These products are often rich in calories but poor in important micronutrients.

Modern-to-traditional FVCs may have a mixed influence on nutrition, depending on the population segment targeted. For example, they can assist in efforts to prevent or at least reduce undernourishment in some rural, remote areas, but they can also create problems associated with over-nutrition in urban areas for patrons of traditional FVC retail outlets. There is substantial enthusiasm for public-private partnerships that link food manufacturers to the network of traditional retailers to alleviate micronutrient deficiencies through fortification.

Traditional-to-modern food value chains

These chains are characterized by smallholder farmers and traders selling primarily high-value crop and livestock products (e.g., meats, dairy products, fruits, and vegetables) to modern supermarkets and food manufacturers. These FVCs are interesting primarily for their impacts on the nutrition of smallholder farmers and traders, not of end consumers. The impacts come from higher-income opportunities, which may involve selling products to supermarket supply chains directly; or indirectly, through off-farm employment in food production and post-harvest activities. Here we focus on participation in domestic markets because developing-country FVCs are primarily domestically oriented,[31] and also focus on nutritional implications for smallholder farmers and traders in rural areas because most of them are net food buyers.[32]

Farmers who participate in supermarket supply chains enjoy higher income opportunities,[33] even when facing strict product safety and product standards established by supermarkets.[34] Nevertheless, these benefits may reach only farmers with advantageous endowments and education.[35] Furthermore, recent studies suggest that the poorest farmers and traders may benefit indirectly by linking with modern FVCs though the labour market markets—for example, off-farm employment in commercial agriculture and post-harvest processing.[36] There is evidence of a positive correlation between smallholder farmer and trader participation in traditional-to-modern FVCs and reduction in undernourishment.[37] Most of these benefits appear to occur indirectly, particularly for the poorest farmers, in the form of off-farm employment opportunities in commercial farms and post-harvest businesses.

Conclusions

FVCs in developing countries have changed dramatically in recent years, driven primarily by the expansion of modern food manufacturers, wholesalers, and retailers, which coexist and interact with traditional FVC actors. These FVCs are changing in ways that have no precedent in developed countries, where the transition occurred gradually, over a longer period of time. The FVC typology discussed here sheds light on how the relationships among participating business, the types of products offered, and the needs of the consumer targeted are all affecting the triple malnutrition burden (undernourishment, micronutrient deficiencies, and over-nutrition) in the developing world.

Drawing general conclusions about the impact of emerging value chains on nutrition is far from simple. Traditional FVCs, for example, tend to facilitate access to micronutrient-rich foods (e.g., fruits and vegetables) for urban low-income people and most rural residents. Nevertheless, lack of post-harvest and distribution infrastructure may limit the ability of traditional FVCs to assist in micronutrient deficiency reduction year round, and may result in higher intermediation costs affecting the food prices and demand for low-income consumers. Given that micronutrient deficiencies affect more people today, interventions to boost the efficiency of traditional FVCs can be effective in improving access to micronutrients, particularly among urban and rural poor people. Modern FVCs, for their part, may simultaneously promote over-nutrition and reduce micronutrient deficiencies among urban emerging middle- and high-income individuals. Nevertheless, these effects may be nonexistent for the urban poor and rural residents because these markets are missed by the modern supermarket.

The interactions between traditional and modern FVC participants in developing countries are extremely important, highlighting the need for a more nuanced view of the links between nutrition and food value chains. In particular, intensive processed/packaged food distribution strategies promoted by modern food manufacturers linking to traditional retailers may contribute to over-nutrition in urban areas, but may prevent or reduce undernourishment in remote rural areas. In addition, the distribution networks established in these chains may offer opportunities to form partnerships between governments and private businesses to use food fortification to reduce micronutrient deficiencies targeting specific regions where this malnutrition problem is prevalent. Regarding efforts to link smallholder farmers and traders to the modern sector, the evidence suggests that important nutritional benefits may occur through elevated incomes, and primarily generated by off-farm employment in farm and post-harvest activities—as opposed to direct selling.

Developing-country FVCs will continue evolving with the expansion of the modern sector and the adoption of innovative food distribution and retailing technologies. This ongoing transformation will play a key role in global initiatives to alleviate the triple burden of malnutrition. Future research should shed light on how these FVC transformations can be leveraged by private firms and governments to reduce micronutrient deficiencies, alleviate undernourishment, and control the so-called over-nutrition epidemic. In addition, very little is known about demand substitution effects among process/packaged foods, staples, fruits and vegetables, and livestock products and how consumers respond to changes in the relative prices of these product categories. This should be a priority for future research. Finally, future work examining individual- or household-level consumption patterns over time can illuminate ways that changes in product assortments offered to end consumers affect malnutrition.

Notes

1 Pinstrup-Andersen and Watson, 2011.

2 FAO, 2013; Gómez et al., 2013.

3 Popkin, 1998, 1999.

4 Reardon and Timmer, 2007.

5 Gómez et al., 2013.

6 Reardon and Timmer, 2007.

7 FAO, 2013.

8 Barrett and Maxwell, 2005; IEG, 2011.

9 FAO, 2013.

10 Reardon et al., 2003, 2007, 2009; Regmi and Gehlhar, 2005.

11 Gorton, 2011; Reardon et al., 2010; Reddy et al., 2010; Ruben et al., 2007.

12 Ruben et al., 2007.

13 FAO, 2005; Guarin 2013.

14 Gorton, 2011; Reardon et al., 2010; Tschirley et al., 2009.

15 Jabbar et al., 2010.

16 Guarin, 2013; Jabbar and Admassu, 2010; Minten, 2008; Schipmann and Qaim, 2010; Wanyoike et al., 2010.

17 Gómez et al., 2011.

18 Reardon and Gulati, 2008; Reardon and Timmer, 2007.

19 Reardon and Barrett, 2000.

20 Humphrey, 2005; Reardon et al., 2003; Reardon and Gulati, 2008.

21 Gómez and Ricketts, 2013.

22 Burch and Lawrence, 2007; Hawkes, 2008; Reardon et al., 2012.

23 Caballero, 2007; Garde, 2008; Harris and Graff, 2012.

24 Hawkes et al., 2010.

25 Euromonitor, 2011.

26 Euromonitor, 2011.

27 Mendez et al., 2005; Wang et al., 2002.

28 Singh and West, 2004.

29 CONFAM, 2012.

30 Information about the Global Alliance for Improved Nutrition (GAIN) can be found at www.gainhealth.org.

31 Gómez et al., 2011.

32 Barrett, 2008.

33 Bellemare, 2012; Miyata et al., 2009.

34 Berdegué et al., 2005; Minten et al., 2008.

35 Michelson 2013; Neven and Reardon, 2009.

37 Gómez et al., 2011; Maertens and Swinnen, 2009.

37 Ndhleve et al., 2012; Smith et al., 2005.

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Policies and Institutions Fostering Innovation and Agriculture Technologies in Brazil

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Compared with other developing countries, Brazil has a relatively well-developed innovation system and a favourable scientific infrastructure. It has several universities well placed in the world rankings, a growing role in world knowledge production, and a diversified economic structure.

However, from the point of view of the National Industry Confederation (CNI) and the Brazilian Micro and Small Business Support Service (Sebrae), the country still faces many challenges in fostering science and technology and in creating an environment more suitable for innovation. Perhaps the most successful example in Brazil of how policies and institutions can foster science and innovation oriented towards society's major goals is in the agricultural sector.

This chapter first aims to describe the main characteristics of the Brazilian innovation system and policies. Second, it provides evidence of the growing participation of a different set of agents in the country's innovation system. Finally, it depicts the country's agriculture research system and outlines improvements needed to address new technological challenges in agriculture and food production.

Brazil's innovation policies and institutions: The current scenario

Over the last 15 to 20 years, Brazil has greatly improved the policies that are intended to foster innovation. Indeed, the country has implemented a series of measures and policies to reinforce its innovation capacity. Among the new policies are research and development (R&D) tax incentives and subsidized credit for innovation, as well as some regulatory measures that ease the university–enterprise relationship. The Brazilian government also substantially increased public R&D expenditures, at least until the recent fiscal crisis in 2014.

Zuniga et al. have systematized the main public policies and instruments that currently exist in Brazil to support innovation (Table 1) as well as the estimated amount of money invested through these instruments in 2012.[1] Some of the funding sources for innovation indicated in the table, such as the mandatory R&D investments from companies in regulated sectors, are not strictly public. These investments are obligations assumed by companies in regulated sectors and are, therefore, private resources.[2]

According to De Negri, all this effort in designing new policies builds a relatively comprehensive picture of innovation policies when it comes to the diversity of instruments. She explains, 'Currently, the country can count on many of the instruments used in most of the developed world to foster innovation, such as: i) subsidized credit; ii) tax incentives; iii) subventions for companies (grants); iv) grants for research projects at universities and research centers, among others'.[3]

Some recent policies deserve special mention because of their role in the country's innovation system, specifically in the agriculture sector. The first relevant attempt to increase funding to foster innovation in the country was the creation of Sectoral Funds. These funds are meant to be defrayed by taxes or contributions levied on certain sectors and to support innovation projects in those sectors. The first of these funds, created in 1999, was the fund for the oil sector, financed by a share of oil and gas royalties.

One of the funds, for agribusiness, was created in 2001; it specifically aims to foster technologies in areas such as agronomy, veterinary medicine, biotechnology, economics, and agricultural sociology. This fund also intends to promote technological updates in the agricultural industry and to stimulate the expansion of investments in tropical agricultural biotechnology and in the diffusion of new technologies. Also created in 2001, the Biotechnology Fund aims to support technologies, research infrastructure, and qualification in the area. Another important sectoral fund for agriculture in Brazil is the Energy Fund, which is particularly concerned with improving energy efficiency and fostering renewable energy, such as biofuels.

The innovation law of 2004, in turn, established the rules of engagement for researchers from public institutions in research projects with

Table 1: Primary innovation and S&T policies and instruments in Brazil (main sources of funding for S&T), 2012

	Policies and Instruments	Value (Current *Reais*)
Tax breaks	Tax incentives for R&D stipulated by Law No. 11,196/2005 (the good law)	1,476.8
	Tax incentives from the Informatics Law (No. 8,248/1991 and No. 10,176/2001)	4,482.2
	Other tax incentives for innovation	464.0
	TOTAL (Tax Incentives)	**6,423.0**
Public credit for innovation (disbursements)[a]	FINEP	1,800.0
	BNDES	2,200.0
	TOTAL (public credit)	**4,000.0**
Public investments in S&T	States (excluding post-graduation)	7,033.7
	Federal Government (excluding post-graduation)	18,387.9
	TOTAL (excluding post-graduation)	**25,421.6**
	TOTAL (with post-graduation)	**40,045.0**
Mandatory investments in R&D for regulated companies	Electric Sector R&D Program (approximate values)	~ 300.0
	Oil Sector R&D Program	1,226.7
	TOTAL	**1,526.7**

Source: Extracted from Zuniga et al., 2016, Table 1, p. 63.

Data sources: ANEEL (Electricity Regulatory Agency database), available at http://www.aneel.gov.br/?idiomaAtual=1; ANP, 2013; BNDES, 2013; the Ministry of Science, Technology and Innovation (MCTI) database, available at www.mcti.gov.br/indicadores; and the Brazilian Innovation Agency (FINEP).

Note: a According to Zuniga et al., the value that expresses the subsidized credit for innovation is the total volume of the credit portfolio for innovation at BNDES and FINEP. In other words, this does not represent the implicit costs of such instruments for the Brazilian government. BNDES = National Bank for Social and Economic Development; FINEP = Brazilian Innovation Agency; S&T = science and technology.

companies, as well as for the commercialization of intellectual property derived from these partnerships. This was a significant improvement in the regulations concerned with the interaction between universities and companies. This law also launched the possibility of public funds being given to companies in the form of a grant for carrying out R&D. Until the promulgation of this law, there had been no such possibility in the Brazilian legal framework.

Finally, the 'Good Law' (Lei do Bem) generated several tax incentives for Brazilian companies in 2005. When it comes to innovation, one of the most important of these is the tax incentives for private investments in R&D. Before this law there were two programmes that provided tax breaks to private companies that invested in R&D in both industry and agriculture. Those programmes demanded that, before receiving the incentive, companies should have their research projects approved by the Ministry of Science and Technology. The bureaucracy involved in this kind of requirement was responsible for this earlier incentive never having been broadly used by Brazilian companies—either in industry or in agriculture. The Good Law, therefore, expanded the comprehensiveness of the tax incentives and facilitated its use for private companies conducting R&D in the country.

From the regulatory point of view, several improvements have been made in Brazilian legislation in the last decades. These begin with the Industrial Property law, approved in 1996, and the cultivars protection law, in 1997. Besides these, a new law on biodiversity made research on Brazilian biodiversity easier. This law entered into force in 2015 and, from this date, research using Brazilian genetic resources, as well as the development of products based on the country's biodiversity, do not require prior authorization.

The emerging role of CNI and Sebrae

New institutional actors have recently emerged as important players in the Brazilian debate on innovation and technology. CNI business leaders created the Entrepreneurial Mobilization for Innovation (MEI) in 2008. The MEI aims to make innovation a centre of corporate strategies and increase the effectiveness of innovation policies in the country. This initiative recognizes that innovation is essential for competitiveness and, therefore, for the country's growth and development. Currently, the MEI has around 200 business leaders as members and counts on support from government working in partnership to strengthen innovation in Brazil.[4]

Besides mobilizing Brazilian entrepreneurs, the CNI, by means of the Brazilian National Service for Industrial Training (SENAI), has also created several new technological institutes in the country. The SENAI institutes of innovation were inspired by the German model of the Fraunhofer Institutes, and they aim to increase the productivity and competitiveness of Brazilian industry by developing innovative solutions for companies of all sizes.

Until now, 21 different institutes have been established to conduct applied R&D, providing technological and laboratory support for prototyping and pilot plants, as well as consultancy work to facilitate technology transfer to Brazilian companies. These institutes are spread over 12 different states of the country. For instance, the Institute of Innovation in Biotechnology, in São Paulo, develops innovative solutions for bioengineering focused on areas such as food processing, chemistry, and energy, among others. The Institute for Biomass Innovation, in Três Lagoas in the state of Minas Gerais, offers solutions in biomass processing for sugar and ethanol producers, pulp and paper, biofuels and biodiesel, and the chemical sectors.

Brazil also has an important network of public and private providers of technology extension services for small and medium-sized enterprises. These services include training in technology and managerial skills, in the diffusion of information, and in metrological services.

The most important organization providing these services and supporting micro and small enterprise development in Brazil is the Brazilian Micro and Small Business Support Service (Sebrae), created in 1972 by the Brazilian government. Sebrae became independent, as a private nonprofit organization, in 1990. It develops its activities in collaboration with the public and private sectors through its National Deliberative Council, which includes government institutions, business organizations, and research institutions.[5] Sebrae offers several solutions in different areas of business organization, among them innovation. Specific programmes to foster innovation have been created.

One of these is SEBRAETEC, a programme that allows small businesses access to technological and innovation support in order to improve processes, products, and services and to introduce innovation in enterprises and markets in the following areas: quality, productivity, intellectual property, sustainability, digital services, and design. Sebrae pays 70% of the company´s innovation costs, and the company is responsible for 30%. Some specific examples of services covered by SEBRAETEC in agriculture and food production are:

- genetic selection in the search for yield increase, because this diagnoses genetic problems that affect fertility, diseases, longevity, and quality in milk and animal farming;
- good agricultural practices and HACCP (Hazard Analysis & Critical Control Points) needed to meet the required standards for wholesale markets and export markets for fruits, vegetables, coffee, honey, distilled beverages (cachaça), and agroindustry products;
- laboratory analysis for quality diagnosis and monitoring, such as water quality parameters for fish and shrimp farming, microbial standards for milk and for sugarcane juice (for cachaça production), and soil tests;
- technical assistance for several types of crops; and
- assistance in meeting the country´s Technical Norms and Standards.[6]

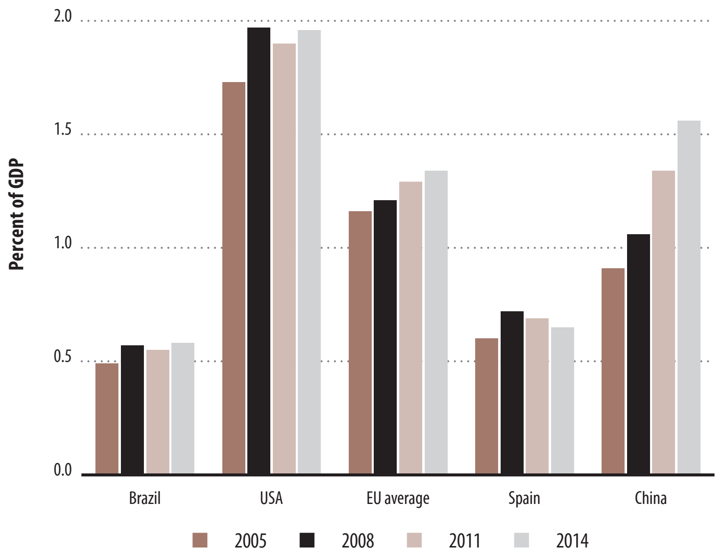
Outcomes and challenges

In terms of innovation policies and the engagement of society in knowledge production, it is possible to conclude that Brazil has achieved important advances in the last decade. One indication of this broader coverage of the policies appears in the latest Brazilian innovation survey.[7] The survey indicates that the share of innovative companies reporting having received public support to innovate has reached about 40%, compared with around 20% in the early 2000s.

The framework of Brazilian innovation policies is broader than it used to be. When it comes to their effectiveness, the results are not so clear. Different researchers in the country have carried out some studies to evaluate the effectiveness of several of these policies.[8] These evaluations, however, are not regular and systematic and are not frequently used by the government to redesign the policies. To some extent Brazilian innovation policies have been known to inspire good examples around the world, although the policy design should eventually be improved. Some studies also suggest that some of the policies adopted are not crowding out but are instead stimulating private investment in R&D.[9] Tax incentives from The Good Law, for instance, have been evaluated by several researchers.[10] The results from these studies, as well as testimonies from several Brazilian industrial leaders, suggest that the effects of this incentive are relevant for Brazilian industry. However, several other policies need much better evaluation.

Indeed, improving the evaluation of innovation policies in Brazil

Figure 1: Business R&D investments (BERD) as a share of GDP, Brazil and selected countries (2005, 2008, 2011, and 2014)



Source: IBGE, 2016; OECD, Innovation in Science, Tewchnology and Industry database, available at http://www.oecd.org/sti/inno/, accessed February 2017.

Note: The European Union member states are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

is crucial, especially in terms of data transparency and accountability. The agencies responsible for supporting innovation should be more committed to evaluation and to the creation and disclosure of indicators and data on the policies. The ministries and public agencies responsible should provide incentive for the creation of some key performance indicators to evaluate the policies under their responsibility. Reinforcing transparency and accountability is, in fact, the only way to improve the assessment of the results of innovation policies.

A more in-depth evaluation could help with an understanding, for example, why—despite the creation and consolidation of several public policies for innovation—overall Brazilian performance on several innovation indicators is still lacking in efficacy. The country's position in the Global Innovation Index (GII) is not improving over the years. On the contrary, in 2011, Brazil held 47th place in the GII rankings; in 2016, the country ranked 69th.[11]

Figure 1 shows business R&D investments (BERD) as a share of GDP. The stability of the Brazil's performance over the years, especially after 2008, is evident. Compared to the performance of most other countries, the country is clearly lagging behind.

Why is this happening? Despite all the efforts that have been made in terms of public policies, why are the aggregate results of the country still weaker than expected? According to De Negri, part of this can be explained by the decrease of industry's share in GDP, since this sector is responsible for a great share of total R&D investment in the country.[12] There are other relevant constraints, however, that prevent the Brazilian economy from becoming more innovative; these constraints equally affect industry and agriculture.

The first obstacle is a very bureaucratic and rigid business environment. One of the indicators of such an environment is the time necessary for an entrepreneur to start a new business: in Brazil, this is more than 100 days. To answer to the demands of the market and to create new products and processes to meet these demands, agility and flexibility are crucial. It is not by chance that the institutional dimension is where Brazil has the worst GII scores. Even worse, the indicators on this dimension show no improvement over the last few years. That is a serious deficiency for the country, and it is time to address it.

The second relevant factor hindering the country's innovation performance is competition and integration with international markets. To foster competition, it is important for Brazil to build an economy that is more integrated in global value chains and international markets. The country needs to foster internationalization—not only in terms of goods and services, but also in terms of knowledge, ideas, and human capital.

Finally, there is a need for readily effective and focused public policies. In spite of the fact that some policies are relatively well evaluated, the country still has to make them more mission-oriented than before. One of the gaps apparent in the Brazilian innovation system is the lack of interaction between universities and research centres, on one hand, and companies on the other. It is necessary to build instruments able to integrate scientific production, knowledge, and technologies with the greater needs of Brazilian society.

In this regard, the innovation system in Brazil's agriculture sector is a great example to follow.

Fostering technologies for agriculture and food production: The challenges ahead

In addition to improving the business environment and building a more internationalized economy, one of the major challenges for Brazilian innovation policies is their ability to promote, in a more intensive way, a kind of R&D geared to the greater needs of Brazilian society—research that is sometimes called 'mission-oriented R&D'. The agriculture sector in Brazil is one of the best examples of how to support mission-oriented R&D.

Throughout its history, Brazil has established a broad and competitive R&D system focused on the agriculture sector. The National Agricultural Research System (SNPA), established in 1992 by ordinance of the Ministry of Agriculture, Livestock and Food Supply, has been able to develop technological innovations that were critical for agribusiness expansion in the country. From more resistant and productive seed varieties to new cultivation techniques, the technologies developed by the SNPA made it possible to grow soybeans in the Brazilian Cerrado.

The system includes institutions such as the Brazilian Agriculture Research Corporation (Embrapa), the State Agricultural Research Organizations (OEPAS), universities, and federal and state research institutions as well as other organizations related to agriculture research. The Agronomic Institute of Campinas (IAC), for instance, founded in 1887, is one of the oldest research institutions in the country and one of those responsible for developing several agriculture technologies. The entire system comprises a very diverse set of institutions—each with several different characteristics and roles—that work together to sustain a virtuous process of innovation in agriculture sector.

Embrapa, a public research institution founded in 1973 under the stewardship of the Ministry of Agriculture, Livestock, and Food Supply, plays a leadership role in this system. Currently, the institution counts on a budget of around 3 billion Brazilian reais (R$) and more than 9,000 employees. It operates through 46 decentralized research units spread out in almost every state in the country. The research portfolio of the agency includes projects such as (1) diagnosing the physical, chemical, and microbiological quality of soils; (2) identifying and mapping weeds resistant to herbicides; (3) using geotechnologies (such as those that map rainfall); and (4) conserving plant growth–promoting microorganisms by working with biological nitrogen fixation and other mechanisms.

Embrapa is also known for its strong use of intellectual property protection and has served as a model for other centres on how to manage technology and technology transfer to other companies and institutions. Embrapa´s Technology Transfer Office staff is recognized as a group of well-trained and competent professionals and Embrapa is among the top patent applicants in the country.

One of the main advantages of this system is its proximity and close relation to farmers, which allows it to provide them with the necessary solutions to their problems. It has proved to be very successful in providing Brazilian farmers with new technologies in areas such as genetic engineering, soil improvement and correction, plant and animal breeding, livestock technologies, and so on. However, some researchers are pointing to the risk that the country will lose technological leadership in several areas in which it has already had a strong influence, falling behind the technological frontier in agriculture. The main challenges in this regard are the human capital and scientific competences in agriculture research. To overcome this risk, Bonacelli et al. suggest an urgent reorientation of policies for agriculture that takes into account new technologies and new scientific competencies.[13]

This reorientation is even more important in face of new trends and challenges in agriculture technologies. Improvements in agricultural productivity and sustainability nowadays depend much more heavily on industrial technologies provided by the agricultural inputs industry than ever before. The *Business Insider Review,*[14] for instance, as well as other technological publications,[15] have listed some of the main emerging agriculture technologies over the next several years.

Sensors are making farms smarter and more connected, which enables real-time traceability as well as the diagnosis of crop and soil conditions, and the monitoring of livestock and farm machinery in real time. Sensors can be useful in several types of situations. Collars with chips and biometrics can identify and monitor vital information about livestock in real time. Crop sensors could prescribe the correct amount of fertilizers to apply to a specific site at a specific point in time, and this information could be sent directly to the application equipment.

Information technology can connect all the machinery and sensors in a farm to provide real-time information and to adopt the measures necessary to solve several kinds of problem. The adequate treatment of the vast amounts of data from crop yields, soil-mapping, fertilizer applications, weather data, machinery, animal health, and so on can make farms much more efficient than before.

Precision agriculture will enable farming management based on observing all these kinds of data and providing adequate answers. Besides that, 'further understanding of crop variability, geo-located weather data and precise sensors should allow improved automated decision-making and complementary planting techniques'.[16]

The food processing industry could also benefit greatly from genetic engineering to create 'new strains of food animals and plants in order to better address biological and physiological needs'.[17] Automation continues to be an important tool for improving agriculture productivity. Nowadays automation also implies using drones, robots, machine learning, and Internet of Things (IoT) technologies.

There are several examples of these technologies that are already developed or in development in Brazil. Embrapa, for instance, has developed the 'electronic tongue' (a conductive and lipid-based sensor for the taste evaluation of beverages) and an irrigation sensor that informs the producer about the need for water in the soil. The combination of sensors and information technologies is the focus of a product developed by a start-up company that allows consumers to track the origin of meat. Another Brazilian company is developing solutions for topography, pest detection, and cattle counting using drones.

The fact that most new agriculture technologies are coming from the input industry—including machinery, agriculture chemical, animal genetics, seeds—demonstrates the enormous challenges faced by the agricultural research system, both in Brazil and in general. Although it has the biggest tropical agriculture industry in the world, until now Brazil has not been able to take advantage of this large-scale production to create a competitive and internationalized input industry. In fact, despite having produced several important technologies for the agriculture sector, there are few internationally competitive Brazilian companies in either the food production chain or in the agricultural input market. Indeed, in the list of the major food-processing companies in the world, there is just one Brazilian company, which is in the meat industry. The Brazilian international presence in the agriculture input industry—such as crop seed/biotech, agricultural chemicals, animal health and breeding, and farm machinery industries—is also not as relevant as it could be given the size of its agriculture sector.

Moreover, increasing global market concentration in the agriculture input industry—as noted by the United States Department of Agriculture (USDA)—implies that fewer firms are now responsible for many of the innovations that result in growth in agriculture productivity.[18]

Conclusions

For Brazil to play a leading role in the most important technological trends in agriculture today, it is vital that the country place the technologies of industry and services at the service of agriculture. Thus, from the perspective of CNI and Sebrae, some challenges faced by Brazilian agriculture need much more attention from public policies and the agriculture research system. These challenges are related, among others, to determining the best way to:

- intensify the adoption of precision agriculture and zootechnics, genetics, geo-technology, big data, robots, drones, and artificial intelligence;
- increase the use of sustainable production processes;
- incorporate low-cost technologies, product innovations, and business model innovations into family agriculture; and
- intensify the use of software and mobile applications to support business management in the areas of logistics, farm finance, traceability, weather information, e-commerce, and cooperative organizations´ management.

The challenge presented by these trends is to make it possible for smallholders as well as large farms to access the new technologies so that they too can benefit from the promise of productivity and quality offered by these innovations. Several of these technological trends and challenges also constitute opportunities for small business, especially in the service sector. The implications for the Brazilian innovation system in agriculture are huge. They demand a new vision with policies oriented towards fostering innovation in agriculture to prevent the country from being relegated to only using new technologies instead of also generating them.

It is necessary, for instance, that the government continue to sponsor research to develop and deliver new technologies to Brazilian farms. To address the challenges above, it is also necessary to integrate agriculture needs with industry and services inputs. To provide just one example, the European Union, under the umbrella of the Horizon 2020, is sponsoring projects that look at the feasibility of bringing cost-effective precision farming tools from the laboratory to the farm.[19]

Besides designing more focused innovation policies, it is vital to solve some of other challenges mentioned earlier. Reducing bureaucracy and improving the business environment could be an important boost to the generation of new ideas and the creation of new businesses that could take advantage of the huge size of the Brazilian agriculture market. It is also imperative to look abroad and be connected to the main trends in agriculture research, which implies modernizing and internationalizing Brazilian research institutions and companies.

Notes

1 This table was extracted from Zuniga et al., 2016, p. 63; it is the only known attempt to systematize in a single table all the public policies for innovation in Brazil. Unfortunately, they have not updated the data.

2 Zuniga et al., 2016.

3 De Negri, 2015, p. 2.

4 CNI, 2016.

5 Zuniga et al., 2016.

6 Brazil's technical norms for food and beverage production are regulated by ANVISA (Agência Nacional de Vigilância Sanitária).

7 This survey was conducted by the Instituto Brasileiro de Geografia e Estatística. See IBGE 2016.

8 Zuniga et al. (2016) mention a few of these studies. The main institutions producing evaluation studies in Brazil are the Institute for Applied Economic Research (IPEA), the Center for Strategic Studies and Management (CGEE), and some universities such as Unicamp.

9 Zuniga et al., 2016.

10 Zuniga et al., 2016.

11 CNI, 2016.

12 De Negri, 2016.

13 Bonacelli et al., 2016.

14 Zappa, 2014.

15 See also Leclerc, 2016.

16 Zappa, 2014.

17 Zappa, 2014.

18 Fuglie et al., 2012.

19 For information about the European Union's Horizon 2020 programme, see https://ec.europa.eu/programmes/horizon2020/.

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Mobilizing Science, Technology, and Innovation to Transform Japanese Agriculture

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The agricultural sector in Japan is currently undergoing drastic changes. A comparison of statistical data for the years 1980 to 2016 shows that gross agricultural production decreased from 10.3 trillion yen to 8.8 trillion yen, agricultural land decreased from 5.46 million hectares (ha) to 4.47 million ha, the working population in the agricultural sector decreased from 6.97 million to 1.92 million, and the food self-sufficiency rate decreased from 53% to 39%, indicating a clear contracting tendency for agriculture in Japan. Moreover, the total area of farmland that has been abandoned because small-scale farmers quit or did not have a successor has increased from 123,000 ha to 284,000 ha, and the average age of farmers has greatly increased—reaching 66.8 years old in 2016. As a response to these trends, there has been an accumulation of agricultural land for specific core farmers,[1] a trend that is expected to continue. Japanese agriculture is thus drastically changing from small-scale farming to large-scale farming with fewer workers. However, complex farmland structures with numerous small independent farms still remain in many places, making the productivity of agriculture in Japan low compared with that of other developed countries.

Japanese agriculture: The current state and policy objectives

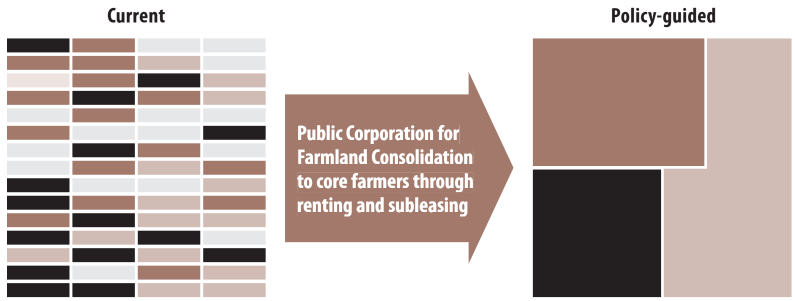
In 2013, the Japanese government initiated the Japan Revitalization Strategy, a new growth strategy to overcome two decades of economic stagnation since 1990. With regard to agriculture, the government stated that its objective was to make agriculture, forestry, and fishery a growing industry, and it set key performance indicators (KPIs) (Box 1), such as an increase in the ratio of farmland used by business farmers to 80% in the next 10 years (ending in 2023). In order to achieve this objective, the government established a new organization called the Public Corporation for Farmland Consolidation to Core Farmers through Renting and Subleasing in 2014 (Figure 1). This organization rents separated small areas of farmland or uncultivated land from quitting farmers and consolidates small areas, if needed, to provide large-scale farmland for core farmers. In 2015, the farmland area utilized by core farmers increased by 80,000 ha,

Box 1: Key performance indicators for agriculture in the Japan Revitalization Strategy

- Increase the ratio of farmland used by business farmers to 80% in the next 10 years (ending in 2023); this was 48.7% as of the end of Fiscal Year 2013.
- Reduce the cost of rice production by business farmers by 40% in the next 10 years (ending in 2023) over the current national average cost, including through efforts by industry on aspects of materials and distribution. The national average cost of rice production in 2011 was ¥16,001/60 kg.
- Increase the number of corporate farmers fourfold from the 2010 level to 50,000 in the next 10 years (ending in 2023). In 2010 there were 12,511 farming corporations.
- Expand the size of the agriculture sector based on the collaboration of primary, secondary, and tertiary sectors of the economy (called the 'sixth industrialization of Agriculture, Forestry and Fisheries') to ¥10 trillion in 2020.
- With regard to dairy farming, increase the number of projects to promote collaboration among the primary, secondary, and tertiary sectors to 500 by 2020.
- Increase the value of exports of Agricultural, Forestry and Fishery products and foods to ¥1 trillion before 2020, the initial target year.

Source: Japan Revitalization Strategy, 2013; see http://www.kantei.go.jp/jp/singi/keizaisaisei/pdf/en_saikou_jpn_hon.pdf.

Figure 1: Farmland consolidation through public corporation



Source: Based on MAFF, with permission, available at http://www.maff.go.jp/j/keiei/koukai/kikou/attach/pdf/index-39.pdf (in Japanese).

Note: Because the average age of farmers has greatly increased and small-scale farmers have been quitting, the accumulation of farmlands to core farmers is in progress. In many cases, small farmlands are separated and so cannot be used by core farmers, thus inhibiting the improvement of productivity. To solve this problem, public corporations that rent farmland from quitting farmers and sublease to core farmers are established in each prefecture. Under this scheme, farmland owners will be paid by the corporation, and the corporation will consolidate the small farmlands into one large area, which it subleases to core farmers.

indicating that the accumulation of farmlands to the core farmers is progressing properly.

To promote the transition to large-scale farming, Japan's agricultural land law was amended to ease regulations for possession of farmland by a farming company (the new law was implemented on 1 April 2016). Of the four conditions (company style, business style, constituent members or voting rights, and board members) required for companies to own farmland, the last two were eased, allowing farming companies to be scaled up. The new law eases the promotion of investment into farming companies, which is expected to eventually make Japanese business farms larger. This will contribute to reaching another KPI formulated in the Japan Revitalization Strategy: 'Increase the number of corporate farmers fourfold from the 2010 level to 50,000 in the next 10 years (ending in 2023)'.

Another KPI in that strategy is a reduction by 40% of the cost of rice production by business farmers in the next 10 years (ending in 2023) compared with the current national average cost,[2] including through efforts by industry on aspects of materials and distribution. It seems to be difficult to reach this number using only policy tools. Investment in research and technology development is critical in this circumstance.

Since the structure of Japanese agriculture is evolving to large-scale farming, technology that supports this transition is needed. Two main technical problems face this trend in land use–based agriculture. First, automation technology for farm operations is needed to expand the limit of farmland use per person, which is critically important for large-scale farming. Second, the establishment of an efficient farm management system is needed for appropriate farm work plans to enable the management of many separated small-scale farms with multiple crop varieties to spread out harvest timing.

In fact, the Cross-ministerial Strategic Innovation Promotion Program (SIP)[3]—a national program for science, technology, and innovation initiated in 2013 by the Council for Science, Technology and Innovation—aims to confront the most important societal challenges facing Japan, as well as to contribute to the resurgence of the Japanese economy. The SIP has become a powerful tool to address these challenges. Indeed, the project entitled 'Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries'[4] is among 11 projects selected for the SIP.[5]

One of the main goals of this project is to increase the income of farmers by using innovative technology for smart farming and to enhance the value of agricultural products, working with agricultural policy making to introduce farmland structural reform, and expanding the size of agriculture-related industry (e.g., seedling industry).

The project has identified two major ways to reach these goals:

1. Incorporate robotics, information and communication technologies (ICTs), genome information, and other leading-edge technologies to produce a uniquely Japanese smart, ultra-labour-saving, and highly productive agriculture model.

2. Enhance the value of agricultural, forestry, and fishery products by developing new materials and offering distinct, functional health foods and other products, using techniques from medicine and engineering.

Finally, in 2016 the Japanese government formulated its 5th Science and Technology Basic Plan.[6] In this document, the government proposes the living concept 'Society 5.0', where ICTs, which have recently significantly advanced, will be fully utilized for the benefit of all citizens. Eleven projects in the SIP have been assigned as to explore the concept of Society 5.0, including the project

Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries.

Research on smart agriculture: An overview

Recently research deploying the Internet of Things (IoT), big data, and artificial intelligence (AI) has been galvanized. In the SIP project Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries, these novel technologies are also integrated into the research activity for developing next-generation technologies that boost the productivity of Japanese agriculture.

To establish a large-scale smart farming system for rice production, automation technology needs to be developed. An efficient farm management system for appropriate farm work plans that enable the management of many separated small farms is also needed to reduce rice production costs. In this SIP project, two types of end users are considered: core farmers with family-style farms (of about 30 ha) and company farmers with larger farms (about 100 ha).

Research is being carried out to develop cultivation techniques based on automatically driven farm equipment, an automated water control system for paddy fields, a farming assistance system based on space assessment information, a precise automated fertilization system with sensing soil fertility for each farm, and a farming plan simulation system that enables efficient farm work in many small separated farms. Research is also being carried out to develop ground-breaking varieties of crops—such as crops with super high productivity, using various techniques such as genome-editing technology—and to enhance the value of agricultural products based on scientific evidence for health (brain function and body locomotive function, etc.). By developing these technologies, the area of farm land per person is expected to expand from 12 ha to about 24 ha, thus removing factors limiting farm size for core farmers.

These technologies include an automatic driving system for farm equipment that is expected to contribute to the expansion of working farmland per person by using geometric space information generated by precise Global Positioning System (GPS) technology. This will enable work to be done at night as well as performed simultaneously by multiple types of equipment. Automatic driving systems for tractors and unstaffed work system products (with human monitoring) will be put on the market by 2018, when the Quasi-Zenith Satellite System service will become available. Moreover, an unstaffed automatic driving system with remote monitoring that can cross fields is under development and expected to be ready by 2020. Ensuring that safety guidelines are met is an ongoing effort of the Ministry of Agriculture, Forestry and Fisheries. A first-of-its-kind system for working large fields was developed successfully in 2016. Four automatic robot-tractors are used in this system to boost work efficiency. These tractors can work together with location error of less than 4 centimetres. Although tractor systems for large fields in Western countries have adverse effects on plant growth because of the high pressure exerted by tractors on the soil, the Japanese system does not have this problem, and farm work plans can therefore be designed to be flexible by changing the number of tractors being used.

To control water in paddy fields, farmers manually change the water level by using valves. Developing labour-saving technology is therefore needed. Core farmers have to manage many small areas of farmland that have been abandoned by small-scale farmers. Core farmers plant different varieties of rice to distribute the harvesting timing, resulting in a significant increase in the burden of water management. To address this issue, research is now being conducted to develop an automated remote-controlled water control system. Automated valve-controlling equipment with a water-level sensor and networking equipment for wireless control have so far been developed. Water level–sensing data are stored in a cloud service, and farmers can remotely monitor these data and set the desired water level with a smart phone or tablet. This technology enables a 50% to 90% reduction in labour required for water control, which accounts for about 30% of rice paddy farm work. The technology is therefore expected to contribute to a significant increase in the area of farmland that can be used per person.

Technologies for an automated multi-robot tractor system or automated water control system for paddy fields need farm work plans based on precise farmland information such as specific data on crop growth, climate, water level, temperature, and so on. In the SIP Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries project, technologies for collecting data on crop growth (nitrogen content, chlorophyll content, etc.) and soil fertility from many small separated farmland areas are being developed to maximize appropriate harvest timing and efficient fertilization. Satellites or drones are used to obtain these data. A system that generates maps over an area of 3,000 square kilometres for a crop's protein content or the appropriate harvest timing for rice has been developed. Farmers or farming advisors can obtain information at any time from this system by using a tablet or smart phone. The information enables quality control of products, and the system has been used for a branding strategy for local rice labels such as 'Seiten no Hekireki' in Aomori Prefecture and 'Tuya Hime' in Yamagata Prefecture. Research is also being conducted to develop a sensing system that uses a drone equipped with a spectroscopic sensor or thermal imaging sensor and a controlling module. Information about visible light, near-infrared light, or thermal infrared light can be used to estimate nitrogen content, chlorophyll content, photosynthesis activity, and water stress. Based on this information, a diagnostic algorithm for accurately estimating plant growth is now being established.

Information about farmland such as data on plant growth, soil fertility, and climate data obtained by various sensors must be appropriately selected and processed before providing the results to farmers. Therefore a system for managing many farmlands that integrates and processes information from multiple systems and generates a farming plan according to each farmer's strategy is now being developed. Elements of this system—including technologies such as an automatic driving system, an automated water-control system, and a farming plan simulation system—have been integrated into a single package of technologies and introduced to representative farmers in Chiba Prefecture. This enables the optimization made possible by using multiple technologies that comprise a single system and assessment of integrated technologies from the viewpoint of management. This approach is also effective for obtaining feedback from users, which can lead to practical improvements of the integrated technologies. The newly developed technologies are expected to be used widely by Japanese rice farmers.

Many types of sensing systems for obtaining climate information on soil fertility, water level, temperature, and so on in paddy fields are connected to the Internet, and numerous data collected by these sensing systems will be accumulated in cyberspace. A data platform will be established and a huge amount of data about paddy fields will be available to everyone. These data can be analysed by AI or other tools, and data obtained every year will be utilized for further advanced cultivation technology.

In the field of horticulture, for example, environmental information—such as information on temperature, humidity, and CO_2 concentration inside a solar-powered plant factory—are collected by sensors connected to the Internet. These data are analysed together with biological data inside the tomato fruit obtained by cyclopaedic analysis of gene expression, metabolites, or other biological data. These integrated data will be utilized for environment control programmes to optimize the cultivating environment for tomatoes and other crops, enabling maximization of crop yield and controlling its quality to meet market requirements that may change on a daily basis. This novel technology will also be used to analyse the know-how of excellent farmers. Their techniques will be digitalized and provided to young farmers who have less experience with cultivation. These novel trials will enable a smooth transition of the cultivation techniques of experienced farmers to young farmers, and this is expected to help the Japanese agriculture industry to be competitive in the international market.

The future of crop breeding: Utilizing genome-editing technology

Recently, in addition to traditional breeding techniques, genome-editing technology that assists in making precise and targeted changes to the genome of living cells has been greatly advanced (the most significant of these techniques is the CRISPR/Cas9).[7] This is expected to be a driving force for the development of ground-breaking crop varieties that cannot be achieved by traditional breeding techniques, and is predicted to accelerate the development of new varieties with high capacity.

In the SIP's Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries, studies with mutagenesis induced by heavy ion beams or other mutagens have been carried out to elucidate specific genomic loci that are responsible for production traits and to apply them for developing new ground-breaking varieties. The SIP project has already obtained null-segregant rice plants in which genes responsible for grain size or number have been edited. These plants can contribute to the ground-breaking variety with super high yield.

In the near future, the isolation and characterization of useful genes that are responsible for the translocation of nutrient compositions will enable the development of more productive varieties with greater yield. In tomatoes, genes responsible for gamma-amino butyric acid (GABA) content and parthenocarpy or other traits are now being edited to create varieties that are free from the need for artificial pollination or have a high GABA content in order to reduce the farmer's hormone processing cost (for pollinating the plants) or to enhance the value of the products. Other major crops such as wheat, soybeans, potatoes, and so on have also been investigated as possible candidates for optimizing genome-editing conditions or creating ground-breaking varieties.

Because the CRISPR/Cas9-based technology and other existing genome-editing technology, such as TALEN-based technology, have already been patented mainly by universities in the United States of America and Germany, research is also being conducted to develop Japanese genome-editing technology. Technology that induces point mutations in the targeted genes, such as target-AID (activation-induced cytidine deaminase),[8] as well as technology utilizing a pentatricopeptide repeat (PPR) motif,[9] which can be designed to bind any specific DNA/RNA site, are under development. These technologies are also being examined for creating ground-breaking crop varieties, and they constitute an integral part of the SIP project. Internationally competitive crop varieties and agricultural products based on these technologies will be developed in the near future and will contribute to an increase in exports of Japanese agricultural products.

Living modified organisms (LMOs) are regulated by multiple laws in Japan, but primarily by the law on biosafety—the Law Concerning the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms—which has been enacted to 'ensure the precise and smooth implementation of the Cartagena Protocol on Biosafety to the Convention on Biological Diversity'. In this Law, 'LMO' is defined as 'an organism that possesses nucleic acid, or a replicated product thereof, obtained through technologies for the processing of nucleic acid extracellularly or technologies for fusing of the cells of organisms belonging to different taxonomical families'.[10] Genome-editing technology can edit intended specific genomic sites without external nucleic acid or trace marks. Therefore there is no consistent decision as to whether genome-edited crops are subject to regulation or not. Considering this situation, research is also being conducted to develop a method to prove that the genome-edited crops do not possess extracellularly processed nucleic acid; methods for promoting consumer acceptance based on benefits are also being considered. Thus there is cooperation between administrative work and technology aiming at public acceptance of genome-edited agricultural products.

Conclusions

In the SIP project Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries, research on smart agriculture—especially research concerning rice production and the development of ground-breaking varieties—are ongoing towards the KPIs stated in the Japan Revitalization Strategy. By combining novel varieties that respond to consumers' needs with next-generation cultivation technology that utilizes ICTs and other cutting-edge technologies, the productivity of Japanese agriculture is expected to be greatly enhanced. These state-of-art technologies could also be introduced to developing countries, and are expected to contribute to tackling the global food supply problem in the future.

Notes

1 'Core farmer' is defined in Japanese agriculture policy as an 'efficient and stable farming management body such that the main workers' lifetime income and labor time are at a level similar to that of workers in other industries'.

2 The average cost of rice production in 2011 was 16,001 yen per 60 kilograms.

3 See http://www8.cao.go.jp/cstp/panhu/sip_english/sip_en.html.

4 For more information about the Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries project, see http://www8.cao.go.jp/cstp/panhu/sip_english/42-45.pdf.

5 The 2016 budget for the SIP Technologies for Creating Next-Generation Agriculture, Forestry and Fisheries was 2.925 billion yen. Other SIP projects and their budgets (billion yen) in 2016 are as follows:

- Innovative Combustion Technology: 1.9
- Next-Generation Power Electronics: 2.41
- Structural Materials for Innovation: 3.758
- Energy Carriers: 3.49
- Next-Generation Technology for Ocean Resources Exploration: 4.66
- Automated Driving System: 2.713
- Infrastructure Maintenance, Renovation, and Management: 3.156
- Enhancement of Societal Resiliency against Natural Disasters: 2.33
- Innovative Design/Manufacturing Technologies: 2.19
- Cyber-Security for Critical Infrastructure: 2.5

6 See http://www8.cao.go.jp/cstp/english/basic/5thbasicplan.pdf.

7 This technique uses RNA-guided endonucleases known as Cas9 from the microbial adaptive immune system named CRISPR (clustered regularly interspaced short palindromic repeats), which can target any genomic loci specified by short guide-RNA. See Hue et al., 2014, for more details.

8 Nishida et al., 2016.

9 Yagi et al., 2015 and Yagi et al., 2014.

10 See https://www.env.go.jp/en/laws/nature/law_ccsubdrlmo.pdf.

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Technological Future of the Agriculture and Food Sector in Russia

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The global agriculture and food sector is changing rapidly because of the intensive increase of global food demand, which is in turn the result of population growth and significant shifts in consumer preferences. There is a clear need for improvement in the sector's technological, infrastructural, and institutional basis to ensure its sustainable development.

The situation is further aggravated by a number of environmental issues, including the degradation of ecosystems, biodiversity loss, and the deterioration of soil and sea productivity. Climate change leads to growing pressures on the agricultural productive areas and on the world's oceans. In the long term, there are significant risks of fertilizer deficits due to depletion of mineral deposits. Furthermore, declining pesticide efficiency due to the inability of agrichemical science to keep up with the pace of pests' evolution is an unfolding trend with serious implications. This creates risks for the globalization of agri-food trade, and it leads to a resurrection of 'food nationalisms' and intensifying economic vulnerabilities associated with the globalized trade.[1]

Unfortunately, the new wave of technological advances (such as biotechnology, artificial ecosystems, circular agriculture, precision agriculture, robotics, smart logistics, and landless food production through the direct chemical synthesis of nutrients) rolls out rather slowly in many parts of the world. This is the result of a shortage of investment, political/societal/religious hostility to radical technologies, and inadequate labour force competences. Less expensive, yet highly effective, technological innovations and entirely new mechanisms for their promotion are required. The latter include the redesign of existing government policies related to science and technology (S&T), innovation, entrepreneurship, industrial organization, competition, and investment.

Having abundant land resources and significant industrial, S&T, and educational capacities, the Russian Federation (Russia) will, most probably, play an important role in combating the global challenges outlined above. To achieve this, however, the country will need to continue its reforms of the agriculture and food sector so that it becomes able to generate and absorb technological and organizational innovations more efficiently.

Implications of global challenges

In today's deeply internationalized economy, global challenges are important elements of the strategic agendas of national agriculture and food sectors, although some national priorities are determined solely by domestic factors. The global challenges affecting the agriculture and food sector could be categorized, rather generally, into environmental, social, economic, political, and axiological (related to the values foundations of societies).[2] However, most of the challenges and trends, in terms of their causation, are mixed by nature.

First of all, a growing discrepancy between the dynamics of food demand and supply makes the future of agriculture rather difficult to predict. Rates of agricultural productivity growth are declining because there is now a 'technology pause' between the 'green revolution' and the emergence of future production systems, which promise to be highly efficient, agile, autonomous, and isolated from the natural environment.[3]

The authors acknowledge the technical assistance provided by Elena Tochilina and Irina Loginova, who greatly helped in preparing this chapter.

The chapter was prepared within the framework of the project 'Study of Global Technology Trends: Development of Quantitative Approaches for Trend Analysis' of the Basic Research Program at the National Research University Higher School of Economics (HSE) and supported within the framework of a subsidy by the Russian Academic Excellence Project '5–100'.

The interlinked environmental challenges—which affect (and are partially produced by) the agriculture and food sector and threaten the stability of the world's food supply—further aggravate the global food problem. As mentioned earlier, they include climate change, soil degradation, decreasing bioproductivity of the oceans, biodiversity loss, groundwater scarcity and contamination, reduction of the effectiveness of agrochemicals due to evolution of pests,[4] and the long-term threat of exhaustion of mineral resources for fertilizers, among others. Therefore the trend of declining productivity growth rates can even evolve into declining overall production with dire consequences for the food security of developing nations.

There are also a number of socioeconomic and values-based challenges. Among them are economic globalization and the volatility of global food markets affected by new, non-food uses of agricultural products, such as biofuels; the growing polarization of food consumption patterns as a result of income, cultural, and educational gaps; the transformation of the demand for labour in agriculture, which threatens the sustainability of the rural lifestyles; growing biosafety threats against the backdrop of the rise of 'garage biotechnology', or amateur biotech endeavours; risks to arranging guaranteed continuity of food supply for megacities and broader urban agglomerations; and many others.

The answers provided by S&T and innovation to the global challenges are expressed in terms of the rise of new platform (universal, or convergent) technologies.[5] The developed nations demonstrate the rapid progress of radically new technologies (new generation sequencing, bioreactor-based synthetic food production,[6] total recycling, biocontrolled and artificial agroecosystems, vertical farms, swarm robotic intelligence, etc.),[7] while the developing ones are still engaged in the adoption of the technologies of the previous wave (genetically modified crops, drip irrigation, and so on).

S&T and innovation processes are enabled by accompanying new business models made possible by modern information and communication technologies, which dramatically reduce both food losses and transaction costs in agriculture and food logistics. The diffusion of convergent technologies—including combinations of high-performance computation, broadband networking, and near-real-time data flows from satellites and aerial vehicles—seems to be one of the most important drivers of these organizational innovations.[8]

In parallel, technology development creates certain threats of large-scale disruptions for developing countries. These could be beneficial in the long term and on the global scale, but are harmful to short-term economic stability and food security at the national level. There are numerous 'wild cards' (or 'black swans') of this sort that refer to structural shifts with low probability but high impact for the agriculture and food sector.[9] The diffusion of genetically modified organisms (GMOs) in global crop production and aquaculture could make exports of the non-GMO countries uncompetitive and damage their trade balance. Shifts in the natural habitats imposed by climate change can cause unexpected panzootic events, which are negative for the animal husbandry sector. Synthetic food technology commercialization can radically shift the demand-supply balance for factors of production, such as agricultural land, resulting in financial turmoil in some countries.

It is particularly important to distinguish the opportunities and threats on the national level that are emerging from global challenges. Because of Russia's circumstances and location, the global food problem, climate change, and the development of radical technologies tend to affect the country differently than the rest of the world, at least in the short term. Russia comes out ahead in this regard mainly because less technologically advanced and less industrially and institutionally developed countries often lose from global innovation in the short run, when they lose rents associated with inexpensive exports.

The global food problem is constituted of the global demand for food rising above limits of sustainable supply.[10] It poses tremendous challenges to sustainable development, creating the risk of extreme famine events in Africa and South East Asia.[11] For Russia, with its vast land and water resources, the rising global demand for food provides a chance to establish itself in new international agriculture and food markets in circumstances when the markets of developed nations, being divided between producers from the United States of America, the European Union, Brazil, Canada, and Australia, are virtually closed for the country's exporters.

Climate change, being disastrous for most subtropical and tropical agriculture and food producers because of higher frequencies of droughts, tsunamis, floods, and other extreme weather conditions, affects mostly non-agricultural areas of Russia, such as its Arctic regions. The impact of climate change on the main agricultural regions in chernozyom (fertile black soil) and grey wood soil zones is mild and mixed, though the scientific consensus on the long-term net effects for Russia's agriculture has not yet been reached.[12]

Diffusion of many promising technologies, such as genetically modified crops associated with much lower production costs, presents both opportunities and threats for the Russian agriculture and food sector—which is an established grain and oil seed exporter with a very conservative political stance towards GMOs. Recent progress in aquaculture (including recirculating aquaculture systems and plant-based fish feed) promise substitution of traditional, inefficient, and environmentally harmful sea fishing practices. In Russia, aquaculture technologies are quite underdeveloped, although its fisheries sector is one of the largest in the world. This situation creates economic threats to sectoral businesses in the northern and far eastern regions of the country.

In general, the described pattern is caused by excessive reliance on extensive production factors as a result of quite favourable natural prerequisites and insufficient attention to longer-term competitiveness factors related to progress in technology.

The Russian agriculture and food sector is sensitive to the situation in global markets of both the means of production (machinery, biomaterials, etc.) and the final products (grain, milk, meat, etc.). The capacity to both absorb foreign and domestic knowledge and to produce domestic innovations will be crucial to successfully facing the global challenges. Intensive investment and new initiatives in this field are needed for the agriculture and food sector to become more resilient. It must have less reliance on imported technologies, genetic material, veterinary drugs, fine biochemical and chemical substances, and less dependence on exports of agricultural raw materials rather than food products with high added value.

The status of the Russian agriculture and food sector

Russia is one of the world's largest producers of food products (e.g., grain, oil seed, and meat). Its output reached US$80 billion in 2015, with exports of US$16.2 billion. This sector has shown remarkable stability during the economic turbulence of recent years. Although the national economy has experienced some stagnation effects since 2014, the agriculture and food sector demonstrated steady growth rates of 2% to 3% per year, and the share of loss-making agricultural companies has continued to shrink, becoming significantly lower than that in many other sectors of the economy. Nowadays this sector is an important pillar of political stability on the national level, which is highly dependent on the wide availability of affordable food of good quality. Russia is almost self-sufficient in food: from 81% to 100% of internal demand for food (depending on the product category) was covered by domestic production in 2015. The agriculture and food sector is crucial for social welfare in the rural areas because it employs around 9 million people. It is anticipated that growth rates of production and exports could accelerate further because of the growing demand in developing countries of Africa and Asia for the food products that Russia produces.

Although the country has inherited a rather unbalanced and rigid agriculture and food sector from the Soviet era, post-Soviet institutional reforms allowed for the efficient reallocation of resources based on market competition and the adoption of state-of-the-art technological innovations. The optimization of supply chains was coupled with the concentration of production in the areas that were most favourable in terms of both their soil and climate conditions and their location. All these factors allowed Russia to move from the brink of famine in the late 1980s to solid food security in the 2010s, and to significantly increase agriculture and food exports.

At the same time, the overall productivity of the sector remains relatively insufficient because of the uneven penetration of new technologies and the slow diffusion of the new wave of organizational innovations, such as digitization of trading and logistics, equipment time sharing, life-long learning, and so on. These factors underpin the slow progress of production intensification across certain regions, sub-sectors, and particular types of producers.

Other challenges include low demand for innovations produced by the domestic applied agricultural research and development (R&D), as well as weak communication between the sectors of education, S&T, and agricultural business. The latter does not demonstrate substantial demand for domestic R&D and technology, while research institutes and universities have been generally unable to provide a continuous supply of ready-to-use and commercially attractive technologies (they are more and more inclined towards research that is supported by public funding but that has no specific objective or orientation).[13] Thus the positive effects of weak national currency for production and exports growth have been countered because a quick import substitution of significant part of technologies, equipment, chemicals, and genetic materials is not feasible. The challenge for domestic manufacturing of high-tech agriculture inputs, such as equipment, genetics, advanced fertilizers, and specialized information systems, is even more difficult to solve because of other barriers, such as economies of scale.

Of great importance is the sector-wide application of enabling

Figure 1: Propensity to introduce new technologies by economic entities of different types in Russia's agriculture sector

Technology to be introduced	Private farm holdings (self-sufficient farms)	Owner-operated farms/ individual enterprises (semi-commercial farming)	Medium agricultural enterprises, agricultural cooperatives (commercial farming)	Major agricultural holdings (commercial, export-oriented farming)
Organic agriculture	Medium	High	Medium	Low
Precision agriculture	Low	Low	Medium	High
Large-scale 'assembly-line' livestock breeding	Low	Low	Low	High
Zero-tillage farming	Low	Low	High	High
Loose housing of livestock	Medium	High	High	High
Drip irrigation	Low	Medium	Medium	High
Custom on-demand preparation of fertilizers	Low	Low	High	High
Integrated pest management	Medium	Medium	High	High
Urban agriculture (vertical farming)	Low	Low	Low	High
Automation and computerization	Low	Low	Medium	High
Genetically modified and hybrid seed use	Medium	Medium	High	High
Biofuels	Low	Low	High	High

Source: HSE, 2017a.
Note: Likelihood of technology introduction: High Medium Low.

technologies such as broadband digital communications,[14] the Internet of Things, global geopositioning and other satellite services, unmanned aerial monitoring, smart digital trade infrastructures, robotics, biotechnology and bioenergy, and nanotechnology and new materials. However, efficient production systems based on the state-of-the-art technologies are concentrated within a limited range of large companies, mostly in the southern regions and around the largest urban agglomerations, while small producers in other areas are not able to absorb available technology innovations (Figure 1).

An answer to such challenges can be found in the re-arrangement of the sectoral innovation system, which is notable for its poor linkages between S&T organizations and businesses. Bridging the gap between academia and industry may allow Russia to become one of the major exporters of globally competitive high-quality agricultural products, production means, and services within two decades. There is also a need for closer technological cooperation and market integration with other emerging economies, because this could allow Russia to gain access to large export markets for various means of agricultural production. No less important are further efforts to improve the domestic investment climate to attract direct investment from developed countries with gradual localization of high-tech products and technologies.

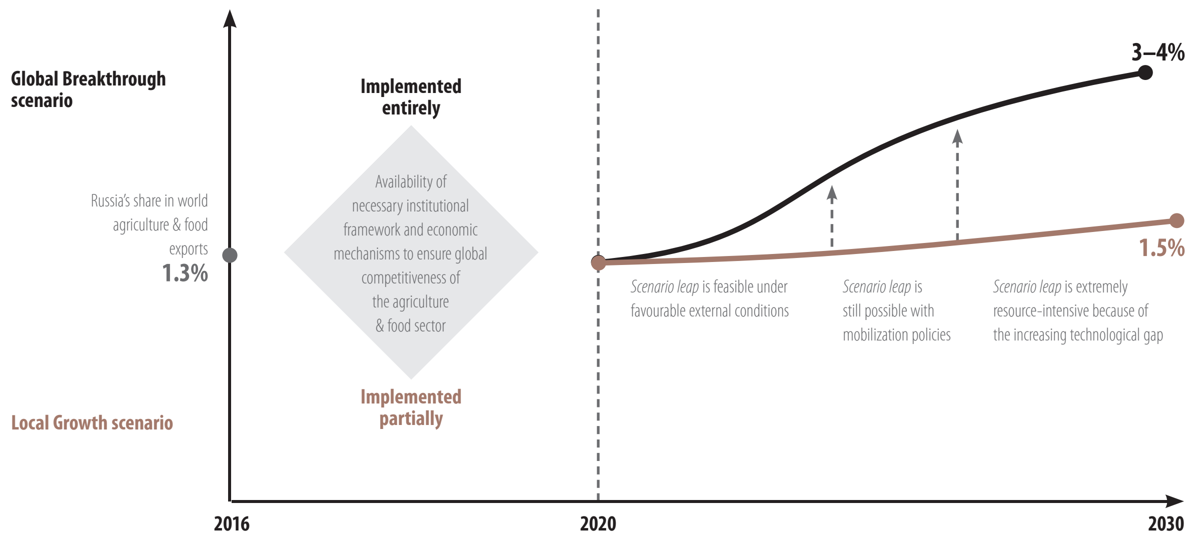
Prospects of S&T development

A complex picture of global challenges creates both threats and opportunities for Russia's agriculture and food sector. Whether Russian regulators, S&T organizations, and agriculture and food producers will be able to proactively adapt to threats and efficiently use evolving opportunities depends on the ability of different actors to clearly identify emerging global trends, map existing strengths and weaknesses, be agile in adapting the developmental strategies, and cooperate efficiently on a wide range of issues.

For the agriculture and food sector's stakeholders to become more able to participate in cooperative future-oriented capacity building, the Government of the Russian Federation set the task of developing long-term S&T foresight of the agriculture and food sector in 2015. Depending on the future evolution of various global and national trends; the composition of existing strengths, weaknesses, opportunities, and threats; and the most likely policy choices made at key threshold points—macroeconomic, institutional, and political ones—two possible development scenarios can be considered for the period from 2020 to 2030.[15]

Russia can become a global supplier of high-value-added products, technologies, and services. This is the goal of the 'Global Breakthrough' scenario. Another option is less ambitious and easier to achieve, yet also desirable: this entails saturating the domestic market with competitive domestic products and technologies—the 'Local Growth' scenario. Both trajectories are possible and may start at the same point in time from identical external conditions. The difference between the higher and the lower trajectories is determined

Figure 2: S&T development scenarios for the Russian agriculture and food sector



Source: HSE, 2017a.

by the quality of the institutional framework and economic mechanisms by the year 2020; the gap between these trajectories will grow over time, making the leap from the less favourable scenario to the more ambitious one more and more resource-intensive (Figure 2).

In the Local Growth scenario, increasing commodity prices and devaluation-driven import substitution would stabilize the economy and allow it to return to a model of intensive imports of advanced technologies, equipment, and materials and large-scale exports of agriculture and food products. By 2020, the annual growth rate of the agriculture and food sector output would achieve 3% to 4% because of expansionary monetary and fiscal policies to help improve the investment climate. There would be a steady positive growth in the amount and quality of the harvest of most agricultural crops. In the food industry, a steady increase of output is expected. There would be a decrease in the growth rates of animal farming, which is affected by both the saturation of the internal market and the existing barriers to export expansion. No significant structural changes in the sector and no intensive revitalization of national agricultural applied R&D based on cooperation with business would be expected (the level of non-public funding of agricultural R&D in this scenario could grow slightly from the current 17% to about 20%).[16] Slow import substitution of basic and traditional technologies would continue, while dependence on state-of-the-art solutions would persist. The points of growth under this scenario would be traditional commodities markets, which would not require adaptations to shifts in consumer preferences.

In the Global Breakthrough scenario, the strong growth of the agriculture and food sector would be supported by reformed S&T and innovation policies, a sound institutional environment, and an efficient innovation infrastructure and would go hand in hand with timely structural changes in production chains. Because more efficient business models and new technologies would enable highly competitive production, no export barriers would hinder the expansion of the sector. Natural resources (vast fertile lands, available water resources) and cheap yet high-quality domestically produced fertilizers would be utilized in full. The growth of the agriculture and food sector would be accelerated by 1 to 2 percentage points in relation to the Local Growth scenario. Significant structural shifts would be envisaged for S&T and innovation activities, particularly those that take place on the basis of effective stimuli for academy-industry cooperation. The share of non-public funding of agricultural R&D could reach 35% to 45%. Accelerated replacement of obsolete production facilities, tax incentives, and other benefits aimed at promoting high-tech import substitution could lead to an intensification of innovation activity. Increased competition due to saturation of the domestic market could also contribute to growth in innovation.

In addition to traditional markets, domestic producers would be able to occupy various highly profitable niches in knowledge-based services for the agriculture and food sector; among these are cutting-edge solutions in biotechnology, information

Table 1: Prospective S&T development areas for the agriculture and food sector

Traditional technologies	Emerging technologies
• Accelerated selection, seed growing, and animal breeding technologies • Traditional genetic engineering of agricultural plants and animals • Vaccines, antibiotics, and antiviral drugs for animal farming • Integrated pest management techniques and bio-pesticides • Equipment for biosafety control throughout the value chain • Technologies of compound, slow-release, and customized fertilizers • Basic precision agriculture technologies (geo-positioning, navigation, and digital maps) • General-purpose agricultural machine-building technologies • Technologies for the deep processing of agricultural and fishery materials[a] • Basic biotechnologies of food processing	• Next-generation sequencing and other advanced biotechnologies • Technologies for sustainable, circular, and organic agriculture • Advanced precision agriculture technologies (unmanned aerial vehicles, sensor networks, swarm robotics, artificial intelligence) • Equipment for urban agriculture (recirculating aquaculture, vertical farms) • Advanced waste utilization technologies, including next-generation bioenergy • Smart agro-logistics, robotic storage, and transportation systems • Technologies for the production of highly personalized and functional food • Technologies for the production of synthetic and tissue-engineered foods

Source: HSE, 2017a.
Note: a 'Deep processing' refers to the production of high-value-added products with the use of sophisticated technologies—such as producing not only flour from grain, but also extracting amino acids from grain for the purposes of biotech industry; or producing pharmaceuticals from fish-based raw materials.

and communication technologies, robotics, aerospace, remediation of natural environment, and ecosystems design (Table 1). These would allow the sector to diversify overall output and secure export revenues. Technology-supported gradual transition from cycle-vulnerable business models of bulk commodities production to those based on the creation and export of intellectual property and tacit knowledge in various forms would also contribute to the sustainable growth of the sector.

Conclusions

The Russian agriculture and food sector may be defined as stable for the time being because of the strong institutional reforms that have been implemented during the last 25 years. Post-Soviet Russia has managed to establish an effective production-distribution system in agriculture, thus deflecting the risks of acute food shortages and achieving food security. However, the current productivity level in agriculture is not yet satisfactory. Undoubtedly there is still room for improvement in the institutional design of the sector to resolve such negative issues as regional and subsectoral monopolies, administrative pressures on local businesses, high transaction costs due to deficiencies of the commodities exchange infrastructure, and so on. In addition, a number of problems concerning both the adoption of imported technologies and the development of domestic ones that would be competitive on the market need to be addressed.

Therefore the current main goal is to shift the agriculture and food sector from a sustainable production system to a sustainable innovation system. For this purpose, it is necessary to revive the sector's applied agricultural R&D capacity, making agricultural R&D activities financially sustainable. Reforms aimed at the revival of applied agricultural R&D can be implemented only by promoting close cooperation between agricultural science and business under a suitable institutional framework. Fostering the ability of the agriculture and food sector to create new knowledge and technologies and promote them to competitive markets is a necessary condition for achieving the developmental parameters of the Global Breakthrough scenario. To this end, S&T and innovation policy for the agriculture and food sector in Russia must, within several years, evolve towards an evidence-based paradigm designed to encourage intensive development, resource efficiency, and environmentally sound practices; provide targeted support for innovating companies; and suppress the opportunities of benefiting from non-innovative rents (such as land ownership) at the cost of other market actors and consumers.

The scenarios described above will assist policy makers in establishing relevant measures for the uptake of technologies by national agriculture and food producers. Development of national S&T capacities will depend on proper institutional solutions and economic mechanisms for technology transfer and innovation; a harmonious system of S&T foresight and monitoring will play important role in this regard.

Notes

1 'Food nationalism' here refers to a government stance that emphasizes import substitution and protectionism in food and trade policy, so that the country primarily targets growth in domestic production to ensure food self-sufficiency for major products, rather than importing them from international markets.

2 HSE, 2017a.

3 The mainstream technologies of the 1960s (fertilizers, pesticides, and advanced selection) that were so effective in boosting production have become obsolete in terms of their inability to enhance productivity further at the growth rates demonstrated earlier. At the same time, many new technologies are being introduced rather slowly. Thus it is likely that there are currently only a few drivers that promise immediate and radical productivity growth in the sector.

4 Hassanali et al., 2008.

5 Sokolov and Chulok, 2016.

6 Bonny et al., 2015.

7 Gokhberg, 2016.

8 Aubert et al., 2014.

9 For a discussion about these 'wild cards', see Saritas and Smith, 2011; for a discussion about 'black swans', see Taleb, 2007.

10 OECD, 2009; Godfray et al., 2010.

11 OECD, 2013.

12 HSE, 2016; Saritas and Kuzminov, 2017 (forthcoming).

13 Termed 'non-oriented research', this is an activity without clear market-related objectives.

14 Suprem et al., 2013.

15 HSE, 2017a.

16 HSE, 2017b.

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Innovation in the Agri-Food Sector in Latin America and the Caribbean

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Agri-food systems are fundamental to development. Over and above their contribution to a country's gross domestic product (GDP), which is less than the contribution of the manufacturing and services sectors, the multiple strategic functions of agriculture in economic, social, and environmental development determine that its participation is far greater than its share of GDP.

The agri-food sector faces the global challenge of providing enough food, feed, fuel, and fibre to meet growing and changing demand. The agricultural innovation system needs to develop and distribute innovations able to enhance productivity and sustainability along the supply chain, while helping the sector cope with climate change issues.[1] In developing countries, when talking about rural development it is fundamental to consider the additional challenge of strengthening rural societies and addressing the sustainability challenge, paying particular attention to social inclusion and equity.

The food processing industry is typically described as a relatively mature and slow-growing area of business that displays a relatively low level of research and development (R&D) investment and is quite conservative in the type of innovations it introduces to the market. The main reason for this characterization relates to end-customers, who are usually wary of radically new products and changes in consumption patterns. Nevertheless, the recent stringency of legal requirements related to safety and health transforms food product and process innovation into a highly complex, time-consuming, and risky endeavour. Moreover, recent changes in the nature of both food demand and food supply, coupled with an ever-increasing level of competitiveness, have rendered innovation not only an unavoidable corporate activity, but also one that is increasingly vital for overall agribusiness profitability.[2]

This chapter analyses the main sources of innovation for agri-food systems and current trends in technological change, with an emphasis on biotechnology. It also includes a review of the scientific and technological activities necessary for innovation in the agri-food sector. Finally, the chapter adopts a system's approach and includes an analysis of the role of the different actors of innovation in the sector.

Innovation in the agri-food sector

An innovation system for food and agriculture includes both participants of the supply chain (suppliers, producers, agro-industrial processors, distributors, exporters) and government workers and those involved with universities, research institutes, outreach and development agencies, and so on. Policies, legal frameworks, and attitudes that encourage and guide knowledge incorporation processes, technology, and value-added production also complement the concept.[3]

In the case of agriculture, innovations commonly originate with suppliers; these can be considered 'process innovations' because they relate to production techniques—for example, the adoption of improved seeds; equipment for irrigation, harvesting, and packaging; and information management technologies—as well as improvements for quality assurance and farm management. According to the Organisation for Economic Co-operation and Development (OECD),[4] suppliers of farmers develop product innovations such as improved seeds and animal breeds, agricultural machines, irrigation systems, and greenhouses. The same happens in food processing industries, which produce product innovations such as particular foods to satisfy special niche markets (organic foods, for instance), functional food ingredients, and nutraceuticals (any products with extra health benefits derived from food sources) as well as enhanced raw materials from agriculture for industries such as the chemical, pulp, and paper, and pharmaceutical industries.

The value chain: Complex and evolving

Innovations are now common along the value chain, which is extremely complex and multi-layered with a wide range of actors who participate

Table 1: Summary of innovations for the agri-food sector, 2012–17

Technology	Main innovations	Purpose or expected results
Agrochemicals		
Fertilizers	• Nano-fertilizers that supply one or more nutrients to plants and enhance their growth and yields • Nano-materials that improve the performance of conventional fertilizers	Nano-fertilizers can significantly improve crop growth and yields; enhance the efficiency of fertilizer use; reduce nutrient losses; and/or minimize adverse impacts on the environment.
Herbicides	• Herbicide tolerance traits (either from mutant selection or genetic modification) and safeners*	Improved safeners prevent herbicidal injury to crop plants without reducing weed control.
Pesticides	• Safety in manufacture and use • Convenience for the user • Ease of pack disposal or re-use • Reduction of the amount of pesticide applied • Reduction of waste and effluent of all kinds • Nano-encapsulation	Developments in pesticide formulation technology and novel formulation types, sometimes in special packaging such as water-soluble packs, can give products a competitive advantage, add value, or extend the life cycle of active ingredients.
Information technologies	• Automation in facilities (greenhouses, storage, etc.) • Data acquisition and analysis • Positioning • Mobile applications • Intelligent sensors	Information technologies can result in improvements in resource and water management; improvements in monitoring soils, weather, and markets; traceability and food safety; and better logistics and quality management.
Equipment	• Automation • Flexible devices • Robotics for homogeneous tasks	Cutting-edge equipment can deliver greater productivity and autonomy.
Food safety	• Monitoring of pathogens • Risk management • Analysis of consumer requirements	Food safety technologies can ensure compliance with regulatory requirements and niche-market demands.
Processing	• Quality improvement • Functional ingredients • Efficient resource and energy management	Better processing techniques can result in an improvement in product properties, shelf-life. and presentation.
Packaging	• Use of active materials for packaging • Sensors and indicators • Radio-frequency identification (RFID)	Packaging can improve product shelf-life and appearance and enhance food safety.
Biotechnology	• GM plants and animals • Molecular breeding • Improved enzymes, yeasts, and bacteria for processing	Biotechnology can improve yields, reduce costs, improve quality, and provide better quality-control and safety systems.

Source: Authors, based on Abrol and Shankar, 2014; Bechar and Vigneault, 2017; Lee et al. 2015; Lehmann, 2012; and Magaña, 2014.

Note: * Herbicide safeners selectively protect crop plants from herbicide damage without reducing activity in target weed species.

in innovation in the agri-food sector. According to the OECD, governments implement policies and regulations that affect the business and innovation environment (tax and agricultural policies, for example). Other actors involved in the innovation process are brokers, input suppliers, markets, and consumers.[5]

Suppliers, who can be considered the first of the direct actors in the chain, include suppliers of seeds, fertilizers, crop protection, gene-modifying technologies, machinery, equipment, veterinary vaccines, probiotics, information technology, and energy. They are connected by networks to producers or agriculture firms that work in agriculture, livestock, and fisheries and aquaculture. These producers are in turn connected to agro-industrial firms that provide processing, packaging, storage, and conservation services. Distributors and brokers then provide traders, storage services, and distribution agents. Finally, local and export markets service retailers, consumers, and export/import agencies. Underlying all these elements are financial services, which include development banking, commercial banks, public funds, international cooperation (international research centres, such as the International Maize and Wheat Improvement Center), and multi-lateral aid.

Over all these direct actors is the regulatory and policy framework, which establishes incentives and 'rules of the game' that also have an influence because they set the environment for firms' activities. External sources of innovation include public and private research organizations, extension services, international research centres, technology brokers, universities, and technology transfer offices. These external actors supply important knowledge-based services to support innovations along the value chain.

Sources of innovation for the agri-food sector

Because of the complexity of the agri-food value chain, many technological inputs are used to support innovation. A review of recent advances is presented in Table 1 to illustrate the diversity of technologies impacting different activities of this industry.

Table 2: New plant breeding techniques

Technique	Purpose
Sequence-specific nuclease (SSN)	Facilitates precise insertion and editing of genes through mutation or replacement
Oligo-directed mutagenesis (ODM)	Introduces a similar sequence that can be used as pattern to repair differences
Cisgenesis and intragenesis	Uses genes of the same species to induce new traits in specific crops
RNA-dependent DNA methylation	Induces transcriptional silencing of genes
Reverse breeding	Provides a precise method of producing hybrids
Agro-infiltration	Uses Agrobacterium as a tool for the temporary expression of genes in plant tissues
Grafting on genetically modified (GM) rootstock	GM rootstocks can be used for improving performance of non-GM scions
Genomics or synthetic biology	Implies the introduction of multiple genes to modify metabolic paths
Induced early flowering	Transgenic early-flowering F1 seedlings are backcrossed in year 2 with another line

Source: Authors, based on Schaart et al., 2016.

The wide range of innovations introduced to this sector meets the requirements of a new competitive environment. The main drivers for efficiency in the agriculture and agri-food industry relate to increased pressure by customers on suppliers for sustainably produced products, as well as competitive pressure that triggers the need to reduce costs and the desire to expand into new export markets, which in turn implies complying with international food safety and health regulations.

Biotechnology innovations for agri-food

A set of important innovations is based on biotechnology. The phrase 'modern biotechnology' refers to various scientific techniques used to produce specific desired traits in plants, animals, or microorganisms using genetic knowledge. Since its introduction to agriculture and food production in the early 1990s, biotechnology has been utilized to develop new tools for improving productivity in crops such as soybeans, corn, cotton, canola, papaya, squash, potato, and apple that are improved versions of the traditional varieties. In addition, improved yeast and enzymes are used to make different food products through biotechnology.[6]

In the area of agriculture, biotechnology has been used to produce genetically modified organisms (GMOs), thus increasing productivity and introducing plants that are resistant to pests, drought, and contaminated soils. The use of biotechnology has led to an increase in yields and reduced cost in important crops such as maize, soybeans, cotton, and canola. Just recently genetically modified (GM) apples and potatoes have been approved for environmental release and consumption in the United States of America.[7]

The use of biotechnology in processing has brought better quality, safety, and long life to food products. New developments are also expected to bring to light raw materials with specific traits useful to specific processing industries. But modern biotechnology has been undergoing a heated debate about the safety of products that has led to strict regulations and entry barriers in important markets (notably in Europe).

Table 2 presents a classification of new plant breeding techniques that are being developed as a response to that restrictive environment. They include: (1) improved plants that contain a new DNA fragment (usually a new gene); (2) improved plants that do not contain a new DNA fragment, but that have a mutation or modification in their own DNA; and (3) improved plants that do not contain a new DNA fragment or any modification of their DNA (such as hybrids).[8]

Biotechnology in Latin America and the Caribbean

Applications of agricultural biotechnology have demonstrated its potential to support improvements in agricultural productivity and the sector's economic growth. However, biotechnology opens new challenges and issues that must be addressed by R&D organizations as well as systems and policy makers.

In Latin America and the Caribbean, the biotechnology industry began to develop in the second half of the 1980s as a consequence of the reduction of barriers that limited foreign investment. The growth of the biotechnology industry was also associated with changes in the laws of intellectual property rights to grant patent protection to biotech inventions and plant breeders' rights to new plant varieties. Patent protection brought confidence to investors, which led to an intensification of research and technology flows.

Research in biotechnology has been supported in different countries in the region, resulting in the development of some new research institutions (universities and research centres). But the creation of biotechnology firms has not been supported to the same degree, so there has been only limited success in building local successful biotech industries. On the other hand, starting in the 1990s, large multinational corporations with large research budgets entered the markets of the largest countries in the region and began to play an increasingly important role as agents of biotechnology diffusion.[9]

As a consequence, even though the land area cultivated with GMOs has grown at an accelerated pace, this expansion has happened only for three crops (soybeans, corn, and cotton), two traits (herbicide resistant and insect resistant, or combinations of both) and eight countries—Argentina, Brazil, Bolivia, Colombia, Honduras, Mexico, Paraguay, and Uruguay—with a large concentration in Argentina and Brazil. Chile has allowed GM plants exclusively for seed production and export. All the GM crops launched commercially in the region have been developed by private multinational firms.

Although important investments have been made in research, no GM product developed by national innovation systems in Latin America has yet been transferred to producers in the region. This reveals that one important problem faced by Latin American innovation systems is the lack of interaction between institutions that generate knowledge and the users of the innovation. A new system of incentives is needed to encourage knowledge generators to embrace diverse demands and propose effective solutions to the problems of producers and companies of different sizes.

This does not mean that technologies have not been produced by the innovation sector in Latin American countries. However, most of the biotechnology innovations produced by the public and private sectors in these countries are conventional applications of biotechnology (tissue culture, fermentation, and the use of molecular tools for breeding).

Countries with a recorded history of investment in human resources as well as innovation and technical change—namely, Argentina, Brazil, Cuba, and Mexico—have an enhanced capacity in terms of the number of techniques used and mastered. There have been some notable achievements in these countries in the development of genomics and some GM crops, but a problem arises in developing commercial applications for those technologies. Countries with an intermediate capacity—such as Colombia, Costa Rica, Chile, Peru, Uruguay, and the Bolivarian Republic of Venezuela—have the capacity to utilize conventional and modern techniques, but their capacities are geographically dispersed and highly concentrated in academic settings. In turn, the rest of the countries in Latin America—Bolivia, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua, Panama, and Paraguay—have a poor innovation capacity for conventional biotechnology innovations and even less capacity for modern biotechnology.

Regulatory systems in the region are rather restrictive. Some countries (such as Mexico for corn between 1998 and 2009, as well as Ecuador and Peru declaring moratoria for planting all GM crops) have declared moratoria on the use of GM plants in their agriculture. Such precautionary measures have proven to be ineffective because these countries import GM food products, but they erect barriers to the environmental release of seeds. This has established obstacles to the development of locally modified plants, which demotivates investments in innovation. There is an intense debate in Mexico about GM food production and its impact on the environment and the population. Thus it is necessary to strengthen the study of GMOs through multidisciplinary and committed work that can objectively demonstrate the challenges and feasibility of this type of production.

Regarding research, regional institutions working on agricultural biotechnology in Latin America cover a wide range of techniques, crops, and productivity limitations. This range reflects the wide diversity of genetic resources in the region and the notable efforts made by the research systems and organizations to address strategic regional and national crops and traits.

This diverse innovation portfolio has, however, led to a dispersion of efforts mainly because no concurrent significant increase in the level of human and financial resources is in place. Countries need to set priorities to focus their efforts and resources towards feasible programmes with stronger ties to farmers and firms.

In terms of the environmental and food safety evaluations needed to commercialize GM products, most countries require improvements to their regulatory bodies and oversight mechanisms. Even in those countries with an existing critical mass of mechanisms (institutions, regulations, infrastructure) to ensure biosafety, social and political pressures have caused the dissemination of technologies approved by the biosafety regulatory authorities to slow.

A faster response from regulatory authorities is required, because a poor capacity to conduct biosafety assessments, strongly influenced by the lack of political will to implement modern biotechnology applications, is demotivating investment by public and private sectors to boost R&D and biotechnology diffusion. Even if the institutional framework is complete, it is essential to assume that a major overhaul of the organization of the structures will be required for its implementation—the framework is currently extremely complex and bureaucratic, which contributes to the uneven diffusion of its benefits, since only a few actors have the qualifications to manage innovation in this environment.

In the case of intellectual property management, countries such as Argentina, Brazil, Chile, and Mexico make use of instruments and negotiation capacity. However, the highest shares of intellectual property protection instruments in these countries are held by non-residents. This suggests that more effective incentives for creative processes should be implemented. In most Latin American countries, agricultural research has taken a very academic route. The indicators are telling: while production of scientific articles has solidly increased in the last 10 years, the generation of intellectual property and effective technological solutions for producers represents a very small percentage of research results.

This relative scarcity of innovative solutions is the consequence of an incentive system for researchers that emphasizes academic production and sidesteps problems in the sector. More technologies are now urgently needed for the efficient use of water to improve land, correct pollution problems, increase production yield, and improve comprehensive farm management.

Moreover, a lack of reliability and quality of supplies means that successful industries resort to imports or to large local suppliers to obtain their supplies. No effort is made to develop new suppliers, which would generate market incentives to improve production. This is an opportunity for innovators.

Technological innovations are systematically incorporated by commercial agriculture producers, who resort to technological resources in other countries. They also turn to these other countries for technical support as well as for machinery, agrochemicals, and seed suppliers. Some local producers work by contract to export vegetables, and their relationship with a broker or their customers in the importing market gives them access to technological packages supplied by sales companies that act as intermediaries. In both cases, links with domestic institutions are scarce.

In some countries, public and some private financial organizations have various support schemes for farmers and companies, but they do not have effective instruments to finance technology development projects, create new businesses, or adopt technology. The requirements of these organizations often exclude a wide range of producers (small farmers), which can widen performance gaps.

A sound innovation policy requires that shared socioeconomic objectives provide the motivation for better articulation of the innovation system and the space for designing more effective policy instruments than what now exists.

The formulation of policies that raise the public's confidence and that successfully insert useful and sustainable biotechnology innovations will be a major challenge that countries in Latin America and the Caribbean will face in the near future.

Challenges for agri-food biotechnology innovations: The case of Mexico

Mexico is equipped with knowledge and expertise in agricultural biotechnology—it has important research facilities at universities such as the National University of Mexico, the Center for Research and Advanced Studies of the National Polytechnic Institute, and the Metropolitan Autonomous University, as well as public research centres such as the Center for Research and Assistance in Technology and Design of the State of Jalisco; the Yucatan Center for Scientific Research; and the National Institute of Forestry, Agriculture and Livestock Research. Mexico also has regulatory systems in place to assess biotechnology products according to the country's Biosafety of GMOs Law. However, Mexico is at crossroads as a result of negative perceptions of GMO technology, including fears about the environmental impacts of genetically engineered crops that some opponents have spread among some sectors of society. This has erected additional barriers to new investors, and the number of Mexican biotechnology firms is low and concentrated in applying traditional techniques (fermentation, use of enzymes, tissue culture, and molecular breeding).

The most important GM crop produced in Mexico is cotton, which covers more than 90% of the planted area in the country. It is a success story because the use of chemical pesticides has been reduced by more than 50% and important cost advantages have been brought to producers.[10]

The second GM crop that has reached commercial release in Mexico is soybeans. Permits were granted in 2012 for production on 253,500 hectares. However, Mexican honey producers have expressed great concern, particularly since the European Court of Justice ruled that honey—which contains trace amounts of pollen from genetically engineered crops authorized for human consumption in the European Union—must be labelled if the amount of genetically engineered pollen surpasses 0.9%. Because of this ruling, all honey shipments from Mexico must undergo laboratory testing to identify and quantify the type of genetically engineered presence.[11]

The Mexican government was about to grant permits for the commercial planting of GM corn in very specific areas that are distant to fields considered centres of origin and diversification for the crop. In September 2013, a federal judge responding to a legal action initiated by a consortium of activist groups effectively suspended the plantings of all GM corn in Mexico by placing a provisional injunction. After four years it is still not clear whether those permits will be granted. This lack of clarity is an obstacle not only for the commercial use of seeds developed by multinational firms but also for technologies generated by Mexican research groups.

This discussion highlights the role of institutions and policies in the diffusion and generation of new biotechnological innovations. It also shows that emphasis has to be given to the transfer of knowledge to commercial firms because they are a key factor in the development of agri-food biotechnology. Countries in Latin America and the Caribbean need new policies aimed not only at strengthening research capacities but also at translating research results into viable biotechnologies to solve some of the critical problems of agriculture.

Conclusions

Research capacities created in Latin American countries need to translate into actual solutions to the problems of the agri-food sector. In order to achieve this goal, a new system of incentives is necessary to encourage knowledge generators to embrace diverse demands and propose effective solutions to the problems of producers and companies of different sizes.

Although the institutional framework that is essential for regulating new technologies, such as innovations in biotechnology, is complete, it still needs a fundamental overhaul of its structure so that it can be implemented. Currently the institutions are so complex and bureaucratic that only a few actors—primarily multinational firms—have the qualifications needed to navigate the system. The result is that the framework, instead of helping to diffuse the benefits of new technologies through all levels of the sector, ends up ensuring that their diffusion is uneven.

Innovation policy requires that shared socioeconomic objectives, such as those related to sustainability and more equitable development of the agri-food sector, provide the motivation for a better articulation of the innovation system and increasing the space for designing more effective policy instruments than now exists.

Notes

1 Moreddu, 2016.

2 Costa and Jongen, 2006.

3 The *Oslo Manual* defines innovation as the implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations (OECD and Eurostat, 2005).

4 OECD, 2013.

5 OECD, 2013, p. 13.

6 Food Insight, no date, available at http://www.foodinsight.org/Background_on_Food_Biotechnology.

7 To get a more precise view on biotech innovations, a review was conducted of recent biotechnology patents (2011–2017). There were 736 identified patents. The leading inventors are Monsanto Technology LLC, Pioneer Hi Bred Int., BASF Plant Science, Du Pont, and Syngenta. Together these firms have more than 50% of the patent files, which is an indicator of the high level of concentration of innovation.

8 Schaart et al., 2016.

9 Otero, 2008.

10 Solleiro et al., 2014.

11 Mexican honey producers filed a court injunction against the approval of GE soybeans for commercial production. This has led to a long legal procedure and the judge has ordered a temporary suspension of the permits arguing that the public consultation of the local communities was not adequate. 'As a result of this issue, approximately 15,000 hectares were not planted to GE soybeans in 2012 and there have been no more applications for commercial or pilot releases of GE soybeans during 2013 to 2015' (USDA FAS, 2015, p. 5).

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Enhancing Innovation in the Ugandan Agri-Food Sector: Progress, Constraints, and Possibilities

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Uganda's performance as an innovation economy has been improving consistently, particularly in comparison with other low-income and Sub-Saharan African countries. Since 2015, the Global Innovation Index (GII) has ranked Uganda as an 'innovation outperformer,' a title given to countries that, over a number of years including the two most recent, have been identified as innovation achievers and pillar outperformers.[1] This laudable progress stems from sustained economic growth coupled with a commitment to private-sector development and innovation policy reforms.[2] Though encouraging, this nascent progress will translate into real benefits for the broader Ugandan population only if policy makers understand and address specific constraints in the innovation systems of the agri-food sector—the largest sector in the Ugandan economy.

Agriculture is the backbone of Uganda's economy, employing about 73% of the country's labour force predominantly in rural areas, but it made up 27% of the country's GDP in 2014.[3] Given that many households in Uganda rely on agricultural production for their livelihoods, innovation in this sector can have direct and potent welfare effects. This potential is particularly striking given that the Ugandan agri-food sector is hampered by low productivity and profitability. Annual growth in agricultural output has also been lower than expected, declining from 7.9% in 2001 to 3% in 2014 and falling short of the 6% growth target for the per capita agricultural GDP set by the African governments under the Comprehensive Africa Agriculture Development Programme.[4]

Increasing agricultural productivity through improved technology and production practices has been a persistent priority at the national level. To be effective, this priority must prompt policy actions that specifically and explicitly account for the underlying innovation systems that will ultimately generate real productivity improvements.

Distinctive features of agri-food value chains in Africa

The agri-food value chain components range from the supply of agricultural inputs such as seeds by input suppliers, wholesalers, and retailer agro-dealers to farming activities such as planting, farming, and harvesting and to post-harvest activities such as bulking and processing of raw output, branding, and marketing of value-added agri-food products that reach end consumers (see Figure 1).

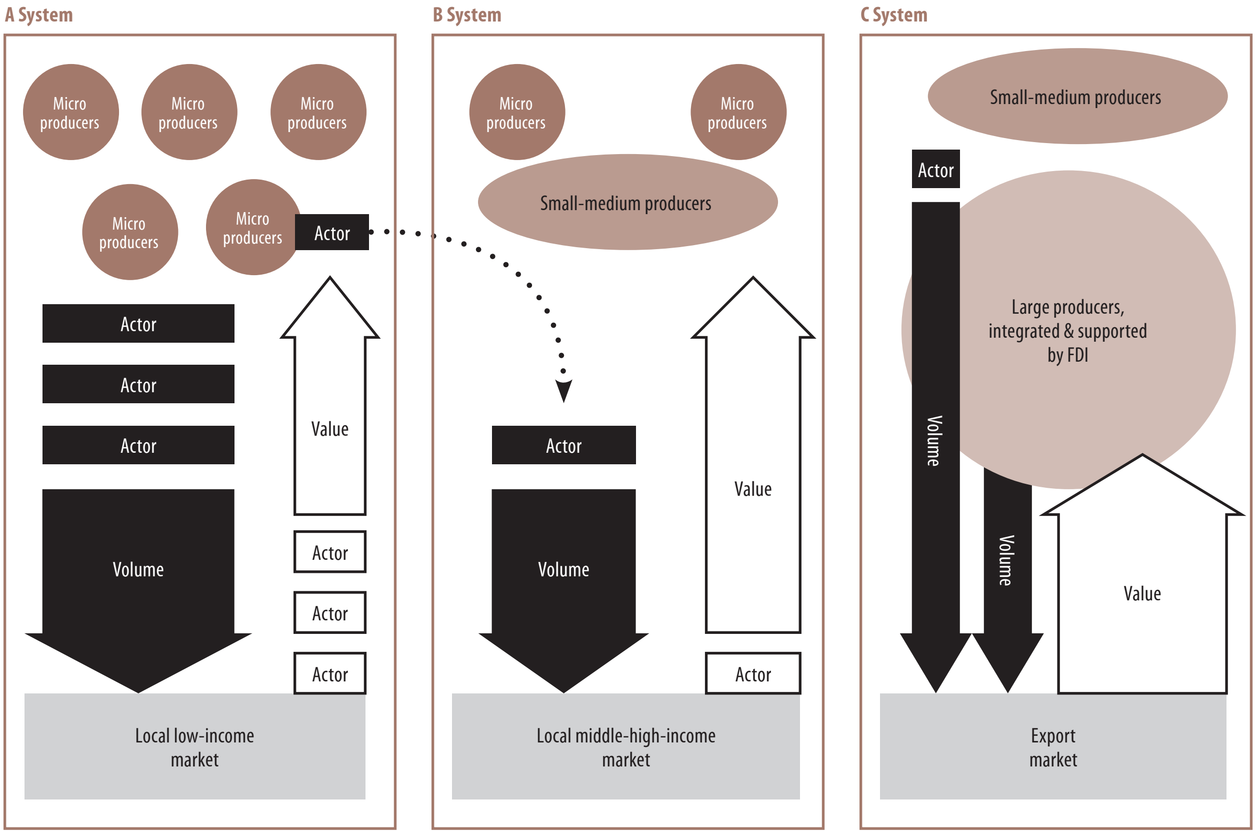
With these important dimensions in mind, it is easy to appreciate the marked heterogeneity that characterizes agricultural value chains in Africa. Indeed, this heterogeneity is often so pronounced that it results in three distinct and parallel systems of

Figure 1: Agriculture value chain with links between consumers and producers

Production	Harvesting and transport	Primary processing and storage	Secondary processing	Distribution, packaging, and handling	Wholesale and retail markets
• Smallholder farmers • Farmers' associations • Input providers	• Smallholder farmers • Farmers' associations • Logistic companies	• Primary processors • Machinery suppliers	• Secondary processors • Machinery suppliers	• Packaging companies • Logistic companies	• Grocery stores and supermarkets • Food and beverage companies

Source: Authors, based on A.T. Kearney, 2016.

Figure 2: Heterogeneity in production and marketing constraints: Three parallel agri-food value chains in developing countries



Source: Adapted from Trienekens, 2011; originally from Ruben et al., 2007.

value chains. In the A system shown in Figure 2, local value chains consist of low-value-added staple foods; low-income and low-productivity farmers; and local, low-value-added spot markets. The B system comprises larger local farmers with access to improved input markets and products as well as higher-value crops; these farmers can tap into higher-value-added domestic agri-food markets. In the C system, much larger (often plantation-style) farms produce specialized products (often under production contracts) for high-value export markets and must therefore satisfy high international sanitary and phytosanitary standards. In developing countries, these systems typically operate in parallel, often with little interaction, further isolating the most vulnerable and least productive producers in the A system. These realities are key to understanding how value chains operate in Uganda and what upgrading options exist for farmers trapped in less productive systems.

Innovation constraints in African agri-food value chains

The agricultural sub-systems described above often function in parallel with few links other than relying occasionally on another sub-system to balance demand and supply gaps. The existence of these heterogeneous sub-systems, which are only weakly connected, poses unique challenges for supporting innovation and upgradation of these value chains.[5]

In many African countries, producers are saddled with poor infrastructure, weak institutions, barriers to entry, coordination failures, and unfavourable social and political conditions.[6] Although these hurdles may be surmounted individually in some cases, they can be pervasive and subject to substantial collective action problems, with the end result that they complicate the entire culture in which business activities take place.

Barriers to entry are a disadvantage to small-scale producers that have little capital to invest, use traditional techniques, and depend on family labour.[7] Such an environment causes difficulties in meeting product standards and makes it difficult to compete with larger-scale, more efficient, and more technologically sophisticated multinational corporations. Without market knowledge or competitive products, many small-scale producers fail to take advantage of larger markets or the techniques that could help them do so.

Furthermore, coordination failures are typically the result of a trust deficit or asymmetric relationships. Because of poor past performance, many value chains do not engender trusting relationships. This can lead to excessive risk mitigation, causing inefficiencies and reduced value addition.[8]

For commodities with low value added, such as raw agriculture staples, the terms of trade with Western countries are typically asymmetric. In such circumstances, Western partners capture only the high-value portion of the chain, thereby excluding small-scale farmers from participating in larger markets.[9]

These obstacles constrain the ability of system A and B value chain actors from innovating in a way that not only increases their agricultural productivity but also upgrades their systems.

Innovation constraints in the Ugandan agri-food sector

Ugandan farms are typically small: Roughly half of Ugandan farmers own less than three acres of land, a quarter own three to five acres, and a quarter own more than five acres.[10] The total area of arable land planted with either seasonal or permanent tree crops has increased at an annual rate of over 2% over the past 20 years.[11] This increase in crop area, however, was outpaced by population growth, and crop area per capita declined nearly 25% during this period as a result.[12] These trends have contributed to an annual decline in both food and agricultural production per capita of about 2% since 2002.[13] Thus at both the national and household levels there is a pressing need to increase agricultural productivity in Uganda.

Mirroring the above challenges, Ugandan farmers face a host of constraints that limit their ability and incentives to invest in their productivity. Among these constraints are unreliable growing conditions; natural disasters; liquidity constraints; high market risk and uninsured production; lack of access to high-quality agricultural inputs (only poor quality of agricultural inputs are available); lack of training, information, and awareness; limited output market opportunities; and few spillovers from public agricultural research and development (R&D). To the extent that farm-level constraints discourage farmers from adopting new technology, they also discourage private-sector investments in the development, distribution, and marketing of improved agricultural inputs and other technologies. Downstream markets for agricultural outputs are similarly suppressed by low on-farm productivity and concerns about the stability and quality of outputs. As a result, only one-third of agricultural production reaches market.[14] Key Ugandan agriculture innovation constraints at the value chain level are discussed in the next section.

The low quality of agricultural inputs

The low quality of agricultural inputs in Uganda has been documented in several recent studies.[15] Thirteen percent (nine out of the 67 fertilizer retailers surveyed) reported receiving low-quality supplies from wholesalers.[16] In practice, the poor quality appears to be a result of counterfeited or adulterated or generic versions of the supplies. The ubiquity of low-quality inputs seems to be more a result of weak enforcement of guidelines and regulations on input producers and dealers than the lack of technology to produce high-quality supplies. Better enforcement and the adherence to higher standards would help overcome this bottleneck. Additionally, institutional changes aimed at improving the quality of agricultural inputs, markets, and supply chains are central to the innovation process. Importantly, such institutional changes make input suppliers more responsive to the needs of farmers because they increase competition in the market. In many cases, upstream innovation in inputs (e.g., improved germplasm) involves significant public-sector support, but the ultimate return on this public R&D investment is dependent on the efficiency and resilience of the input supply chains that deliver appropriate improved inputs to producers.

Constraints to public and private innovation in the agricultural input supply chain—in particular in the area of seeds, crops, and fertilizers—remains a bottleneck to improving the output of Ugandan agriculture. On the one hand, access to inferior inputs (e.g., counterfeit or ineffective fertilizer) remains a significant challenge where issues of quality and suitability prevail. On the other hand, the rise of new, sometimes domestic, hybrid seed varieties along with organizational innovations and improved distribution of agricultural inputs might offer novel possibilities.

Imperfect financial markets

In Uganda, the majority of rural households do not have access to credit. At the time of the 2005/06 Uganda National Household Survey, 24% of rural households had applied for credit from informal sources compared with 4.4% and 1.8% that had applied to micro-finance institutions and banks, respectively; only 15% and 12% of household heads have the capacity to borrow from micro-finance institutions and banks, respectively.[17] Following the conceptual framework of Boucher et al. (2009), of the non-borrowers in the 2008/09 Uganda Census of Agriculture, about half were credit unconstrained, meaning that—given their production opportunities—they did not need a loan, did not borrow because of high interest rates, or could not profitability pay back the loan.[18] The other half of non-borrowers were credit constrained as a result of lack of collateral, lack of information about credit sources, negative past experiences with receiving credit, or unavailability of lending facilities.[19] Thus financial markets in rural Uganda should not only be equipped to provide finance to individual households in a community experiencing hardship but should also look critically at the demand for start-up capital or insurance against risk that is common across households in a community. Prices and market uncertainties contribute to low investment by making borrowing more uncertain and therefore less attractive. This environment of uncertainty inevitably affects household liquidity. Hybrid seeds and inorganic fertilizers that must be purchased each season are two technologies that are most likely to be affected by liquidity constraints at the household level. Furthermore, imperfect financial markets also impact the way labour is allocated across crops. The poorest households, which are less able to insure themselves against price risk, would tend to allocate less labour to high-return cash crop production, such as coffee production.[20]

Information constraints and a weak knowledge base

Information constraints and also, sometimes, a weak knowledge base among farmers are further bottlenecks.

Information constraints reduce productive investments by farmers by imposing constraints on (1) information about inputs/products and (2) information about practices/processes. Addressing this lack is the focus of public- and private-sector initiatives as well as research and policy recommendations.[21]

Limited information on inputs and products, in turn, negatively affects decisions about what practices and processes to adopt. For example, researchers found that only 2% of farmers in their sample correctly identified the variety of maize that they were growing.[22] If farmers believe they are growing a different variety than the one they are actually planting, they may apply practices and technology appropriate to the wrong variety; this can affect their productivity, as has been shown among cowpea producers in Tanzania.[23]

Often farmers also lack the capabilities to assess the potential and practical use of new technology or innovation, leading to underinvestment and limited adoption of new technologies.

Output markets, processing, and marketing

Agricultural output markets (e.g., markets for coffee, maize, or mangos) can play an important role in facilitating agricultural innovation. They are the first and the most important link through which the farmers can access domestic agro-processors, neighbouring countries, or global markets via processor-exporters. However, output sold by farmers is often purchased by middlemen in the village or at the farm gate shortly after harvest.[24]

The interdependence between actors along this chain implies that downstream costs of market imperfections may be transferred upstream to farmers themselves. Because farmers make input investment decisions with an eye on the ultimate output markets, reforming agricultural output markets is an important way to increase farmers' use of improved inputs such as fertilizer.[25] The nascent rice value chain in Uganda provides a concrete example of this dynamic. Since upland rice has only recently been introduced in the country, there are few rice mills and only one industrial agro-processor of rice in Uganda.[26] The costs of transporting rice between farms and these mills was one of the main factors driving over half of the farmers who had initially adopted this crop two years earlier to abandon growing NERICA rice.[27]

Relatedly, low levels of investment in Uganda's agriculture sector are in part due to coordination problems between producers and purchasers of agriculture products. Smallholder farmers face uncertain demand for output, which reduces their incentives and ability to invest in agricultural production. Agro-processors face uncertain quantity and quality of supply, which is exacerbated by potential suppliers' side-selling opportunities on agricultural spot markets.[28] In this way, uncertainty about demand and supply of commodities facing farmers and agro-processors, respectively, reduces their investment incentives. This agricultural investment trap results in only one-third of agricultural production reaching domestic and export markets.[29]

Lacking spillovers from public agricultural R&D

The public sector conducts the vast majority of agricultural R&D in Uganda, as in many least-developed and low-income countries. These investments focus primarily on technologies to improve agricultural productivity and sustainability. Yet a number of factors, including the lack of complementary investments and capacity, hamper spillovers from public research to private enterprises. These spillovers and the interactions and processes that generate them are complex and dynamic. It is critical that researchers and policy makers better understand the drivers and challenges inherent in generating R&D spillovers, as well as the levels and direction of agricultural R&D.

Creating an enabling environment for agri-food innovation in Uganda

Uganda's performance in previous editions of the GII attests to its growing focus on innovation as a driver of development in some of its key sectors. Within the agriculture sector, Uganda is prioritizing investments in modern biosciences, with a particular focus on disease diagnostics, vaccine development, crop productivity improvement, and value addition.[30] The government is also taking steps (though small) to improve institutional capacity, as evidenced by the growing importance of work of R&D institutions such as the National Coffee Research Institute (NaCORI) and others within the National Agricultural Research Organisation (NARO).

The growing focus and recent measures taken by the government for promoting innovations and value addition in agro-based industries is definitely a step in the right direction. However, to truly stimulate growth, the government needs to create an enabling environment for agri-food innovations by addressing obstacles that impede value addition and innovation in agri-food systems.

Among policy measures to encourage innovation, governments can establish intellectual property rights (IPR) and maintain the institutions that enable these rights to be used and enforced. An IPR regime encourages innovation by allowing inventors to recoup their investments through monopoly rents. The agricultural industry typically relies on patent protection, plant variety protection, and trademarks.

In the past decade, Uganda has taken some major strides towards establishing a well-functioning IPR regime in agriculture. The country recently introduced its Plant Variety Protection Act 2014 and became a signatory to the International Treaty on Plant Genetic Resources for Food and Agriculture, to which it acceded in 2003. It also enacted its Geographical Indications Act 2013, which provides protection and promotes the value of its indigenous and traditional agricultural produce. Enhancing the instruments available to both private and public players in the agri-food sector to create viable business opportunities based on innovation could be a policy priority. At the most basic level, firms will invest in innovation only if they have a defensible strategy for building and maintaining a reputation that attracts customers and differentiates high-quality products and services. The effective use of trademarks may therefore play a role in improved branding and longer-term investments in innovation. Uganda also enacted its Trademark Protection Act in 2010. Since then, compared with other forms of intellectual property (IP) protection—such as patents—the use of trademarks has increased rapidly. Furthermore, trademarks are emerging as the preferred form of protection in the agricultural and food and beverage sectors because the majority of trademark filings occur within these sectors.[31]

In order to provide institutional support for IP protection, Uganda has mandated by law two institutions for the formulation, administration, and enforcement of IPR. The Uganda Registration Services Bureau is mandated with the registration of IP instruments, and the Uganda National Council for Science and Technology is concerned with formulating the national science and technology policy and protection of IPR. This demonstrates that Uganda has the basic framework it needs to promote formal agricultural investment in innovation.

However, to foster innovation in agriculture, Uganda needs to define its key innovation policy commitments in this sector and involve a larger actor base in the management and promotion of IPR. An ongoing World Intellectual Property Organization (WIPO) study will shed further light on the policy options available to Uganda for enhancing its IP regime and making it more inclusive for the agriculture sector (see Box 1).

Policies for supporting innovation include fostering an enabling environment and collective action. The former typically relates to the provision of public goods to address market failures in transportation, communication, and processing. However, policies can also focus on the small producers by aiming to integrate them into the market economy. Indeed, a strong agro-processing sector, which is linked to farmers, is an incentive for small producers to invest more to increase the productivity of their farms. These links with agro-processing rely on a combination of service provision, as mentioned above; facilitation of the private sector through financial services and fiscal policy; and an appropriate regulatory environment achieved through standards, regulations, and enforcement. Collective action offers the possibility of lower costs, a more reliable network, and potentially higher profits.[32] Umbrella organizations play a major role in marketing agricultural produce, providing access to training, and service delivery from external organizations.[33] They also provide an ideal environment for knowledge transfer and innovation as they link farmers

Box 1: Innovation in the Agro-Based Industry in Uganda: Insights from coffee seed supply chains and tropical fruit processing

The Ugandan government has requested the Economics and Statistics Division (ESD) of the World Intellectual Property Organization (WIPO) to conduct a study on innovation in the agro-based industry in Uganda. Two value chains have emerged as promising and two focal links in these value chains have emerged as particularly relevant for this study:

1. **The seed/seedling supply chain in the coffee value chain.** Coffee has always been an important cash crop in the Ugandan agri-food sector. It has endured the booms and busts of the global coffee market as well as devastating diseases. Still, coffee yields continue to be low by international standards (e.g., Robusta coffee yields in Viet Nam are, on average, three to four times larger than yields of the same coffee in Uganda). Although there are several reasons for this, the quality and suitability to local agro-climatic conditions of the coffee varieties and the level of input usage play a central role. Getting high-quality and suitable seedlings to farmers may catalyse other investments. For example, investment in several inputs (i.e., fertilizer, pesticides, and agronomic practices such as planting, spacing, and intercropping) is likely to be higher when a grower has planted the varieties best suited to his growing conditions (such as farm size, soil type, and climate). Thus providing better traceability and information along the seed supply chain could create more favourable incentives and induce more on-farm investment. This focus aligns well with the current agricultural agenda of the Ugandan government, which has set extremely ambitious coffee production goals for the next several years.
2. **Primary post-harvest processing—especially drying and juicing—in the tropical fruits value chain.** Nearly every Ugandan farmer grows tropical fruits of some kind. Although fruits such as mangos, pineapples, and bananas can be highly profitable, they are also perishable and costly to transport. Moreover, markets for unprocessed fruit are typically poorly integrated spatially and prices often fluctuate wildly. Immediately after harvest prices can collapse locally, with a glut of perishable fruit in markets and roadside stalls. In this context, even rudimentary post-harvest processing technologies can add significant value; this has motivated innovative activities in the public and private sector among both formal and informal players. For example, the Food Technology Incubator at Makerere University has played an active role in developing and diffusing these technologies and in providing the marketing and distributional expertise required to form profitable small and medium-sized enterprises in this value chain.

Source

WIPO-Uganda study 'Innovation in the Agro-Based Industry in Uganda: An Empirical Study of Agricultural Innovation in a Least Developed Country'.

with similar interests. Finally, governments can also engage in the direct funding of agricultural R&D. Public-private partnerships also support R&D, education, technology transfer, and incremental problem solving.[34]

The ongoing WIPO-Uganda study titled 'Innovation in the Agro-Based Industry in Uganda: An Empirical Study of Agricultural Innovation in a Least Developed Country' (see Box 1) pays particular attention to the policy options that enhance spillovers from public R&D to private enterprise and to innovation and the productivity of the agri-food sector more broadly.[35] In particular, the study aims to understand how firm innovation processes could help translate public R&D into improved firm or household productivity and social returns. On this basis, the study will apply existing findings to the case of Uganda, and then analyse how innovation and (formal and informal) IP, and related policies, affect returns on R&D investment.

The possibility of domestic spillovers to other sectors of the Ugandan economy is particularly important in this regard because these spillovers are central to the economic development and poverty alleviation process that can be unleashed by investment and innovation in the agri-food sector. For this reason, the WIPO-Uganda study will focus on domestic innovation relevant to domestic and regional agricultural varieties and market opportunities. A variety of specific policy solutions to questions that will likely emerge throughout the course of the study include (1) ways to stimulate or import African domestic research and technology to solve local problems; (2) ways to use local brands, local techniques, local tools, local seeds, and local IP to improve the efficiency and dynamism of the agri-food sector; and (3) ways to transfer promising research, innovation, products, and even services that emerge from the Ugandan agri-food sector to neighbouring markets in the surrounding region.

Conclusions

Uganda has been taking several measures designed to improve its performance in the innovation rankings. The GII rankings for the period 2013 through 2016 show Uganda to be a consistent innovation outperformer in comparison to other economies at the same level of development. However, for Uganda to translate this success to economy-wide gains, it needs to address constraints hampering innovation and productivity improvements in its agriculture sector. This chapter has outlined several factors that impede value addition and upgradation of its agriculture value chains. It has also highlighted some possibilities that could improve the country's agri-food innovation. The policy measures required for Uganda to improve its current innovation standing focus on enhancing its institutions to promote and protect IPR, foster innovation, and provide an enabling environment to cultivate collective action. The ongoing WIPO-Uganda study seeks to improve the understanding of the role of innovation and IPR in the Ugandan agriculture sector and will identify key policy responses that have the potential to enhance the impact of agricultural R&D for innovation and technology diffusion. It will offer policy recommendations and describe possible interventions for enhancing innovation and agribusiness in Uganda by providing empirical evidence from an analysis of innovation in the value chain of its key cash crop, coffee.

Notes

1 'Innovation achievers' are countries for which GII scores are higher than expected, based on their level of economic development as measured by GDP per capita. 'Pillar outperformers' are countries that outperform their income group peers in four or more GII pillars.

2 Ecuru and Kawooya, 2015.

3 World Bank, 2016.

4 World Bank, 2016; Uganda Ministry of Agriculture, Animal Industry & Fisheries, 2010.

5 Trienekens, 2011.

6 Trienekens, 2011; Poulton and Macartney, 2012.

7 De Janvry and Sadoulet, 2005; Daviron and Gibbon, 2002.

8 Webber and Labaste, 2010.

9 Kaplinsky et al., 2002.

10 LSMS-ISA, 2012.

11 FAOSTAT, 2014b.

12 FAOSTAT, 2014a.

13 FAOSTAT, 2015.

14 World Bank, 2011.

15 Ashour et al. 2016; Benson et al. 2012; Bold et al. 2015.

16 Benson et al., 2012.

17 Kasirye, 2007.

18 Munyambonera et al., 2014

19 Munyambonera et al., 2014.

20 Vargas Hill, 2009.

21 Benson et al., 2012; Jansen et al., 2013.

22 Stevenson et al., 2016.

23 Bulte et al., 2014.

24 World Bank, 2015.

25 Benson et al., 2012.

26 World Bank, 2015.

27 New Rice for Africa ('NERICA') is a cultivar group of interspecific hybrid rice developed by the Africa Rice Center (AfricaRice) to improve the yield of African rice cultivars. Kijima et al., 2011.

28 Like financial spot markets, in agriculture spot markets agricultural commodities are traded for immediate delivery.

29 World Bank, 2011.

30 Ecuru and Kawooya, 2015.

31 WIPO, 2017.

32 Dorward et al., 2008.

33 Larsen et al., 2009.

34 Hall, 2006.

35 CDIP/14/7 Project on Intellectual Property and Socio-Economic Development (Phase 2): WIPO-Uganda study 'Innovation in the Agro-Based Industry in Uganda: An Empirical Study of Agricultural Innovation in a Least Developed Country'. Kampala and Geneva: Uganda National Council for Science and Technology, Uganda National Council for Science and Technology and, WIPO Economics and Statistics Division.

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Special Section

Clusters

Identifying and Ranking the World's Largest Clusters of Inventive Activity

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The Global Innovation Index (GII) has traditionally focused on the innovation performance of countries. This focus is rooted in the recognition that innovation outcomes are determined by factors—such as national policies, laws and institutions, federal spending, and cultural ties—that operate at the level of countries as a whole. The country perspective will continue to be a central focus of the GII. However, this emphasis masks important differences in innovation performance within countries, because innovation activities tend to be geographically concentrated in specific clusters linked to a single city or a set of neighbouring cities.

Adopting a cluster perspective opens the door to better understanding the determinants of innovation performance that do not operate at the country level—such as physical and economic geography, sub-national policies and institutions, social networks, and local labour market linkages. The GII has long recognized that innovation hubs at the city or regional level tend to be drivers of innovation performance that deserve an in-depth analysis.[1] Unfortunately, gaining empirical insight into the comparative performance of individual innovation clusters is challenging. There is neither a generally accepted definition of what actually constitutes an innovation cluster nor an 'off-the-shelf' list of such clusters (see the section on assessing regional innovation clusters in Chapter 1). In addition, the geographical boundaries of innovation clusters typically do not correspond to the geographical units for which governments or other entities collect statistical data.

Seeking to overcome these challenges, this special section presents an empirical approach to identifying and ranking the world's largest clusters of inventive activity on the basis of patent filings. Patent data offer rich information on the location of innovative activity. Many researchers have already made use of these data to study individual clusters or selected clusters within a particular region.[2] Our approach goes beyond existing work by identifying and ranking innovation clusters on an internationally comparable basis.

We present our empirical approach in several stages. We first describe the patent data that underlie our research and explain how we geocoded these data to enable the identification of clusters in the next section. We then describe the algorithm we employed to map clusters. Once identified, we discuss how we measured the size of the clusters and explore how sensitive the resulting top 100 rankings are to the algorithm's input parameters. We finally present the key characteristics of the top 100 clusters as they emerge from patent data, and end with a few concluding remarks.

Description of patent data

Patents protect inventions that are new, involve an inventive step, and are capable of industrial application. Innovators interested in obtaining exclusive rights for their inventions have to formally apply for protection at authoritative offices. The patent records of these offices thus offer rich—and otherwise rare—information on the nature of inventive activity. Nonetheless, it is important to point out at the outset that patent data provide only an incomplete and imperfect perspective on overall innovative activity. The well-known limitations of patent data include the following:[3]

- Patents (mostly) capture technological inventions and thus miss out on non-technological innovations—such as organizational or logistical advances—that can be an important source of productivity gains in an economy.
- Patents do not capture all technological inventions because inventors can also protect their

Comments and suggestions from Edward Harris, Yo Takagi, Sacha Wunsch-Vincent, Maryam Zehtabchi, and Hao Zhou are gratefully acknowledged. The views expressed here are those of the authors, and do not necessarily reflect those of the World Intellectual Property Organization or its member states.

inventions with trade secrets—another option for protecting inventions but not a perfect substitute.

- Some industries use the patent system more intensively than others, depending on the nature of relevant technologies and prevailing business strategies.[4]
- Some patents are more valuable and technologically important than others; indeed, research has pointed to a highly skewed distribution of patent value, with relatively few patents accounting for a high share of the overall value of patents.[5]

These limitations do not mean that patent data cannot usefully inform innovation research. However, they should be kept in mind when interpreting the cluster rankings described in this section.

For our investigation, we rely on patents published between 2011 and 2015 under the Patent Cooperation Treaty (PCT) System, which is operated by the World Intellectual Property Organization (WIPO). The PCT is an international cooperation agreement that patent applicants use when they seek patent protection internationally. The System came into force in 1978; by 2010, it had 142 members that together accounted for more than 98% of national and regional patent filings worldwide.[6] In a nutshell, by filing a patent application under the PCT, applicants can delay deciding whether and in which countries they would like to pursue exclusive rights for their inventions, thereby saving in fees and legal costs. In addition, the patent receives a first evaluation, which similarly helps applicants in their subsequent patent filing decisions.[7]

Our reliance on PCT filing data has two motivations. First, the PCT System applies a single set of procedural rules to applicants from around the world and collects information based on uniform filing standards. This reduces potential biases that would arise if similar information was collected from different national sources applying different rules and standards. Second, PCT applications are likely to capture the most commercially valuable inventions. Patenting is a costly process, and the larger the number of jurisdictions in which a patent is sought, the greater the patenting cost. An applicant will seek international patent protection only if the underlying invention generates a sufficiently high return—one that is higher than for patents that are filed only domestically.[8]

On the downside, not all patent applications for which applicants pursue protection internationally go through the PCT System, and not every PCT application will eventually result in a granted patent.[9] Systemic differences in PCT use across countries, industries, and applicants may thus introduce a measurement bias, which—again—should be kept in mind when interpreting our cluster rankings.

Geocoding PCT inventor addresses

Between 2011 and 2015, approximately 950,000 applications were published under the PCT System. Each of these applications lists the names and addresses of the inventor(s) responsible for the invention described in the application. In total, these amount to 2.7 million addresses.

Previous work using patent data assigned inventors to districts, primarily on the basis of the postal codes included in their addresses.[10] However, this approach biases the identification and measurement of clusters because of the so-called modifiable areal unit problem (MAUP)—the choice of district boundaries exerting a strong influence on the shape and size of clusters.[11] The MAUP bias would be compounded in our case, because we seek to identify clusters on an internationally comparable basis and the geographical units associated with postal codes, for example, differ substantially in both characteristics and size, both within and across countries.

For this reason, we geocoded inventor addresses at a higher level of accuracy—ideally at the rooftop level—using the returns of Google Maps. Although the quality of the returns varied, we were able to obtain highly accurate geo-coordinates for most inventors.[12] Table 1 presents a summary of the geocoding results for the top PCT-filing countries. If Google Maps could not identify a specific geocode associated with an address, it typically returned an approximate area where that address is found. Extrapolating this information we were able to categorize our results into different accuracy scores. For most countries, more than two-thirds of the returned geocodes were within a 100 metre accuracy radius and more than 90% of the returns were within a 25 kilometre radius, which is the accuracy threshold we employed for geocodes to be used for identifying clusters.[13] Since patent applications can list more than one inventor, the share of PCT filings with at least one inventor meeting the accuracy threshold is even higher.

Density-based cluster identification

Researchers have used a variety of methods to identify clusters from raw spatial data, depending on the nature of the data and the hypothesized forces giving rise to clustering. These methods range from pure visual identification to different kinds of technical algorithms.

Table 1: Summary of geocoding results

Country	Addresses (%)			
	Geocode accuracy of ≤100 m	Geocode accuracy of ≤10 km	Geocode accuracy of ≤25 km	Share of PCT filings covered by accurate geocodes (%)
Australia	84.6	96.6	97.3	97.9
Austria	92.5	97.6	98.9	99.1
Belgium	54.8	93.0	95.4	96.3
Canada	78.3	95.6	95.9	96.8
China	25.4	60.8	94.9	94.9
Denmark	92.2	94.1	94.1	95.5
Finland	85.3	92.1	93.0	95.2
France	85.2	93.3	94.2	96.8
Germany	96.8	97.9	97.9	98.7
Hungary	90.1	91.4	91.4	94.5
India	60.6	76.7	77.5	85.2
Israel	64.8	79.2	86.9	80.1
Italy	83.5	85.4	85.4	88.3
Japan	81.7	89.9	89.9	91.3
Malaysia	76.0	79.8	79.8	83.2
Netherlands	96.9	99.4	99.5	99.5
Norway	86.8	94.4	94.9	95.5
Korea, Rep.	34.7	78.6	89.4	89.3
Russian Federation	54.5	90.2	93.6	96.1
Singapore	78.1	79.0	79.0	84.5
Spain	66.1	96.0	98.8	98.8
Sweden	91.2	92.0	92.0	94.8
Switzerland	83.7	97.7	98.2	98.5
United Kingdom	70.7	97.5	97.8	98.2
United States of America	83.0	91.7	97.5	98.1

Source: WIPO IP Statistics Database, February 2017; Google Maps API, April 2017.

Having considered the alternative options,[14] we adopted the density-based algorithm for discovering clusters originally proposed by Ester et al. (1996), also referred to as the 'DBSCAN algorithm'. Two reasons determined this choice. First, this algorithm can account for inventor address points that do not belong to any cluster or 'noise points'. This is important for our dataset, because patenting can occur outside of any innovation cluster—by, say, single 'garage inventors'. Second, we are interested in descriptively measuring the innovation output of different localities, while initially being agnostic about what precisely drives the formation of these clusters. The DBSCAN algorithm allows us to flexibly map clusters across countries with varying physical and economic geographies on the basis of the same density criteria.

We performed the DBSCAN algorithm on the geocoded inventor locations. In doing so, we treated multiple listings of the same address—for example, a single inventor being listed in multiple patent applications—as separate data points.

The DBSCAN algorithm requires two input parameters: the radius of the cluster-identifying circle around any given data point, and the minimum number of data points within that circle required for them to be counted towards a cluster. The choice of these input parameters critically determines the shape and size of identified clusters. We tested various combinations of input parameters with three guiding criteria. First, we focused on identifying the world's largest innovation clusters, which calls for a relatively high-density threshold. Second, we visually inspected the resulting clusters to evaluate the extent to which they correspond to intuitive notions of existing clusters. Third, we made use of co-inventor relationships to evaluate the fit of the identified clusters. In particular, we gave preference to parameters that minimized the share of co-inventors outside the identified cluster but located within 160 kilometres of the cluster midpoint.

On the basis of these criteria, we settled on baseline input parameters of 13 kilometres (radius) and 2,000 (minimum number of data points), corresponding to a density of approximately five listed inventors per square kilometre.[15] With these parameter values, the DBSCAN algorithm identified 162 clusters in 25 countries.

Although most clusters were geographically separated from one another, a few were contiguous.[16] In order to decide whether to merge these contiguous clusters into one, we again made use of co-inventor relationships. In particular, we calculated the share of a cluster's co-inventors belonging to all the other clusters as well as to two noise categories—namely, co-inventors located within and beyond 80 kilometres of the cluster midpoint not belonging to any other cluster. We then merged two clusters if two conditions were met for at least one of the clusters: first, the minimum distance between any two points of the two clusters was less than 5 kilometres; and second, the neighbouring cluster accounted for the largest share of co-inventors among all clusters worldwide plus the two noise categories. This procedure led to the merging of 16 contiguous clusters into eight distinct clusters, so that we ended up with 154 clusters for our ranking.[17]

Measuring cluster size and sensitivity analysis

We measured the size of the identified clusters by the number of PCT applications associated with the data points in a given cluster. In doing so, we adopted a fractional counting approach, whereby counts reflect the share of a patent's inventors present in a particular cluster.[18] For example, a patent that lists three inventors in cluster A and one inventor in cluster B would contribute 0.75 to cluster A and 0.25 to cluster B.[19]

Table 1 in Annex 2 presents the resulting ranking of the top 100 clusters. The top 100 clusters account for 59.0% of all PCT filings in 2011–15, the period under consideration. We named clusters according to the main city or cities covered by the cluster. Tokyo–Yokohama—with a wide margin—emerges as the top-ranking cluster, followed by Shenzhen–Hong Kong (China), San Jose–San Francisco, Seoul, and Osaka–Kobe–Kyoto. These five clusters alone account for 23.9 % of all PCT filings.

Figure 1 in Annex 1 depicts the location of the top-100 clusters on a world map, also showing the 'raw' inventor address data points. Figures 2–4 offer zoomed-in regional perspectives and Figures 5–7 depict the shape of the top-3 clusters.[20]

The distribution of clusters across countries is highly uneven. Seven countries feature four or more clusters in the top 100: the United States of America (USA, has 31), Germany (12), Japan (8), China (7), France (5), Canada (4), and the Republic of Korea (4). An additional 16 countries host between one and three clusters.[21] Among middle-income economies other than China, India features three clusters and Malaysia and the Russian Federation each feature one. The top 100 do not include any cluster from Latin America and the Caribbean, Sub-Saharan Africa, or Northern Africa and Western Asia.

The distribution of clusters within countries is also uneven. Notably, in the case of the USA, fewer than half of the 50 states feature a cluster, while California (CA), New York (NY), and Texas (TX) each feature three or more. Finally, note that several clusters span more than one territory—most notable of these is the cluster located in the tri-border region around Basel.

How sensitive is the ranking presented in Table 1 in Annex 2 to different cluster-identifying input parameters? We tested different combinations of input parameters and compared the results to our baseline results. Two important insights emerged. First, although different input parameters influence the exact shape and size of the clusters, the resulting rankings were for the most part similar, with clusters moving up or down only a few ranks, especially for those in the top 30.[22] Tokyo–Yokohama consistently emerged as the top cluster. Second, two prominent (sets of) clusters were particularly sensitive to the chosen input parameters: New York and Frankfurt–Mannheim either emerged as broad clusters—as shown in Table 1 in Annex 2 —or were divided into smaller clusters associated with the main population centres within those two clusters. These included Trenton, New Jersey (NJ); Newark, NJ; and Armonk, NY, for the former, and Wiesbaden, Mannheim–Heidelberg, and Karlsruhe for the latter. Once divided, the smaller clusters had lower ranks, though Frankfurt and New York typically remained within the top 30.

Cluster characteristics

As already mentioned, patent data provide rich information on the nature of inventive activity and we can exploit these data further to characterize the top 100 clusters. Table 2 in Annex 2 presents the largest patent filing entity, the main field of technology, the share of universities and public research organizations (PROs), the largest co-inventing cluster,[23] and the share of women inventors associated with each cluster.

For most clusters, the largest patent applicant is a company, although for several of them it is a university—most notably the Massachusetts Institute of Technology for the 8th ranked Boston–Cambridge cluster. Interestingly, several companies constitute the top applicant for more than one cluster. Ericsson stands out as the largest applicant in five different clusters. Siemens and Intel each appear as the top applicant in four different clusters.

There are pronounced differences in the share of PCT filings accounted for by a cluster's top applicant. For many clusters, this share stands below 10%, suggesting a high degree of applicant diversity. For others, this share is higher, pointing to a more concentrated distribution of applicants within clusters. Most notably, Philips accounts for 85% of the 18th ranked Eindhoven cluster, suggesting a cluster largely revolving around a single company.

Cluster diversity is also reflected in the share of the main technological field associated with a cluster's patent filings. For example, the 2nd ranked Shenzhen–Hong Kong (China) cluster has a strong focus on digital communications, with around 41% of patent filings falling into this technology field. By contrast, the 1st ranked Tokyo–Yokohama cluster appears significantly more diversified, with its main technology field—electrical machinery, apparatus, and energy—accounting for only 6.3% of its PCT filings. The most prominent technology field among the top 100 clusters is medical technology—accounting for the top field in 17 clusters—followed by digital communication (16), pharmaceuticals (15), and computer technology (12). Overall, 18 different technology fields—out of a total of 35—feature as the top field in at least one cluster.

Interesting variation also exists in the prominence of universities and PROs among the top 100 clusters. For some clusters—in particular, Baltimore, Daejeon, Grenoble, Kuala Lumpur, and Singapore—universities and PROs account for more than one-third of PCT filings. In many others, inventive activity largely occurs in companies, with academic institutions accounting for negligible filing shares. Interestingly, many clusters featuring medical technology or pharmaceuticals as their top field have relatively high university and PRO shares, underlying the importance of science linkages in these two fields.

How do the top 100 clusters connect to one another? One way of answering this question is to look at co-inventors located outside a cluster's borders, specifically in the other 99 clusters. On this basis, Table 2 in Annex 2 identifies a cluster's most important partner cluster—defined as the cluster accounting for the largest share of external co-inventors. At least two interesting insights emerge. First, distance and cluster size—in line with the classic gravity model of economists—can in many cases explain the identity of the top partner cluster. For example, Tokyo–Yokohama is the top partner cluster for all other clusters in Japan and Seoul is the top partner cluster for all other clusters in the Republic of Korea. Second, the San Jose–San Francisco cluster is by far the most collaborative cluster, emerging as the top partner in 24 cases, including 6 clusters located outside of the USA.

The value of the top partner's share of external co-inventors captures the diversity of partner clusters. The low share for San Jose–San Francisco confirms the high degree of partner diversity for this cluster. Conversely, many clusters in Japan and the Republic of Korea show high shares, pointing to a more confined set of partners—possibly influenced by language barriers.

The last column in Table 2 in Annex 2 presents the share of women inventors among all inventors located in a particular cluster. As can be seen, women inventors account for fewer than one-third of all inventors across all clusters. However, there is substantial variation in the extent of women's participation; among the top 10 clusters alone the share ranges from 5.6% for Nagoya to 28.9% for Shenzhen–Hong Kong (China). Overall, the patterns shown largely reflect prior insights on the participation of women inventors: clusters in China and the Republic of Korea tend to be relatively more gender equal, as are clusters for which the main field of technology is either pharmaceuticals or biotechnology. [24]

Concluding remarks

This special section has described an empirical approach towards identifying and measuring the size of the world's largest clusters of inventive activity on the basis of international patent filings. It provides a fresh perspective on the spatial agglomeration of innovative activity, relying on a globally harmonized set of criteria.

Notwithstanding the measurement progress offered by this approach, it is important to view the analysis presented here as a first step in a longer-term effort to better capture innovative activity at the sub-national level. Our approach relies exclusively on patent data, which are an imperfect metric for inventive activity and an even less perfect metric for innovative activity more broadly. In addition, although the identification and ranking of clusters is reasonably robust to different input parameter choices, the rankings should be used with due caution. Aside from Tokyo's top rank, they are best interpreted as orders of magnitude, with clusters moving up and down a few ranks depending on meaningful parameter choices.

For the future, we aim to improve and broaden the analysis presented here in at least three ways. First, we will seek to obtain more empirical insights into the forces giving rise to clustering and use these insights to refine our cluster identification approach. Second, we will analyse clusters at the level of specific technologies and industries. Finally, we will try to include other measures of innovative activity—such as scientific publications and the performance of universities and firms—in the analysis to obtain a more complete picture of the innovation taking place across the world's largest clusters.

Notes

1 See especially the 2013 edition of the GII on the theme of 'Local Dynamics of Innovation'.

2 See, for example, Boix and Galletto, 2007.

3 See IPO (2015) for a practical guide on the value and limitations of patent information for empirical analysis and WIPO (2011) for additional background on the economics of the patent system.

4 See, for example, Hall and Ziedonis, 2001.

5 See, for example, Gambardella et al., 2008.

6 The four largest economies that were not party to the PCT System in 2010 were Saudi Arabia, Argentina, the Bolivarian Republic of Venezuela, and Pakistan. Saudi Arabia joined in 2013. An applicant from a non-member state can still file a PCT application if there is a co-applicant from a member state. However, non-membership generally has a negative effect on the participation of applicants from non-members in the System, which one should keep in mind when interpreting the rankings presented here. The 98% coverage figure is an estimate based on national patent filing statistics available in WIPO's IP Statistics Data Centre (http://ipstats.wipo.int).

7 See WIPO (2016) for a more detailed description of the PCT System.

8 For other empirical investigations relying on PCT data, see Miguelez and Fink (2013) and Lax-Martínez et al. (2016).

9 In 2015, so-called PCT national phase entries accounted for 57% of non-resident patent filings worldwide (WIPO, 2016). However, this figure understates the 'market share' of the PCT, because it does not account for PCT applications that do not see any subsequent national phase entry.

10 See, for example, Maraut et al., 2008.

11 See Oppenshaw (1983) for the seminal discussion of the MAUP.

12 For some jurisdictions, this required fine-tuning the address feeds—mainly by progressively removing information that seemingly confused the API's address matching algorithm, such as the applicant name or outdated postal codes.

13 The choice of this threshold partly reflects the reporting categories of the Google Maps API and the choice of cluster density parameters, as described in the next section.

14 For a recent review of clustering methodologies, see Sharma et al., 2016.

15 Since DBSCAN relies on latitude and longitude coordinates to calculate the distance between two points, the second (inverse) geodetic problem implies somewhat shorter distances the further away those points are from the equator.

16 The presence of contiguous clusters partly reflects the nature of the DBSCAN algorithm, because this method has difficulties accounting for obstacles—such as rivers or train tracks—that cut through a cluster. Imperfect geocodes—say, those with an accuracy radius of only 25 kilometres—may compound this problem because they often lead to the same geocode covering a large number of listed inventors. Our choice of a relatively large radius (13 kilometres) for DBSCAN minimizes but does not completely overcome these problems.

17 In particular, we merged Alzenau with Frankfurt–Mannheim, Karlsruhe with Frankfurt–Mannheim, Bonn with Cologne–Dusseldorf, two separate clusters in Houston clusters into a single entity, Södertälje with Stockholm, Takasaki with Tokyo–Yokohama, and Tsukuba with Tokyo–Yokohama. In addition, we merged Cheongju with Daejeon. Although Daejeon was only the second largest co-inventing cluster for Cheongju after Seoul, this largely reflects the strong presence of the Seoul cluster in the Republic of Korea. Indeed, all other identified clusters in the Republic of Korea feature Seoul as the largest co-inventing cluster (see Table 2 in Annex 2). It is also worth pointing out that the merging of clusters had a negligible influence on the overall ranking of clusters, because at least one of the merging entities was always small in size.

18 As alternative size measures, we also tested the simple count of listed inventors belong to a given cluster, and the (non-fractional) number of patents associated with those inventors. The resulting rankings correlated closely with the ranking relying on the fractional count for the top 35 clusters, though it led to several sizeable rank shifts for the remaining clusters that overall showed smaller differences in size scores. We report only rankings relying on fractional patent counts because this is the conceptually most appropriate size measure.

19 Our fractional counts ignore inventors for which we obtained inaccurate geocodes (> 25 kilometres). For example, if a patent has three inventors and the geocode for one inventor is inaccurate, we assigned 0.5 scores to the two inventors with accurate geocodes. However, given the small share of listed inventors and patents affected (see Table 1), the resulting measurement bias is likely to be small.

20 Note that the visualization of the Shenzhen–Hong Kong (China) cluster is somewhat misleading, as the relatively less accurate geocoding results for China (see Table 1) imply that many Chinese addresses are associated with the same geocode; in fact inventors located in Shenzhen account for a far higher share of cluster points than inventors located in Hong Kong (China).

21 This count of clusters assigns multi-territory clusters to the territory accounting for the largest share of PCT filings. Note that an additional two countries—Norway and Hungary—feature clusters that do not rank among the top 100.

22 For this sensitivity analysis, we ignored extreme parameter values that led to counter-intuitive results—such as mega-clusters spanning several hundred kilometres.

23 The 'largest co-inventing cluster' refers to the cluster that appears most often as the location of a listed co-inventor for patents associated with a primary cluster.

24 See Lax-Martínez et al., 2016.

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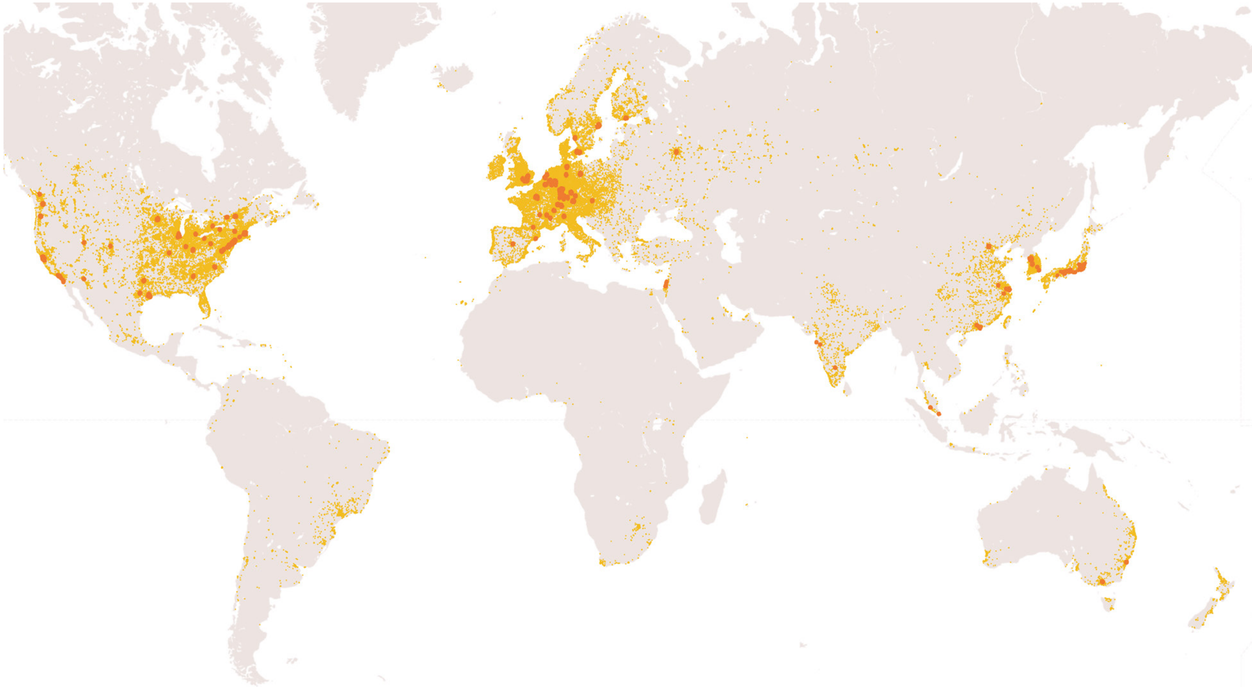
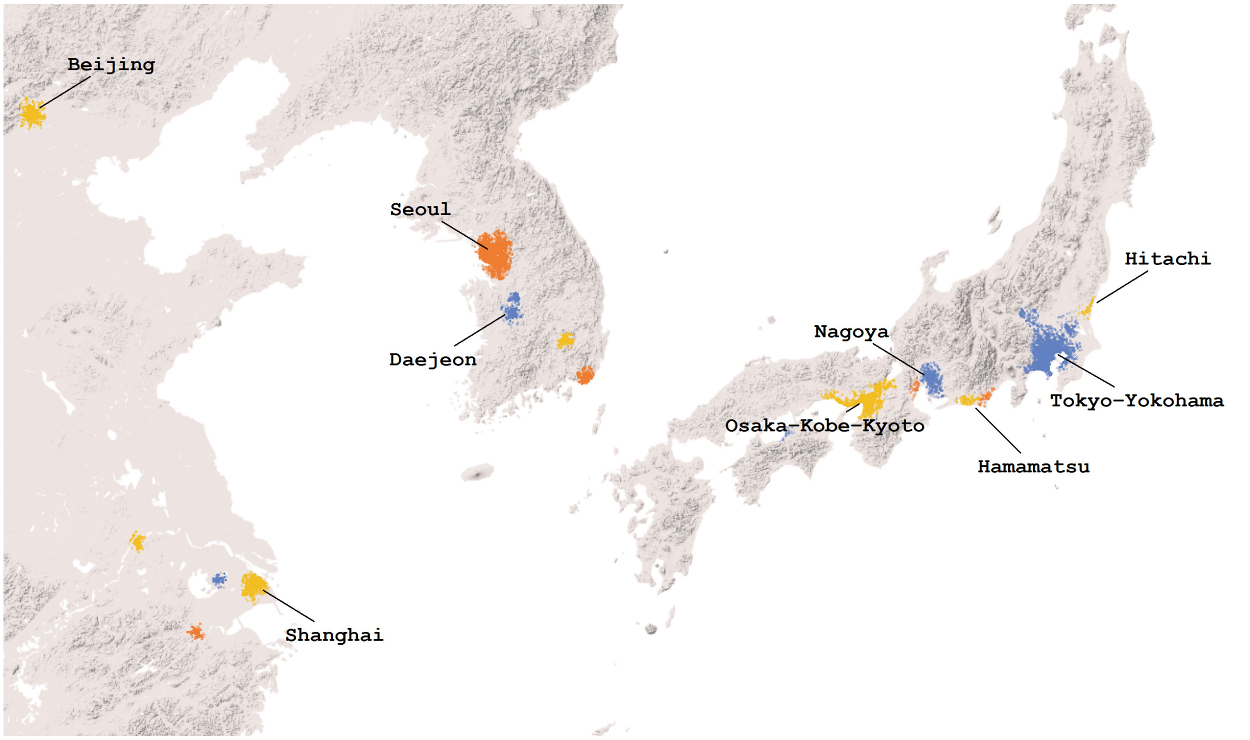
Maps of Clusters

Figure 1: Top 100 clusters worldwide



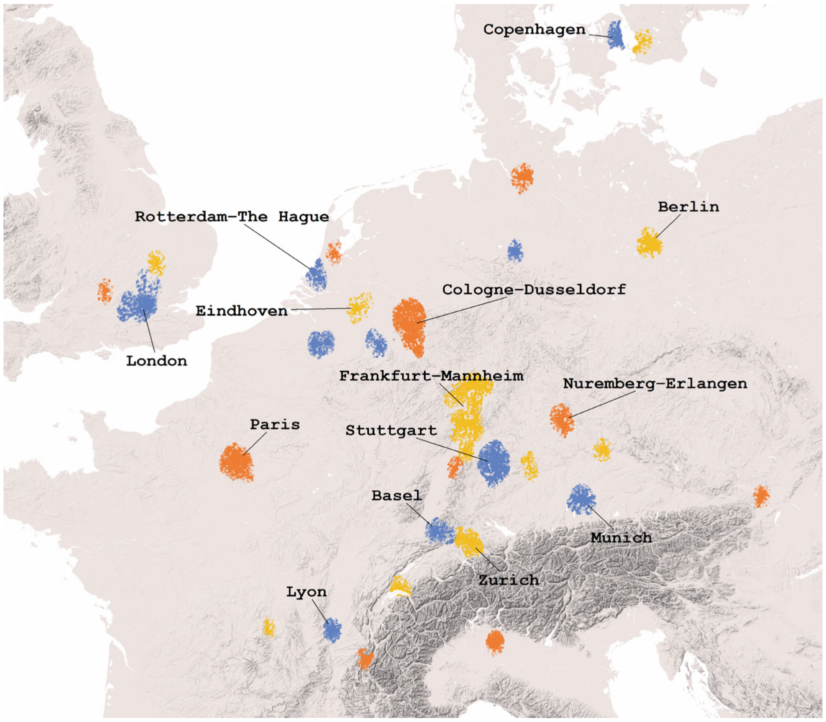
Source: WIPO IP Statistics Database, February 2017; Google Maps API, April 2017.
Map data: Google, INEGI 2017.
Note: Yellow colour represents noise; orange dots represent clusters.

Figure 2: Regional clusters: Asia



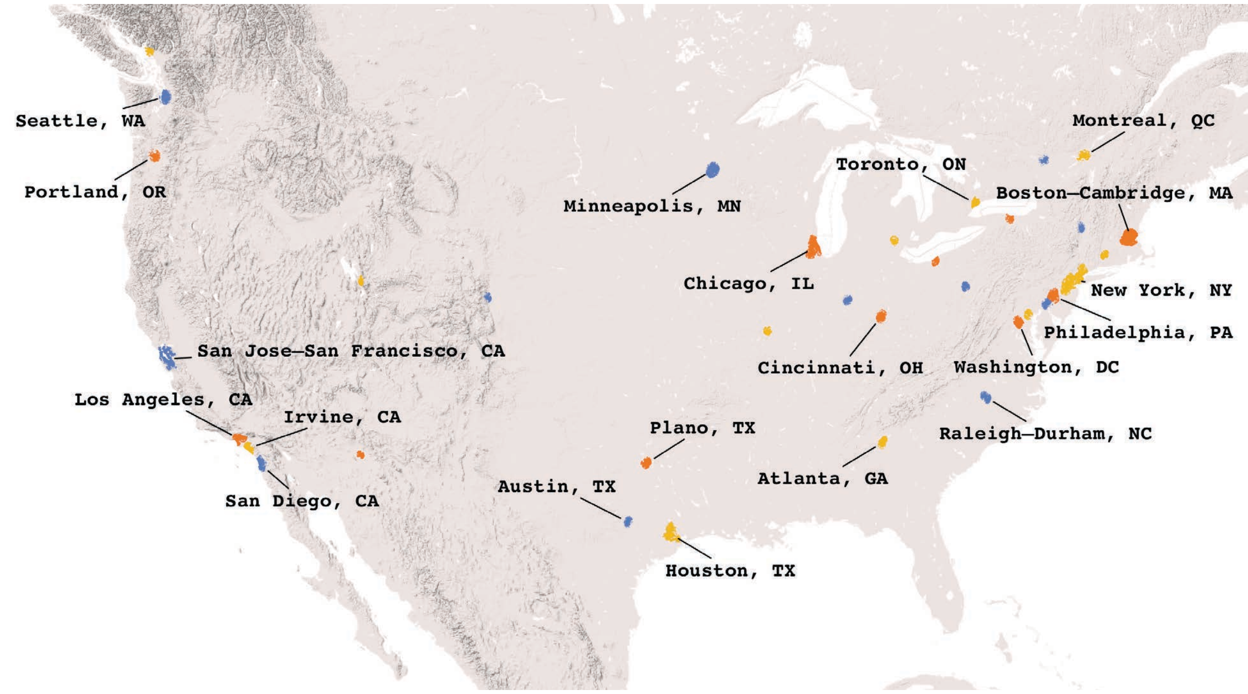
Source: WIPO IP Statistics Database, February 2017; Google Maps API, April 2017.
Map data: Google, SK telcom, ZENRIN 2017.
Note: Colours have been assigned based on the colour of the nearest neighbours (in order to make clear the distinction between any two clusters).

Figure 3: Regional clusters: Europe



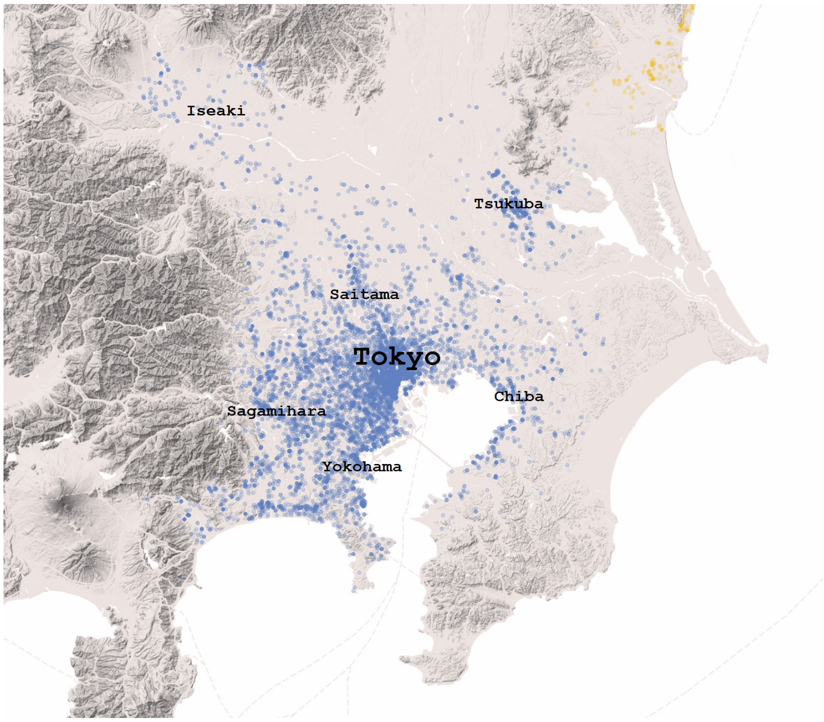
Source: WIPO IP Statistics Database, February 2017; Google Maps API, April 2017.
Map data: Google, Inst. Geogr. Nacional, GeoBasis-DE/BKG 2017.
Note: Colours have been assigned based on the colour of the nearest neighbours (in order to make clear the distinction between any two clusters).

Figure 4: Regional clusters: Northern America



Source: WIPO IP Statistics Database, February 2017; Google Maps API, April 2017.
Map data: Google, INEGI 2017.
Note: Colours have been assigned based on the colour of the nearest neighbours (in order to make clear the distinction between any two clusters).

Figure 5: Top-ranked cluster: Tokyo–Yokohama

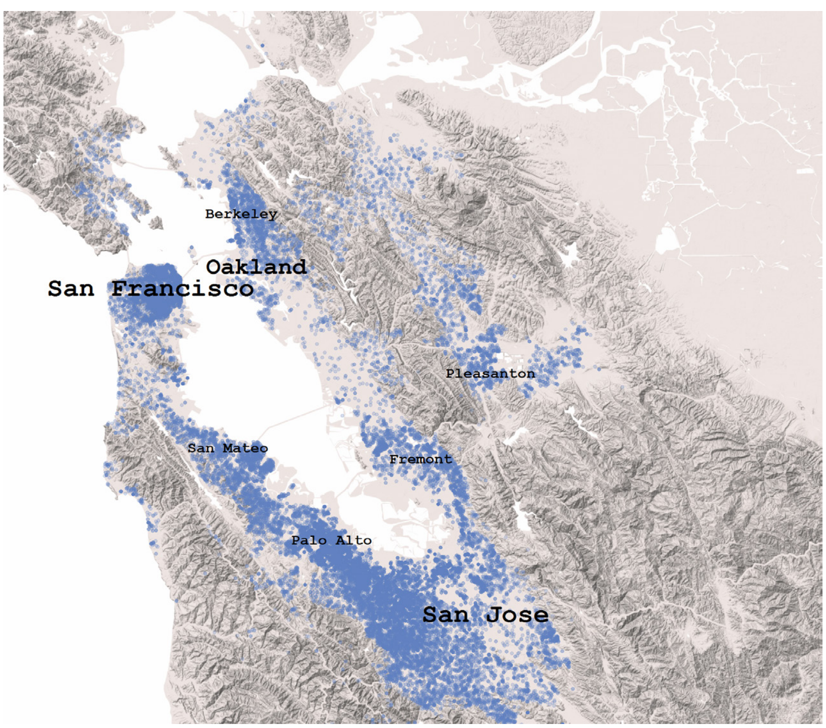


Source: WIPO IP Statistics Database, February 2017; Google Maps API, April 2017.
Map data: Google, ZENRIN 2017.

Figure 6: Second-ranked cluster: Shenzhen–Hong Kong (China)

Source: WIPO IP Statistics Database, February 2017; Google Maps API, April 2017.
Map data: Google 2017.

Figure 7: Third-ranked cluster: San Jose–San Francisco



Source: WIPO IP Statistics Database, February 2017; Google Maps API, April 2017
Map data: Google 2017.

Table 1: Cluster ranking

Rank	Cluster name	Territory(ies)	Number of PCT filings
1	Tokyo–Yokohama	Japan	94,079
2	Shenzhen–Hong Kong (China)	China/Hong Kong (China)	41,218
3	San Jose–San Francisco, CA	United States of America	34,324
4	Seoul	Korea, Rep.	34,187
5	Osaka–Kobe–Kyoto	Japan	23,512
6	San Diego, CA	United States of America	16,908
7	Beijing	China	15,185
8	Boston–Cambridge, MA	United States of America	13,819
9	Nagoya	Japan	13,515
10	Paris	France	13,461
11	New York, NY	United States of America	12,215
12	Frankfurt–Mannheim	Germany	11,813
13	Houston, TX	United States of America	9,825
14	Stuttgart	Germany	9,528
15	Seattle, WA	United States of America	8,396
16	Cologne–Dusseldorf	Germany	7,957
17	Chicago, IL	United States of America	7,789
18	Eindhoven	Netherlands/Belgium	7,222
19	Shanghai	China	6,639
20	Munich	Germany	6,578
21	London	United Kingdom	6,548
22	Tel Aviv	Israel	5,659
23	Daejeon	Korea, Rep.	5,507
24	Stockholm	Sweden	5,211
25	Los Angeles, CA	United States of America	5,027
26	Minneapolis, MN	United States of America	4,422
27	Portland, OR	United States of America	4,146
28	Nuremberg–Erlangen	Germany	4,049
29	Irvine, CA	United States of America	3,965
30	Berlin	Germany	3,632
31	Zurich	Switzerland/Germany	3,615
32	Philadelphia, PA	United States of America	3,172
33	Plano, TX	United States of America	3,147
34	Helsinki–Espoo	Finland	3,045
35	Singapore	Singapore	2,996
36	Basel	Switzerland/France/Germany	2,804
37	Raleigh–Durham, NC	United States of America	2,775
38	Hitachi	Japan	2,648
39	Copenhagen	Denmark	2,613
40	Hamamatsu	Japan	2,496
41	Washington, DC	United States of America	2,491
42	Cincinnati, OH	United States of America	2,481
43	Bengaluru	India	2,479
44	Sydney	Australia	2,380
45	Rotterdam–The Hague	Netherlands	2,235
46	Atlanta, GA	United States of America	2,162
47	Montreal, QC	Canada	2,124
48	Toronto, ON	Canada	2,094
49	Austin, TX	United States of America	2,089
50	Lyon	France	2,063

(Continued)

Table 1: Cluster ranking *(continued)*

Rank	Cluster name	Territory(ies)	Number of PCT filings
51	Wilmington, DL	United States of America	2,046
52	Barcelona	Spain	2,003
53	Regensburg	Germany	2,001
54	Brussels–Leuven	Belgium	1,994
55	Cambridge	United Kingdom	1,984
56	Grenoble	France	1,969
57	Moscow	Russian Federation	1,915
58	Milan	Italy	1,909
59	Hamburg	Germany	1,870
60	Melbourne	Australia	1,799
61	Madrid	Spain	1,796
62	Malmö	Sweden	1,737
63	Guangzhou	China	1,670
64	Indianapolis, IN	United States of America	1,596
65	Lausanne	Switzerland/France	1,580
66	Ottawa, ON	Canada	1,560
67	Hartford, CT	United States of America	1,540
68	Busan	Korea, Rep.	1,470
69	Gothenburg	Sweden	1,461
70	Rochester, NY	United States of America	1,414
71	Vienna	Austria	1,403
72	Phoenix, AZ	United States of America	1,378
73	Vancouver, BC	Canada	1,362
74	Heidenheim–Aalen	Germany	1,352
75	Cleveland, OH	United States of America	1,346
76	Boulder, CO	United States of America	1,319
77	Yokkaichi	Japan	1,318
78	Haifa	Israel	1,298
79	Salt Lake City, UT	United States of America	1,293
80	Ann Arbor, MI	United States of America	1,289
81	Pittsburgh, PA	United States of America	1,283
82	Aachen	Germany/Netherlands/Belgium	1,279
83	Shizuoka	Japan	1,241
84	Buhl	Germany	1,223
85	Hangzhou	China	1,213
86	Albany, NY	United States of America	1,184
87	St. Louis, MO	United States of America	1,138
88	Oxford	United Kingdom	1,134
89	Baltimore, MD	United States	1,089
90	Daegu	Korea, Rep.	1,085
91	Amsterdam	Netherlands	1,063
92	Kuala Lumpur	Malaysia	1,049
93	Clermont-Ferrand	France	1,041
94	Nanjing	China	1,030
95	Mumbai	India	1,012
96	Pune	India	1,006
97	Shikokuchuo	Japan	995
98	Toulouse	France	991
99	Hannover	Germany	979
100	Suzhou	China	956

Notes: The number of PCT filings refers to the 2011–15 period. It represents the inventor fractional count of patents associated with a cluster, as explained in the text.

Table 2: Cluster characteristics

		Largest applicant		Main field of technology			Largest co-inventing top-100 cluster*		
Rank	Cluster name	Applicant name	Share of PCT filings (%)	Field name	Share of PCT filings (%)	Share of universities & PROs (%)	Partner name	Share of co-inventors (%)	Share of women inventors (%)†
1	Tokyo–Yokohama	Mitsubishi Electric	6.4	Electrical machinery, apparatus, energy	6.3	2.9	Osaka–Kobe–Kyoto	22.8	8.5
2	Shenzhen–Hong Kong (China)	ZTE Corporation	32.4	Digital communication	41.2	1.2	Beijing	11.7	28.9
3	San Jose–San Francisco, CA	Google	6.5	Computer technology	18.3	3.4	Portland, OR	5.3	15.0
4	Seoul	LG Electronics	16.6	Digital communication	10.4	10.8	Daejeon	34.6	27.5
5	Osaka–Kobe–Kyoto	Murata Manufacturing	10.4	Electrical machinery, apparatus, energy	8.3	4.2	Tokyo–Yokohama	51.3	8.6
6	San Diego, CA	Qualcomm	56.1	Digital communication	23.6	3.1	San Jose–San Francisco, CA	14.8	16.9
7	Beijing	BOE Technology Group	14.1	Digital communication	22.6	19.0	San Jose–San Francisco, CA	12.2	31.3
8	Boston–Cambridge, MA	Massachusetts Institute of Technology	6.1	Pharmaceuticals	12.4	16.6	San Jose–San Francisco, CA	6.7	17.4
9	Nagoya	Toyota	42.4	Transport	13.0	1.9	Tokyo–Yokohama	41.2	5.6
10	Paris	L'Oréal	7.7	Transport	8.1	9.6	Lyon	4.5	18.9
11	New York, NY	IBM	4.2	Pharmaceuticals	10.9	12.4	San Jose–San Francisco, CA	5.8	20.0
12	Frankfurt–Mannheim	BASF	19.7	Organic fine chemistry	7.2	4.3	Stuttgart	7.8	13.4
13	Houston, TX	Halliburton	12.9	Civil engineering	25.1	5.2	New York, NY	4.0	11.6
14	Stuttgart	Robert Bosch	47.7	Engines, pumps, turbines	11.3	2.3	Frankfurt–Mannheim	12.6	4.8
15	Seattle, WA	Microsoft	41.9	Computer technology	34.6	4.2	San Jose–San Francisco, CA	16.8	13.2
16	Cologne–Dusseldorf	Henkel	7.7	Basic materials chemistry	7.1	2.4	Frankfurt–Mannheim	10.5	13.7
17	Chicago, IL	Illinois Tool Works	11.6	Digital communication	7.4	5.5	San Jose–San Francisco, CA	4.8	13.1
18	Eindhoven	Philips	84.9	Medical technology	17.9	0.9	Rotterdam–The Hague	7.2	12.0
19	Shanghai	Alcatel Lucent	4.3	Digital communication	9.5	11.4	New York, NY	6.3	30.2
20	Munich	Siemens	11.7	Transport	8.0	4.4	Nuremberg–Erlangen	4.4	9.3
21	London	Unilever	6.1	Digital communication	7.2	7.6	Cambridge	7.9	14.7
22	Tel Aviv	Intel	4.1	Computer technology	12.8	8.9	Haifa	22.3	13.5
23	Daejeon	LG Chem	19.8	Electrical machinery, apparatus, energy	10.7	33.9	Seoul	68.6	27.3
24	Stockholm	Ericsson	44.1	Digital communication	26.8	0.5	San Jose–San Francisco, CA	6.2	10.3
25	Los Angeles, CA	University of California	8.4	Medical technology	9.5	21.2	San Jose–San Francisco, CA	12.1	15.0

Continued)

Table 2: Cluster characteristics *(continued)*

		Largest applicant		Main field of technology			Largest co-inventing top-100 cluster*		
Rank	Cluster name	Applicant name	Share of PCT filings (%)	Field name	Share of PCT filings (%)	Share of universities & PROs (%)	Partner name	Share of co-inventors (%)	Share of women inventors (%)†
26	Minneapolis, MN	Medtronic	14.1	Medical technology	32.7	4.0	San Jose–San Francisco, CA	4.4	12.1
27	Portland, OR	Intel	49.1	Computer technology	20.0	2.5	San Jose–San Francisco, CA	24.8	14.0
28	Nuremberg–Erlangen	Siemens	41.5	Electrical machinery, apparatus, energy	11.5	8.3	Munich	8.1	4.7
29	Irvine, CA	Allergan	8.0	Medical technology	21.7	3.0	Los Angeles, CA	13.9	12.7
30	Berlin	Siemens	12.7	Electrical machinery, apparatus, energy	8.5	12.6	Cologne–Dusseldorf	11.8	11.6
31	Zurich	ABB Technology	6.3	Medical technology	6.4	8.0	Basel	10.2	10.4
32	Philadelphia, PA	University of Pennsylvania	8.8	Pharmaceuticals	15.9	19.1	New York, NY	16.5	19.6
33	Plano, TX	Halliburton	17.1	Civil engineering	15.3	4.6	San Jose–San Francisco, CA	8.3	11.9
34	Helsinki–Espoo	Nokia	21.0	Digital communication	19.6	2.7	Beijing	6.4	14.0
35	Singapore	A*STAR	15.3	Medical technology	4.9	35.5	San Jose–San Francisco, CA	6.8	23.0
36	Basel	Hoffman-La Roche	10.6	Organic fine chemistry	13.1	3.0	Zurich	16.2	16.0
37	Raleigh–Durham, NC	Cree	11.1	Pharmaceuticals	9.3	19.7	Frankfurt–Mannheim	6.9	15.7
38	Hitachi	Hitachi	32.4	Electrical machinery, apparatus, energy	19.9	0.5	Tokyo–Yokohama	86.3	7.1
39	Copenhagen	Novozymes	10.4	Biotechnology	11.1	11.9	Malmö	7.2	17.2
40	Hamamatsu	NTN Corporation	25.1	Transport	11.5	3.3	Tokyo–Yokohama	43.1	6.6
41	Washington, DC	US Department of HHS	11.6	Pharmaceuticals	14.7	15.6	San Jose–San Francisco, CA	7.5	19.4
42	Cincinnati, OH	Procter & Gamble	33.3	Medical technology	25.7	4.1	Frankfurt–Mannheim	4.7	14.6
43	Bengaluru	Hewlett-Packard	9.2	Computer technology	17.7	3.3	San Jose–San Francisco, CA	11.6	14.8
44	Sydney	University of Sydney	4.5	Medical technology	8.8	10.8	Melbourne	10.0	12.5
45	Rotterdam–The Hague	TNO	12.2	Other special machines	5.6	22.4	Amsterdam	8.4	11.2
46	Atlanta, GA	Georgia Tech Research	7.1	Medical technology	11.0	9.4	San Jose–San Francisco, CA	4.6	19.0
47	Montreal, QC	Ericsson	10.9	Digital communication	11.9	9.6	New York, NY	6.9	15.4
48	Toronto, ON	University Health Network	3.0	Computer technology	7.4	10.0	San Jose–San Francisco, CA	4.5	12.6
49	Austin, TX	University of Texas System	11.0	Computer technology	19.6	12.6	San Jose–San Francisco, CA	15.3	9.2
50	Lyon	IFP Energies Nouvelles	9.5	Organic fine chemistry	8.0	9.0	Paris	13.8	21.1
51	Wilmington, DL	Du Pont	47.1	Basic materials chemistry	8.2	3.9	Philadelphia, PA	21.1	15.5
52	Barcelona	Hewlett-Packard	8.7	Pharmaceuticals	9.4	17.3	Madrid	7.6	24.0

Continued)

Table 2: Cluster characteristics *(continued)*

		Largest applicant		Main field of technology			Largest co-inventing top-100 cluster*		
Rank	Cluster name	Applicant name	Share of PCT filings (%)	Field name	Share of PCT filings (%)	Share of universities & PROs (%)	Partner name	Share of co-inventors (%)	Share of women inventors (%)†
53	Regensburg	Osram Opto Semiconductors	36.7	Semiconductors	25.8	1.2	Munich	9.8	6.7
54	Brussels–Leuven	Solvay	4.7	Pharmaceuticals	6.1	12.3	Frankfurt–Mannheim	3.8	17.6
55	Cambridge	Cambridge University	6.7	Computer technology	8.1	10.4	London	17.6	14.9
56	Grenoble	CEA	44.3	Semiconductors	10.8	49.2	Paris	11.6	16.0
57	Moscow	Siemens	1.9	Pharmaceuticals	6.1	1.9	San Jose–San Francisco, CA	1.8	13.8
58	Milan	Pirelli	8.5	Pharmaceuticals	5.3	4.3	London	1.5	15.6
59	Hamburg	Henkel	11.0	Organic fine chemistry	14.1	3.1	Cologne–Dusseldorf	5.8	20.1
60	Melbourne	Monash University	5.1	Pharmaceuticals	5.8	16.3	Sydney	9.0	15.2
61	Madrid	Telefonica	13.3	Digital communication	11.1	25.7	Barcelona	9.0	26.9
62	Malmö	Ericsson	19.5	Digital communication	12.6	0.8	Stockholm	18.1	9.5
63	Guangzhou	South China Univ. of Technology	6.8	Computer technology	6.8	19.3	Shenzhen–Hong Kong (China)	10.4	29.2
64	Indianapolis, IN	Dow Agrosciences	22.6	Basic materials chemistry	8.6	6.8	New York, NY	3.4	16.0
65	Lausanne	Nestec	27.6	Food chemistry	7.5	12.4	Zurich	2.9	17.4
66	Ottawa, ON	Huawei Technologies	16.6	Digital communication	30.2	4.3	Plano, TX	13.6	17.4
67	Hartford, CT	United Technologies	65.7	Engines, pumps, turbines	39.6	1.4	Boston–Cambridge, MA	4.9	9.7
68	Busan	Pusan National University	5.6	Medical technology	5.2	22.2	Seoul	48.6	24.7
69	Gothenburg	Ericsson	22.2	Digital communication	9.4	0.3	Stockholm	12.8	11.4
70	Rochester, NY	Eastman Kodak	38.2	Textile and paper machines	9.9	10.1	San Jose–San Francisco, CA	3.9	15.4
71	Vienna	Technische Universität Wien	4.3	Pharmaceuticals	7.8	10.4	Munich	2.9	12.7
72	Phoenix, AZ	Intel	15.4	Semiconductors	11.8	1.7	Portland, OR	9.0	13.0
73	Vancouver, BC	University of British Columbia	6.8	Pharmaceuticals	5.5	11.7	San Jose–San Francisco, CA	8.9	12.9
74	Heidenheim–Aalen	Carl Zeiss	21.9	Optics	15.9	0.2	Stuttgart	9.9	5.7
75	Cleveland, OH	Cleveland Clinic Foundation	9.7	Medical technology	11.1	19.9	New York, NY	2.5	11.2
76	Boulder, CO	University of Colorado	5.8	Medical technology	11.6	7.0	San Jose–San Francisco, CA	8.6	14.4
77	Yokkaichi	Autonetworks Technologies	39.1	Electrical machinery, apparatus, energy	32.3	0.7	Tokyo–Yokohama	33.8	2.9
78	Haifa	Intel	10.8	Medical technology	18.6	8.7	Tel Aviv	46.9	12.9
79	Salt Lake City, UT	University of Utah	14.9	Medical technology	19.3	16.0	San Jose–San Francisco, CA	7.3	10.8
80	Ann Arbor, MI	University of Michigan	27.3	Pharmaceuticals	7.1	29.5	San Jose–San Francisco, CA	4.2	14.1
81	Pittsburgh, PA	University of Pittsburgh	12.8	Medical technology	9.0	21.3	Boston–Cambridge	4.0	14.0

Continued)

Table 2: Cluster characteristics *(continued)*

		Largest applicant		Main field of technology			Largest co-inventing top-100 cluster*		
Rank	Cluster name	Applicant name	Share of PCT filings (%)	Field name	Share of PCT filings (%)	Share of universities & PROs (%)	Partner name	Share of co-inventors (%)	Share of women inventors (%)†
82	Aachen	Ericsson	13.3	Digital communication	9.0	10.5	Cologne–Dusseldorf	16.7	8.9
83	Shizuoka	Fujifilm	48.1	Optics	11.2	0.3	Tokyo–Yokohama	41.2	8.5
84	Buhl	Schaeffler Technologies	48.6	Mechanical elements	44.0	0.5	Frankfurt–Mannheim	28.0	3.6
85	Hangzhou	Alibaba Group	26.5	Computer technology	16.9	12.0	Shanghai	12.2	27.1
86	Albany, NY	General Electric	55.0	Semiconductors	9.9	6.5	New York, NY	9.6	13.0
87	St. Louis, MO	Monsanto Technologies	11.5	Biotechnology	10.4	13.6	Seattle, WA	6.6	17.4
88	Oxford	Oxford University Limited	27.6	Pharmaceuticals	8.3	31.3	London	15.8	18.1
99	Baltimore, MD	Johns Hopkins University	45.3	Pharmaceuticals	15.0	51.9	Washington, DC	13.0	20.7
90	Daegu	Kyungpook National University	12.1	Medical technology	7.7	26.1	Seoul	51.1	26.3
91	Amsterdam	Shell	29.1	Basic materials chemistry	8.6	9.2	Rotterdam–The Hauge	13.6	13.8
92	Kuala Lumpur	Mimos Berhad	50.0	Computer technology	11.4	68.0	Houston, TX	8.0	25.5
93	Clermont-Ferrand	Michelin	74.1	Transport	26.3	3.0	Paris	13.0	17.0
94	Nanjing	Southeast University	10.1	Digital communication	8.7	30.9	Beijing	10.1	31.5
95	Mumbai	Piramal Enterprises	6.7	Organic fine chemistry	15.4	5.9	Bengaluru	11.1	16.8
96	Pune	CSIR	23.2	Organic fine chemistry	15.7	24.5	San Jose–San Francisco, CA	9.8	12.4
97	Shikokuchuo	Unicharm Corporation	90.0	Medical technology	52.3	0.6	Tokyo–Yokohama	34.5	15.5
98	Toulouse	Continental	10.1	Transport	10.0	17.9	Paris	13.8	19.2
99	Hannover	Continental	14.3	Transport	15.3	7.1	Cologne–Dusseldorf	4.1	8.1
100	Suzhou	Ecovacs Robotics	7.7	Furniture, games	7.9	6.0	Shanghai	9.5	25.4

Notes: PCT filing shares refer to the 2011–15 period and are based on fractional counts, as explained in the text. The identification of technology fields relies on the WIPO technology concordance table linking International Patent Classification (IPC) symbols with 35 fields of technology (available at http://www.wipo.int/ipstats/en/). The identification of universities and public research organizations (PROs) relies on keyword-based searches of PCT applicant names, which encompasses all types of educational and public research entities, including universities, colleges, polytechnics, and university hospitals; it also takes account of the different languages used by PCT applicant names. Patent records may show different names for the same applicant. WIPO carries out a name cleaning and harmonization process based on keyword searching and manual verification. This process takes historical changes into account, but not company structure; in other words, subsidiaries or applicants sharing a common parent company are not consolidated. In the table presented here, the colloquial name of the applicant is used where appropriate and may differ from the actual name listed in the application, or from WIPO's cleaned and harmonized name.

*The largest co-inventing top-100 cluster refers to the cluster hosting the highest share of co-inventors. The share of co-inventors is relative to the total number of co-inventors located outside the cluster in question.

†The identification of women inventors relies on the name dictionary described in Lax-Martínez et al. (2016). With this dictionary, we can attribute gender for more than 90% of listed inventors for each cluster except for Beijing, Bengaluru, Guangzhou, Hangzhou, Kuala Lumpur, Seoul, Shanghai, and Suzhou, for which we attribute gender for 84–90% of listed inventors. The share of women inventors is calculated on the basis of listed inventors, so inventors listed in multiple applications are counted multiple times. The calculation ignores inventors whose gender could not be attributed.

Appendices

Appendix I

Country/Economy Profiles

Country/Economy Profiles

The following tables provide detailed profiles for each of the 127 economies in the Global Innovation Index 2017. They are constructed around three sections.

1 Five key indicators at the beginning of each profile are intended to put the economy into context. They present the population in millions,[1] GDP in US$ billions, and GDP per capita in PPP current international dollars.[2] The fourth indicator categorizes the economy into income group and the fifth indicates its geographical region.[3]

2 The next section provides the economy's scores and rankings on the Global Innovation Index (GII), the Innovation Output Sub-Index, the Innovation Input Sub-Index, and the Innovation Efficiency Ratio.

The GII ranking for the 2016 edition comes next. Because there is one less economy in 2017 than in 2016 (four dropped out and three were added), and because of adjustments made to the GII framework every year and other technical factors not directly related to actual performance (missing data, updates of data, etc.), the GII rankings are not directly comparable from one year to the next. Please refer to Annex 2 of Chapter 1 for details.

Scores are normalized in the 0–100 range except for the Innovation Efficiency Ratio, for which scores revolve around the number 1 (this index is calculated as the ratio between the Output and Input Sub-Indices).


Albania

1

2

3

4

The Innovation Input Sub-Index score is calculated as the simple average of the scores in the first five pillars, while the Innovation Output Sub-Index is calculated as the simple average of the scores in the last two pillars.

3 Pillars are identified by single-digit numbers, sub-pillars by two-digit numbers, and indicators by three-digit numbers. For example, *indicator 1.3.1, ease of starting a business,* appears under *sub-pillar 1.3, Business environment,* which in turn appears under *pillar 1, Institutions.*

The 2017 GII includes 81 indicators and three types of data.

4 Composite indicators are identified with an asterisk (*), survey questions from the World Economic Forum's Executive Opinion Survey are identified with a dagger (†), and the remaining indicators are all hard data series.

For hard data, the original value is provided (except for indicators in sub-pillar 7.3, for which the raw data were provided under the condition that only the normalized scores be published). Normalized scores in the 0–100 range are provided for everything else (index and survey data, sub-pillars, pillars, and indices).

When data are either not available or out of date (the cutoff year is 2007, with the exceptions of indicators 2.2.2, 5.1.2, 6.2.5, and 7.2.4; see Appendix III for more details), 'n/a' is used. The year of each data point is indicated in the Data Tables shown in Appendix II. To the right of the indicator title, a clock symbol indicates that the country's data for that indicator are older than the base year. More details, including the year of the data in question, are available in Appendix II.

For further details, see Appendix III, Sources and Definitions, and Appendix IV, Technical Notes.

4 To the far right of each column, a solid circle indicates that an indicator is one of the strengths of the country/economy in question, and a hollow circle indicates that it is a weakness.

All ranks of 1, 2, and 3 are highlighted as strengths, except in particular instances at the sub-pillar level where strengths and weaknesses are not signaled when the desired minimum indicator coverage (DMC) is not met for that sub-pillar.[4] For the remaining indicators, strengths and weaknesses of a particular economy are based on the percentage of economies with scores that fall below its score (i.e., percent ranks).

- For a given economy, strengths (●) are those scores with percent ranks greater than the 10th largest percent rank among the 81 indicators in that economy.
- Similarly, for that economy, weaknesses (○) are those scores with percent ranks lower than the 10th smallest percent rank among the 81 indicators in that economy.

In addition, this year countries with a sub-pillar that does not meet the DMC, independently of whether it is signaled as a strength/weakness, will show the rank for that sub-pillar within brackets. Those that have more than one sub-pillar that fails to meet the DMC in the same pillar will also show the ranks of the pillar where these are located within brackets.

Percent ranks embed more information than ranks and allow for comparisons of ranks of series with missing data and ties in ranks. Examples from the Russian Federation (Russia) illustrate this point:

1. Strengths for Russia are all indicators with percent ranks equal to or above 0.83 (10th largest percent rank for Russia); weaknesses are all indicators with percent ranks equal to or below 0.26 (Russia's 10th smallest percent rank).
2. Russia ranks 22nd out of 127 economies in 6.1.5, *citable documents H index,* with a percent rank of 0.83; this indicator is a strength for Russia.
3. Russia ranks 25th in 2.3.4, *QS university rankings,* but with a percent rank of 0.81, this indicator is not a strength for Russia.
4. The rank of 48 (percent rank of 0.24) in 7.2.3, *global entertainment and media market,* is a weakness for Russia. By contrast, the rank of 47 for Senegal in 5.2.1 *university/industry research collaboration* is a strength for Senegal (with a percent rank of 0.62, this is above the cutoff for strengths for Senegal, which is 0.57).

Percent ranks are not reported in the Country/Economy Profiles but they are presented in the Data Tables (Appendix II).

Notes

1 Data are from the United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2015 Revision*.

2 Data for GDP and GDP per capita are from the International Monetary Fund *World Economic Outlook 2016* database.

3 Countries/economies are classified according to the World Bank Income Group (July 2016; see https://blogs.worldbank.org/opendata/new-country-classifications-2016) and special classification based on the online version of the United Nations publication *Standard Country or Area Codes for Statistical Use,* originally published as Series M, No. 49, and now commonly referred to as the M49 standard (April 2017; see https://unstats.un.org/unsd/methodology/m49/). These are: EUR = Europe; NAC = Northern America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = South East Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa.

4 Data stringency requirements are used in the attribution of strengths and weaknesses at the sub-pillar level. When countries do not meet a data minimum coverage (DMC) requirement at the sub-pillar level (for sub-pillars with two indicators, the DMC is 1; for three it is 2; for four it is 2; and for five it is 3), they are not attributed a strength or weakness at the sub-pillar either. Furthermore, if the country in question does not meet the DMC requirements at the sub-pillar level, but still obtains a ranking higher than or equal to 10 or a ranking equal to or lower than 100 at the sub-pillar level, for caution this rank is put in brackets. This procedure is to ensure that incomplete data coverage does not lead to erroneous conclusions about strengths or weaknesses, or particularly about strong or weak sub-pillar rankings.

Index of Country/Economy Profiles

Albania

Key indicators

Population (millions)	2.9
GDP (US$ billions)	12.1
GDP per capita, PPP$	11,300.8
Income group	Upper-middle income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**28.9**	**93**	
	Innovation Output Sub-Index	15.7	115	○
	Innovation Input Sub-Index	42.0	70	
	Innovation Efficiency Ratio	0.4	122	○
	Global Innovation Index 2016 (out of 128)	28.4	92	
1	**Institutions**	**63.3**	**62**	
1.1	Political environment	57.7	50	
1.1.1	Political stability & safety*	72.5	45	
1.1.2	Government effectiveness*	42.9	69	
1.2	Regulatory environment	56.3	80	
1.2.1	Regulatory quality*	47.2	65	
1.2.2	Rule of law*	28.9	82	
1.2.3	Cost of redundancy dismissal, salary weeks	20.8	87	
1.3	Business environment	75.9	43	
1.3.1	Ease of starting a business*	91.7	39	●
1.3.2	Ease of resolving insolvency*	65.0	40	●
1.3.3	Ease of paying taxes*	71.0	73	
2	**Human capital & research**	**23.5**	**91**	
2.1	Education	39.0	92	
2.1.1	Expenditure on education, % GDP	3.5	91	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	5.9	104	○
2.1.3	School life expectancy, years	15.5	35	●
2.1.4	PISA scales in reading, maths, & science	415.2	57	
2.1.5	Pupil-teacher ratio, secondary	13.5	53	
2.2	Tertiary education	30.2	81	
2.2.1	Tertiary enrolment, % gross	58.1	44	
2.2.2	Graduates in science & engineering, %	16.8	73	
2.2.3	Tertiary inbound mobility, %	1.7	74	
2.3	Research & development (R&D)	1.3	101	
2.3.1	Researchers, FTE/mn pop. ◷	157.3	80	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.2	95	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**46.4**	**66**	
3.1	Information & communication technologies (ICTs)	52.5	74	
3.1.1	ICT access*	47.3	87	
3.1.2	ICT use*	38.8	71	
3.1.3	Government's online service*	59.4	67	
3.1.4	E-participation*	64.4	54	
3.2	General infrastructure	34.2	77	
3.2.1	Electricity output, kWh/cap	1,634.6	83	
3.2.2	Logistics performance*	16.2	110	
3.2.3	Gross capital formation, % GDP	28.8	24	●
3.3	Ecological sustainability	52.5	38	●
3.3.1	GDP/unit of energy use	12.5	22	●
3.3.2	Environmental performance*	74.4	57	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.2	31	●
4	**Market sophistication**	**51.7**	**41**	
4.1	Credit	28.8	82	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	35.5	90	
4.1.3	Microfinance gross loans, % GDP	0.5	35	
4.2	Investment	71.7	[4]	
4.2.1	Ease of protecting minority investors*	71.7	19	●
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	54.6	95	
4.3.1	Applied tariff rate, weighted mean, %	1.1	15	●
4.3.2	Intensity of local competition†	58.3	107	○
4.3.3	Domestic market scale, bn PPP$	34.2	105	
5	**Business sophistication**	**25.3**	**102**	
5.1	Knowledge workers	23.3	103	
5.1.1	Knowledge-intensive employment, % ◷	16.0	85	
5.1.2	Firms offering formal training, % firms	23.8	66	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, % ◷	3.3	81	
5.1.5	Females employed w/advanced degrees, % total	9.2	65	
5.2	Innovation linkages	20.8	101	
5.2.1	University/industry research collaboration†	33.9	96	
5.2.2	State of cluster development†	32.9	110	○
5.2.3	GERD financed by abroad, % ◷	7.4	54	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	90	
5.3	Knowledge absorption	31.8	69	
5.3.1	Intellectual property payments, % total trade	0.6	54	
5.3.2	High-tech imports less re-imports, % total trade	4.3	114	○
5.3.3	ICT services imports, % total trade	1.5	42	
5.3.4	FDI net inflows, % GDP	9.1	13	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**11.4**	**118**	○
6.1	Knowledge creation	2.0	120	○
6.1.1	Patents by origin/bn PPP$ GDP	0.4	78	
6.1.2	PCT patent applications/bn PPP$ GDP ◷	0.1	72	
6.1.3	Utility models by origin/bn PPP$ GDP ◷	0.0	60	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.2	98	
6.1.5	Citable documents H index	1.8	120	○
6.2	Knowledge impact	12.5	114	○
6.2.1	Growth rate of PPP$ GDP/worker, %	(2.7)	106	○
6.2.2	New businesses/th pop. 15–64 ◷	1.1	65	
6.2.3	Computer software spending, % GDP	0.1	86	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	8.5	40	●
6.2.5	High- & medium-high-tech manufactures, % ◷	0.1	88	
6.3	Knowledge diffusion	19.6	83	
6.3.1	Intellectual property receipts, % total trade	0.0	69	
6.3.2	High-tech exports less re-exports, % total trade	0.4	91	
6.3.3	ICT services exports, % total trade	2.8	37	●
6.3.4	FDI net outflows, % GDP	0.5	66	
7	**Creative outputs**	**20.0**	**100**	
7.1	Intangible assets	27.6	114	○
7.1.1	Trademarks by origin/bn PPP$ GDP	26.5	77	
7.1.2	Industrial designs by origin/bn PPP$ GDP ◷	0.4	82	
7.1.3	ICTs & business model creation†	49.6	102	
7.1.4	ICTs & organizational model creation†	32.6	118	○
7.2	Creative goods & services	5.7	104	
7.2.1	Cultural & creative services exports, % of total trade	0.0	65	
7.2.2	National feature films/mn pop. 15–69	3.3	54	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.1	88	
7.3	Online creativity	19.2	65	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	7.3	45	
7.3.2	Country-code TLDs/th pop. 15–69	1.3	74	
7.3.3	Wikipedia edits/mn pop. 15–69 ◷	5.1	60	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Algeria

Key indicators

Population (millions)	40.4
GDP (US$ billions)	168.3
GDP per capita, PPP$	14,503.9
Income group	Upper-middle income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**24.3**	**108**
Innovation Output Sub-Index	15.6	117
Innovation Input Sub-Index	33.1	105
Innovation Efficiency Ratio	0.5	111
Global Innovation Index 2016 (out of 128)	24.5	113

1	**Institutions**	**47.0**	**103**	
1.1	Political environment	33.8	108	
1.1.1	Political stability & safety*	38.5	111	
1.1.2	Government effectiveness*	29.1	95	
1.2	Regulatory environment	47.6	106	
1.2.1	Regulatory quality*	12.2	125	○
1.2.2	Rule of law*	15.1	112	
1.2.3	Cost of redundancy dismissal, salary weeks	17.3	71	
1.3	Business environment	59.7	99	
1.3.1	Ease of starting a business*	77.5	106	
1.3.2	Ease of resolving insolvency*	47.7	68	
1.3.3	Ease of paying taxes*	54.0	108	
2	**Human capital & research**	**25.8**	**86**	
2.1	Education	41.4	83	
2.1.1	Expenditure on education, % GDP ⓓ	4.3	70	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⓓ	14.4	60	●
2.1.4	PISA scales in reading, maths, & science	361.7	69	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	35.9	63	●
2.2.1	Tertiary enrolment, % gross	36.9	70	
2.2.2	Graduates in science & engineering, %	27.6	17	●
2.2.3	Tertiary inbound mobility, %	0.6	88	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**42.3**	**79**	
3.1	Information & communication technologies (ICTs)	24.5	113	
3.1.1	ICT access*	50.3	82	
3.1.2	ICT use*	29.2	89	
3.1.3	Government's online service*	6.5	125	○
3.1.4	E-participation*	11.9	122	
3.2	General infrastructure	59.6	8	●
3.2.1	Electricity output, kWh/cap	1,650.2	82	
3.2.2	Logistics performance*	32.7	75	
3.2.3	Gross capital formation, % GDP	47.8	1	●
3.3	Ecological sustainability	42.8	74	
3.3.1	GDP/unit of energy use	10.0	48	●
3.3.2	Environmental performance*	70.3	76	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	110	
4	**Market sophistication**	**29.5**	**122**	
4.1	Credit	8.8	125	○
4.1.1	Ease of getting credit*	10.0	124	○
4.1.2	Domestic credit to private sector, % GDP	21.6	110	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	22.8	124	
4.2.1	Ease of protecting minority investors*	33.3	124	○
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	81	
4.3	Trade, competition, & market scale	56.7	85	
4.3.1	Applied tariff rate, weighted mean, %	8.3	108	
4.3.2	Intensity of local competition†	46.3	123	○
4.3.3	Domestic market scale, bn PPP$	609.4	33	●
5	**Business sophistication**	**21.0**	**119**	
5.1	Knowledge workers	16.6	115	
5.1.1	Knowledge-intensive employment, % ⓓ	10.0	95	
5.1.2	Firms offering formal training, % firms ⓓ	17.3	83	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total ⓓ	4.6	78	
5.2	Innovation linkages	19.6	111	
5.2.1	University/industry research collaboration†	28.5	108	
5.2.2	State of cluster development†	34.2	105	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	107	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	101	
5.3	Knowledge absorption	26.9	91	
5.3.1	Intellectual property payments, % total trade ⓓ	0.2	81	
5.3.2	High-tech imports less re-imports, % total trade	11.7	25	●
5.3.3	ICT services imports, % total trade ⓓ	0.3	110	
5.3.4	FDI net inflows, % GDP	0.4	118	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**14.4**	**107**	
6.1	Knowledge creation	3.8	101	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	101	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	97	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.4	97	
6.1.5	Citable documents H index	7.2	81	
6.2	Knowledge impact	27.4	81	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.0	37	●
6.2.2	New businesses/th pop. 15–64	0.6	83	
6.2.3	Computer software spending, % GDP	0.0	124	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.0	109	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.3	39	●
6.3	Knowledge diffusion	12.2	124	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	104	
6.3.2	High-tech exports less re-exports, % total trade	0.0	125	○
6.3.3	ICT services exports, % total trade ⓓ	0.3	112	
6.3.4	FDI net outflows, % GDP	(0.0)	112	
7	**Creative outputs**	**16.7**	**116**	
7.1	Intangible assets	26.0	120	
7.1.1	Trademarks by origin/bn PPP$ GDP	24.9	79	
7.1.2	Industrial designs by origin/bn PPP$ GDP ⓓ	1.5	52	●
7.1.3	ICTs & business model creation†	45.2	115	
7.1.4	ICTs & organizational model creation†	29.6	120	
7.2	Creative goods & services	5.7	105	
7.2.1	Cultural & creative services exports, % of total trade	0.0	84	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	1.1	55	
7.2.4	Printing & publishing manufactures, % ⓓ	1.2	49	●
7.2.5	Creative goods exports, % total trade	0.0	125	○
7.3	Online creativity	9.0	101	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	107	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	110	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	3.0	99	
7.3.4	Video uploads on YouTube/pop. 15–69	6.5	66	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Argentina

Key indicators

Population (millions)	43.8
GDP (US$ billions)	541.7
GDP per capita, PPP$	22,553.6
Income group	Upper-middle income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**32.0**	**76**
Innovation Output Sub-Index	22.6	81
Innovation Input Sub-Index	41.4	72
Innovation Efficiency Ratio	0.5	94
Global Innovation Index 2016 (out of 128)	30.2	81

1	**Institutions**	**46.4**	**109**	
1.1	Political environment	51.1	68	
1.1.1	Political stability & safety*	62.2	66	
1.1.2	Government effectiveness*	39.9	77	
1.2	Regulatory environment	36.3	118	○
1.2.1	Regulatory quality*	17.7	119	○
1.2.2	Rule of law*	15.9	111	
1.2.3	Cost of redundancy dismissal, salary weeks	30.3	117	○
1.3	Business environment	51.7	118	○
1.3.1	Ease of starting a business*	73.6	115	○
1.3.2	Ease of resolving insolvency*	41.9	87	
1.3.3	Ease of paying taxes*	39.8	122	○
2	**Human capital & research**	**42.6**	**34**	●
2.1	Education	57.4	34	●
2.1.1	Expenditure on education, % GDP	5.5	30	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	22.2	43	
2.1.3	School life expectancy, years	17.3	16	●
2.1.4	PISA scales in reading, maths, & science	468.9	39	
2.1.5	Pupil-teacher ratio, secondaryⓐ	12.2	43	
2.2	Tertiary education	40.9	44	
2.2.1	Tertiary enrolment, % grossⓐ	82.9	11	●
2.2.2	Graduates in science & engineering, %	14.1	89	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	29.5	37	
2.3.1	Researchers, FTE/mn pop.ⓐ	1,202.1	44	
2.3.2	Gross expenditure on R&D, % GDPⓐ	0.6	55	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	43.6	35	●
2.3.4	QS university ranking, average score top 3*	46.0	28	●
3	**Infrastructure**	**46.6**	**65**	
3.1	Information & communication technologies (ICTs)	64.0	49	
3.1.1	ICT access*	67.7	58	
3.1.2	ICT use*	54.5	52	
3.1.3	Government's online service*	71.0	43	
3.1.4	E-participation*	62.7	59	
3.2	General infrastructure	28.2	96	
3.2.1	Electricity output, kWh/cap	3,286.6	59	
3.2.2	Logistics performance*	41.6	65	
3.2.3	Gross capital formation, % GDP	16.5	106	
3.3	Ecological sustainability	47.6	51	
3.3.1	GDP/unit of energy use	9.3	56	
3.3.2	Environmental performance*	79.8	43	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.6	55	
4	**Market sophistication**	**37.7**	**104**	
4.1	Credit	18.3	116	○
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	14.7	117	○
4.1.3	Microfinance gross loans, % GDP	0.0	78	○
4.2	Investment	32.4	100	
4.2.1	Ease of protecting minority investors*	61.7	50	
4.2.2	Market capitalization, % GDP	9.6	77	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	78	
4.3	Trade, competition, & market scale	62.6	59	
4.3.1	Applied tariff rate, weighted mean, %	7.4	106	
4.3.2	Intensity of local competition†	57.1	112	○
4.3.3	Domestic market scale, bn PPP$	879.4	25	●
5	**Business sophistication**	**33.6**	**59**	
5.1	Knowledge workers	46.8	42	
5.1.1	Knowledge-intensive employment, %ⓐ	23.9	61	
5.1.2	Firms offering formal training, % firmsⓐ	63.6	5	●
5.1.3	GERD performed by business, % of GDPⓐ	0.1	59	
5.1.4	GERD financed by business, %ⓐ	26.5	55	
5.1.5	Females employed w/advanced degrees, % totalⓐ	16.4	34	
5.2	Innovation linkages	17.0	119	○
5.2.1	University/industry research collaboration†	40.4	68	
5.2.2	State of cluster development†	37.2	94	
5.2.3	GERD financed by abroad, %ⓐ	0.6	91	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	98	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	67	
5.3	Knowledge absorption	37.1	44	
5.3.1	Intellectual property payments, % total trade	2.6	7	●
5.3.2	High-tech imports less re-imports, % total trade	13.4	17	●
5.3.3	ICT services imports, % total trade	1.4	47	
5.3.4	FDI net inflows, % GDP	1.6	93	
5.3.5	Research talent, % in business enterpriseⓐ	6.2	72	
6	**Knowledge & technology outputs**	**17.6**	**89**	
6.1	Knowledge creation	9.5	67	
6.1.1	Patents by origin/bn PPP$ GDP	0.6	71	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	45	
6.1.4	Scientific & technical articles/bn PPP$ GDP	9.6	68	
6.1.5	Citable documents H index	25.3	35	●
6.2	Knowledge impact	23.0	98	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.2)	90	
6.2.2	New businesses/th pop. 15–64	0.4	89	
6.2.3	Computer software spending, % GDP	0.2	68	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	8.0	42	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	20.4	73	
6.3.1	Intellectual property receipts, % total trade	0.2	35	
6.3.2	High-tech exports less re-exports, % total trade	2.0	56	
6.3.3	ICT services exports, % total trade	2.3	48	
6.3.4	FDI net outflows, % GDP	0.2	83	
7	**Creative outputs**	**27.6**	**80**	
7.1	Intangible assets	36.6	90	
7.1.1	Trademarks by origin/bn PPP$ GDP	59.0	37	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.1	58	
7.1.3	ICTs & business model creation†	46.6	114	○
7.1.4	ICTs & organizational model creation†	48.5	80	
7.2	Creative goods & services	12.9	78	
7.2.1	Cultural & creative services exports, % of total trade	0.4	31	
7.2.2	National feature films/mn pop. 15–69	6.2	31	
7.2.3	Global ent. & media market/th pop. 15–69	13.4	29	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.1	86	
7.3	Online creativity	24.4	52	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	3.1	65	
7.3.2	Country-code TLDs/th pop. 15–69	5.8	45	
7.3.3	Wikipedia edits/mn pop. 15–69	5.3	53	
7.3.4	Video uploads on YouTube/pop. 15–69	37.4	35	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Armenia

Key indicators

Population (millions)	3.0
GDP (US$ billions)	10.8
GDP per capita, PPP$	8,467.9
Income group	Lower-middle income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**35.7**	**59**	
Innovation Output Sub-Index	31.6	47	
Innovation Input Sub-Index	39.7	82	
Innovation Efficiency Ratio	0.8	17	●
Global Innovation Index 2016 (out of 128)	35.1	60	

		Score/Value	Rank	
1	**Institutions**	**61.9**	**63**	
1.1	Political environment	47.7	74	
1.1.1	Political stability & safety*	56.8	78	
1.1.2	Government effectiveness*	38.7	79	
1.2	Regulatory environment	66.5	55	
1.2.1	Regulatory quality*	48.5	61	
1.2.2	Rule of law*	29.4	80	
1.2.3	Cost of redundancy dismissal, salary weeks	11.0	38	
1.3	Business environment	71.5	61	
1.3.1	Ease of starting a business*	96.1	9	●
1.3.2	Ease of resolving insolvency*	46.1	71	
1.3.3	Ease of paying taxes*	72.5	67	
2	**Human capital & research**	**19.4**	**103**	
2.1	Education	28.9	110	
2.1.1	Expenditure on education, % GDP	2.8	103	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	15.0	82	
2.1.3	School life expectancy, years	13.2	67	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	27.5	88	
2.2.1	Tertiary enrolment, % gross	44.3	60	
2.2.2	Graduates in science & engineering, %	14.1	90	○
2.2.3	Tertiary inbound mobility, %	4.1	47	
2.3	Research & development (R&D)	1.8	95	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.2	83	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**39.0**	**91**	
3.1	Information & communication technologies (ICTs)	49.9	79	
3.1.1	ICT access*	65.7	62	
3.1.2	ICT use*	38.5	72	
3.1.3	Government's online service*	42.8	96	
3.1.4	E-participation*	52.5	82	
3.2	General infrastructure	23.4	112	○
3.2.1	Electricity output, kWh/cap	2,574.8	68	
3.2.2	Logistics performance*	6.6	121	○
3.2.3	Gross capital formation, % GDP	20.6	76	
3.3	Ecological sustainability	43.7	68	
3.3.1	GDP/unit of energy use	7.7	74	
3.3.2	Environmental performance*	81.6	37	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	115	○
4	**Market sophistication**	**50.5**	**46**	
4.1	Credit	59.1	16	●
4.1.1	Ease of getting credit*	75.0	19	●
4.1.2	Domestic credit to private sector, % GDP	45.7	75	
4.1.3	Microfinance gross loans, % GDP	4.8	7	●
4.2	Investment	40.2	62	
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDP◷	1.2	85	○
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	52.2	101	
4.3.1	Applied tariff rate, weighted mean, %	2.5	59	
4.3.2	Intensity of local competition†	63.5	86	
4.3.3	Domestic market scale, bn PPP$	26.6	112	○
5	**Business sophistication**	**27.7**	**85**	
5.1	Knowledge workers	37.0	65	
5.1.1	Knowledge-intensive employment, %	31.1	46	
5.1.2	Firms offering formal training, % firms	16.2	84	○
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	14.5	42	
5.2	Innovation linkages	19.1	114	○
5.2.1	University/industry research collaboration†	36.9	86	
5.2.2	State of cluster development†	38.9	89	
5.2.3	GERD financed by abroad, %	2.3	74	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	70	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.5	37	
5.3	Knowledge absorption	27.1	90	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	5.1	109	
5.3.3	ICT services imports, % total trade	0.9	73	
5.3.4	FDI net inflows, % GDP	2.8	66	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**25.7**	**50**	
6.1	Knowledge creation	28.9	32	
6.1.1	Patents by origin/bn PPP$ GDP	4.5	25	●
6.1.2	PCT patent applications/bn PPP$ GDP	0.3	45	
6.1.3	Utility models by origin/bn PPP$ GDP	2.1	13	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	29.0	26	●
6.1.5	Citable documents H index	9.9	62	
6.2	Knowledge impact	24.2	91	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.4	31	
6.2.2	New businesses/th pop. 15–64	1.5	55	
6.2.3	Computer software spending, % GDP	0.1	88	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	107	
6.2.5	High- & medium-high-tech manufactures, %◷	0.0	97	○
6.3	Knowledge diffusion	24.0	57	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.3	93	
6.3.3	ICT services exports, % total trade	3.5	22	●
6.3.4	FDI net outflows, % GDP	0.2	88	
7	**Creative outputs**	**37.5**	**44**	
7.1	Intangible assets	49.1	41	
7.1.1	Trademarks by origin/bn PPP$ GDP	107.4	11	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.2	56	
7.1.3	ICTs & business model creation†	59.0	68	
7.1.4	ICTs & organizational model creation†	54.6	58	
7.2	Creative goods & services	26.1	43	
7.2.1	Cultural & creative services exports, % of total trade	0.3	35	
7.2.2	National feature films/mn pop. 15–69	16.6	8	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %◷	1.8	25	
7.2.5	Creative goods exports, % total trade	0.4	60	
7.3	Online creativity	25.7	48	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.8	68	
7.3.2	Country-code TLDs/th pop. 15–69	4.9	51	
7.3.3	Wikipedia edits/mn pop. 15–69	7.2	7	●
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Australia

Key indicators

Population (millions)	24.3
GDP (US$ billions)	1,256.6
GDP per capita, PPP$	47,389.1
Income group	High income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**51.8**	**23**	
Innovation Output Sub-Index	39.1	30	
Innovation Input Sub-Index	64.6	12	
Innovation Efficiency Ratio	0.6	76	○
Global Innovation Index 2016 (out of 128)	53.1	19	

		Score/Value	Rank	
1	**Institutions**	**87.4**	**14**	
1.1	Political environment	83.9	17	
1.1.1	Political stability & safety*	85.7	24	
1.1.2	Government effectiveness*	82.2	15	
1.2	Regulatory environment	91.2	11	
1.2.1	Regulatory quality*	88.1	8	
1.2.2	Rule of law*	92.7	13	
1.2.3	Cost of redundancy dismissal, salary weeks	12.0	43	
1.3	Business environment	86.9	16	
1.3.1	Ease of starting a business*	96.5	7	●
1.3.2	Ease of resolving insolvency*	78.7	20	
1.3.3	Ease of paying taxes*	85.6	23	
2	**Human capital & research**	**60.2**	**9**	
2.1	Education	58.6	26	
2.1.1	Expenditure on education, % GDP	5.3	41	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	16.9	66	○
2.1.3	School life expectancy, years	20.5	1	●
2.1.4	PISA scales in reading, maths, & science	502.3	19	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	58.1	10	
2.2.1	Tertiary enrolment, % gross ◷	90.3	3	●
2.2.2	Graduates in science & engineering, % ◷	15.9	79	○
2.2.3	Tertiary inbound mobility, % ◷	18.3	6	●
2.3	Research & development (R&D)	64.0	13	
2.3.1	Researchers, FTE/mn pop. ◷	4,530.7	15	
2.3.2	Gross expenditure on R&D, % GDP ◷	2.2	16	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	68.6	19	
2.3.4	QS university ranking, average score top 3*	81.6	7	●
3	**Infrastructure**	**64.8**	**7**	●
3.1	Information & communication technologies (ICTs)	88.9	4	●
3.1.1	ICT access*	82.3	20	
3.1.2	ICT use*	77.0	15	
3.1.3	Government's online service*	97.8	2	●
3.1.4	E-participation*	98.3	2	●
3.2	General infrastructure	53.7	12	
3.2.1	Electricity output, kWh/cap	10,388.2	13	
3.2.2	Logistics performance*	80.0	19	
3.2.3	Gross capital formation, % GDP	24.9	45	
3.3	Ecological sustainability	51.8	41	
3.3.1	GDP/unit of energy use	8.2	67	○
3.3.2	Environmental performance*	87.2	13	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.9	26	
4	**Market sophistication**	**65.3**	**9**	
4.1	Credit	72.5	5	●
4.1.1	Ease of getting credit*	90.0	5	●
4.1.2	Domestic credit to private sector, % GDP	137.6	13	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	45.2	40	
4.2.1	Ease of protecting minority investors*	58.3	62	
4.2.2	Market capitalization, % GDP	88.6	13	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	22	
4.3	Trade, competition, & market scale	78.2	13	
4.3.1	Applied tariff rate, weighted mean, %	1.9	53	
4.3.2	Intensity of local competition†	81.9	6	●
4.3.3	Domestic market scale, bn PPP$	1,188.8	19	
5	**Business sophistication**	**45.4**	**27**	
5.1	Knowledge workers	67.5	10	
5.1.1	Knowledge-intensive employment, % ◷	44.9	13	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP ◷	1.2	17	
5.1.4	GERD financed by business, % ◷	61.9	9	
5.1.5	Females employed w/advanced degrees, % total ◷	22.6	16	
5.2	Innovation linkages	32.0	52	
5.2.1	University/industry research collaboration†	54.5	32	
5.2.2	State of cluster development†	49.6	42	
5.2.3	GERD financed by abroad, % ◷	1.6	80	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	7	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.0	28	
5.3	Knowledge absorption	36.6	48	
5.3.1	Intellectual property payments, % total trade	1.4	20	
5.3.2	High-tech imports less re-imports, % total trade	11.5	28	
5.3.3	ICT services imports, % total trade	1.0	69	○
5.3.4	FDI net inflows, % GDP	3.2	53	
5.3.5	Research talent, % in business enterprise ◷	27.9	46	○
6	**Knowledge & technology outputs**	**32.1**	**34**	
6.1	Knowledge creation	34.3	25	
6.1.1	Patents by origin/bn PPP$ GDP	2.0	45	
6.1.2	PCT patent applications/bn PPP$ GDP	1.5	22	
6.1.3	Utility models by origin/bn PPP$ GDP	1.0	27	
6.1.4	Scientific & technical articles/bn PPP$ GDP	48.7	9	
6.1.5	Citable documents H index	63.6	10	
6.2	Knowledge impact	44.0	19	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.8	62	○
6.2.2	New businesses/th pop. 15–64	14.9	5	●
6.2.3	Computer software spending, % GDP	0.3	51	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	12.0	32	
6.2.5	High- & medium-high-tech manufactures, % ◷	0.3	49	
6.3	Knowledge diffusion	17.9	96	○
6.3.1	Intellectual property receipts, % total trade	0.3	31	
6.3.2	High-tech exports less re-exports, % total trade	2.0	55	
6.3.3	ICT services exports, % total trade	0.8	89	○
6.3.4	FDI net outflows, % GDP	0.1	91	○
7	**Creative outputs**	**46.1**	**24**	
7.1	Intangible assets	50.3	36	
7.1.1	Trademarks by origin/bn PPP$ GDP	70.8	25	
7.1.2	Industrial designs by origin/bn PPP$ GDP	2.5	41	
7.1.3	ICTs & business model creation†	68.5	35	
7.1.4	ICTs & organizational model creation†	64.8	28	
7.2	Creative goods & services	27.4	38	
7.2.1	Cultural & creative services exports, % of total trade ◷	0.3	38	
7.2.2	National feature films/mn pop. 15–69	1.9	61	○
7.2.3	Global ent. & media market/th pop. 15–69	63.9	8	
7.2.4	Printing & publishing manufactures, % ◷	2.1	19	
7.2.5	Creative goods exports, % total trade	0.8	48	
7.3	Online creativity	56.2	12	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	63.6	9	
7.3.2	Country-code TLDs/th pop. 15–69	52.8	14	
7.3.3	Wikipedia edits/mn pop. 15–69	6.6	24	
7.3.4	Video uploads on YouTube/pop. 15–69	44.8	23	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Austria

Key indicators

Population (millions)	8.6
GDP (US$ billions)	387.3
GDP per capita, PPP$	47,249.9
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**53.1**	**20**	
Innovation Output Sub-Index	43.3	21	
Innovation Input Sub-Index	62.9	18	
Innovation Efficiency Ratio	0.7	41	
Global Innovation Index 2016 (out of 128)	52.6	20	

		Score	Rank	
1	**Institutions**	**87.1**	**15**	
1.1	Political environment	86.3	14	
1.1.1	Political stability & safety*	92.6	8	●
1.1.2	Government effectiveness*	80.0	19	
1.2	Regulatory environment	93.0	9	●
1.2.1	Regulatory quality*	78.7	17	
1.2.2	Rule of law*	93.5	10	●
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	82.0	27	
1.3.1	Ease of starting a business*	83.7	85	○
1.3.2	Ease of resolving insolvency*	78.9	19	
1.3.3	Ease of paying taxes*	83.4	37	
2	**Human capital & research**	**61.0**	**8**	●
2.1	Education	59.7	24	
2.1.1	Expenditure on education, % GDP	5.6	29	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	27.5	17	
2.1.3	School life expectancy, years	16.0	31	
2.1.4	PISA scales in reading, maths, & science	492.2	25	
2.1.5	Pupil-teacher ratio, secondary	9.6	22	
2.2	Tertiary education	66.0	2	●
2.2.1	Tertiary enrolment, % gross	81.5	13	
2.2.2	Graduates in science & engineering, %	27.9	15	
2.2.3	Tertiary inbound mobility, %	15.9	10	●
2.3	Research & development (R&D)	57.5	18	
2.3.1	Researchers, FTE/mn pop.	4,955.0	11	
2.3.2	Gross expenditure on R&D, % GDP	3.1	5	●
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	51.7	27	
2.3.4	QS university ranking, average score top 3*	46.3	26	
3	**Infrastructure**	**63.0**	**16**	
3.1	Information & communication technologies (ICTs)	82.4	16	
3.1.1	ICT access*	83.5	15	
3.1.2	ICT use*	66.7	27	
3.1.3	Government's online service*	91.3	11	●
3.1.4	E-participation*	88.1	14	
3.2	General infrastructure	51.5	19	
3.2.1	Electricity output, kWh/cap	7,206.5	27	
3.2.2	Logistics performance*	94.1	7	●
3.2.3	Gross capital formation, % GDP	22.5	61	○
3.3	Ecological sustainability	55.1	29	
3.3.1	GDP/unit of energy use	11.2	32	
3.3.2	Environmental performance*	86.6	18	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.0	33	
4	**Market sophistication**	**53.1**	**30**	
4.1	Credit	47.2	36	
4.1.1	Ease of getting credit*	60.0	55	○
4.1.2	Domestic credit to private sector, % GDP	87.0	35	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	40.2	63	○
4.2.1	Ease of protecting minority investors*	65.0	31	
4.2.2	Market capitalization, % GDP	25.5	56	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	25	
4.3	Trade, competition, & market scale	72.0	29	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	76.5	22	
4.3.3	Domestic market scale, bn PPP$	415.9	43	
5	**Business sophistication**	**50.3**	**19**	
5.1	Knowledge workers	63.3	17	
5.1.1	Knowledge-intensive employment, %	40.6	23	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	2.2	5	●
5.1.4	GERD financed by business, %	52.5	18	
5.1.5	Females employed w/advanced degrees, % total	16.0	36	
5.2	Innovation linkages	43.7	23	
5.2.1	University/industry research collaboration†	63.6	15	
5.2.2	State of cluster development†	63.8	18	
5.2.3	GERD financed by abroad, %	16.0	28	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	52	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	4.9	14	
5.3	Knowledge absorption	43.9	24	
5.3.1	Intellectual property payments, % total trade	0.8	44	
5.3.2	High-tech imports less re-imports, % total trade	9.3	50	
5.3.3	ICT services imports, % total trade	1.9	24	
5.3.4	FDI net inflows, % GDP	0.5	114	○
5.3.5	Research talent, % in business enterprise	63.7	7	●
6	**Knowledge & technology outputs**	**38.2**	**21**	
6.1	Knowledge creation	42.7	18	
6.1.1	Patents by origin/bn PPP$ GDP	10.4	11	●
6.1.2	PCT patent applications/bn PPP$ GDP	3.4	13	
6.1.3	Utility models by origin/bn PPP$ GDP	1.4	19	
6.1.4	Scientific & technical articles/bn PPP$ GDP	36.1	18	
6.1.5	Citable documents H index	42.8	17	
6.2	Knowledge impact	37.8	40	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.2	79	○
6.2.2	New businesses/th pop. 15–64	0.7	80	○
6.2.3	Computer software spending, % GDP	0.6	14	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	11.0	34	
6.2.5	High- & medium-high-tech manufactures, %	0.4	15	
6.3	Knowledge diffusion	34.1	29	
6.3.1	Intellectual property receipts, % total trade	0.4	25	
6.3.2	High-tech exports less re-exports, % total trade	9.2	22	
6.3.3	ICT services exports, % total trade	2.9	32	
6.3.4	FDI net outflows, % GDP	1.8	38	
7	**Creative outputs**	**48.3**	**17**	
7.1	Intangible assets	54.9	24	
7.1.1	Trademarks by origin/bn PPP$ GDP	61.1	34	
7.1.2	Industrial designs by origin/bn PPP$ GDP	7.9	15	
7.1.3	ICTs & business model creation†	72.9	26	
7.1.4	ICTs & organizational model creation†	67.1	25	
7.2	Creative goods & services	33.9	23	
7.2.1	Cultural & creative services exports, % of total trade◷	1.1	12	
7.2.2	National feature films/mn pop. 15–69	6.5	28	
7.2.3	Global ent. & media market/th pop. 15–69	65.3	7	
7.2.4	Printing & publishing manufactures, %	1.3	42	○
7.2.5	Creative goods exports, % total trade	1.2	40	
7.3	Online creativity	49.6	18	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	36.9	19	
7.3.2	Country-code TLDs/th pop. 15–69	61.4	11	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.7	19	
7.3.4	Video uploads on YouTube/pop. 15–69	34.9	41	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Azerbaijan

Key indicators

Population (millions)	9.9
GDP (US$ billions)	35.7
GDP per capita, PPP$	17,993.4
Income group	Upper-middle income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**30.6**	**82**	
	Innovation Output Sub-Index	20.5	89	
	Innovation Input Sub-Index	40.7	78	
	Innovation Efficiency Ratio	0.5	103	
	Global Innovation Index 2016 (out of 128)	29.6	85	
1	**Institutions**	**55.9**	**74**	
1.1	Political environment	41.6	90	
1.1.1	Political stability & safety*	47.1	97	
1.1.2	Government effectiveness*	36.2	84	
1.2	Regulatory environment	50.8	96	
1.2.1	Regulatory quality*	35.6	85	
1.2.2	Rule of law*	21.8	97	
1.2.3	Cost of redundancy dismissal, salary weeks	21.7	90	
1.3	Business environment	75.3	47	
1.3.1	Ease of starting a business*	97.7	5	●
1.3.2	Ease of resolving insolvency*	44.8	78	
1.3.3	Ease of paying taxes*	83.5	35	●
2	**Human capital & research**	**17.9**	**108**	
2.1	Education	18.0	[125]	
2.1.1	Expenditure on education, % GDP	2.6	108	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	29.1	84	
2.2.1	Tertiary enrolment, % gross	25.5	89	
2.2.2	Graduates in science & engineering, %	22.0	46	
2.2.3	Tertiary inbound mobility, %	2.1	67	
2.3	Research & development (R&D)	6.5	70	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.2	87	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	14.7	56	
3	**Infrastructure**	**50.5**	**50**	
3.1	Information & communication technologies (ICTs)	65.2	47	
3.1.1	ICT access*	67.8	57	
3.1.2	ICT use*	57.0	45	
3.1.3	Government's online service*	68.1	47	
3.1.4	E-participation*	67.8	47	
3.2	General infrastructure	36.5	68	
3.2.1	Electricity output, kWh/cap	2,592.0	65	
3.2.2	Logistics performance*◷	17.8	107	
3.2.3	Gross capital formation, % GDP	29.8	19	●
3.3	Ecological sustainability	49.9	47	
3.3.1	GDP/unit of energy use	10.9	39	
3.3.2	Environmental performance*	83.8	31	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	89	
4	**Market sophistication**	**55.3**	**23**	●
4.1	Credit	43.4	43	
4.1.1	Ease of getting credit*	40.0	98	
4.1.2	Domestic credit to private sector, % GDP	38.5	84	
4.1.3	Microfinance gross loans, % GDP	4.3	10	●
4.2	Investment	65.0	[13]	
4.2.1	Ease of protecting minority investors*	65.0	31	●
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	57.6	80	
4.3.1	Applied tariff rate, weighted mean, %	5.2	92	
4.3.2	Intensity of local competition†	58.6	106	○
4.3.3	Domestic market scale, bn PPP$	167.9	64	
5	**Business sophistication**	**23.8**	**110**	○
5.1	Knowledge workers	29.0	88	
5.1.1	Knowledge-intensive employment, %	23.4	62	
5.1.2	Firms offering formal training, % firms	20.2	75	
5.1.3	GERD performed by business, % of GDP◷	0.0	77	
5.1.4	GERD financed by business, %◷	30.5	50	
5.1.5	Females employed w/advanced degrees, % total◷	12.9	50	
5.2	Innovation linkages	20.1	107	
5.2.1	University/industry research collaboration†	42.7	52	
5.2.2	State of cluster development†	45.2	65	
5.2.3	GERD financed by abroad, %◷	0.2	97	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	67	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	74	
5.3	Knowledge absorption	22.3	112	○
5.3.1	Intellectual property payments, % total trade◷	0.1	97	
5.3.2	High-tech imports less re-imports, % total trade	3.1	121	○
5.3.3	ICT services imports, % total trade	0.7	83	
5.3.4	FDI net inflows, % GDP	5.7	24	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**15.4**	**104**	
6.1	Knowledge creation	3.3	108	
6.1.1	Patents by origin/bn PPP$ GDP	1.3	59	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	99	○
6.1.3	Utility models by origin/bn PPP$ GDP◷	0.1	46	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.2	108	
6.1.5	Citable documents H index	3.3	109	
6.2	Knowledge impact	16.7	109	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.7)	95	
6.2.2	New businesses/th pop. 15–64	1.0	71	
6.2.3	Computer software spending, % GDP	0.1	97	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.4	101	
6.2.5	High- & medium-high-tech manufactures, %◷	0.1	74	
6.3	Knowledge diffusion	26.1	48	
6.3.1	Intellectual property receipts, % total trade◷	0.0	107	○
6.3.2	High-tech exports less re-exports, % total trade	0.1	115	○
6.3.3	ICT services exports, % total trade	0.5	102	
6.3.4	FDI net outflows, % GDP	3.6	16	●
7	**Creative outputs**	**25.5**	**87**	
7.1	Intangible assets	37.9	82	
7.1.1	Trademarks by origin/bn PPP$ GDP	16.5	91	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.1	107	○
7.1.3	ICTs & business model creation†	63.8	50	
7.1.4	ICTs & organizational model creation†	60.8	37	●
7.2	Creative goods & services	7.5	98	
7.2.1	Cultural & creative services exports, % of total trade	0.0	66	
7.2.2	National feature films/mn pop. 15–69	7.4	21	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %◷	0.7	82	
7.2.5	Creative goods exports, % total trade	0.0	119	○
7.3	Online creativity	18.8	66	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.0	96	
7.3.2	Country-code TLDs/th pop. 15–69	1.1	79	
7.3.3	Wikipedia edits/mn pop. 15–69	5.6	48	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Bahrain

Key indicators

Population (millions)	1.4
GDP (US$ billions)	31.8
GDP per capita, PPP$	50,094.9
Income group	High income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**34.7**	**66**
Innovation Output Sub-Index	24.9	67
Innovation Input Sub-Index	44.4	55
Innovation Efficiency Ratio	0.6	88
Global Innovation Index 2016 (out of 128)	35.5	57

1	**Institutions**	**67.3**	**51**	
1.1	Political environment	47.3	75	
1.1.1	Political stability & safety*	37.7	114	
1.1.2	Government effectiveness*	56.9	41	
1.2	Regulatory environment	79.0	26	●
1.2.1	Regulatory quality*	63.3	37	
1.2.2	Rule of law*	52.9	45	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	75.6	45	
1.3.1	Ease of starting a business*	87.8	60	
1.3.2	Ease of resolving insolvency*	44.7	80	
1.3.3	Ease of paying taxes*	94.4	4	●
2	**Human capital & research**	**30.6**	**73**	
2.1	Education	42.4	[82]	
2.1.1	Expenditure on education, % GDP ⓓ	2.6	107	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	9.9	23	●
2.2	Tertiary education	44.5	35	
2.2.1	Tertiary enrolment, % gross	37.4	69	
2.2.2	Graduates in science & engineering, %	19.5	60	
2.2.3	Tertiary inbound mobility, %	13.9	12	●
2.3	Research & development (R&D)	5.0	76	
2.3.1	Researchers, FTE/mn pop. ⓓ	362.0	67	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.1	103	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	13.7	57	
3	**Infrastructure**	**54.6**	**38**	
3.1	Information & communication technologies (ICTs)	77.8	25	●
3.1.1	ICT access*	79.1	29	
3.1.2	ICT use*	74.8	20	●
3.1.3	Government's online service*	82.6	22	●
3.1.4	E-participation*	74.6	32	
3.2	General infrastructure	50.9	22	●
3.2.1	Electricity output, kWh/cap	20,039.0	3	●
3.2.2	Logistics performance*	57.8	43	
3.2.3	Gross capital formation, % GDP	19.7	83	
3.3	Ecological sustainability	35.3	101	
3.3.1	GDP/unit of energy use	4.1	111	○
3.3.2	Environmental performance*	70.1	77	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.4	58	
4	**Market sophistication**	**42.7**	**84**	
4.1	Credit	37.0	57	
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	73.7	40	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	32.8	98	
4.2.1	Ease of protecting minority investors*	50.0	89	
4.2.2	Market capitalization, % GDP	61.8	28	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	57	
4.3	Trade, competition, & market scale	58.3	77	
4.3.1	Applied tariff rate, weighted mean, %	3.3	71	
4.3.2	Intensity of local competition†	70.1	60	
4.3.3	Domestic market scale, bn PPP$	66.4	86	
5	**Business sophistication**	**26.8**	**93**	
5.1	Knowledge workers	25.1	98	
5.1.1	Knowledge-intensive employment, % ⓓ	20.9	71	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP ⓓ	0.0	78	
5.1.4	GERD financed by business, % ⓓ	21.8	60	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	39.6	32	
5.2.1	University/industry research collaboration†	45.4	42	
5.2.2	State of cluster development†	60.3	23	●
5.2.3	GERD financed by abroad, % ⓓ	12.4	41	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	2	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	89	
5.3	Knowledge absorption	15.7	125	○
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	5.3	104	
5.3.3	ICT services imports, % total trade ⓓ	0.3	112	
5.3.4	FDI net inflows, % GDP	0.4	119	○
5.3.5	Research talent, % in business enterprise ⓓ	0.4	82	○
6	**Knowledge & technology outputs**	**20.8**	**73**	
6.1	Knowledge creation	1.9	121	○
6.1.1	Patents by origin/bn PPP$ GDP	0.2	100	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	67	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.7	114	○
6.1.5	Citable documents H index	2.4	113	
6.2	Knowledge impact	30.7	67	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.8	64	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.4	27	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.8	58	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	81	
6.3	Knowledge diffusion	29.9	40	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.1	110	
6.3.3	ICT services exports, % total trade ⓓ	3.3	25	●
6.3.4	FDI net outflows, % GDP	1.5	39	
7	**Creative outputs**	**29.0**	**71**	
7.1	Intangible assets	36.5	91	
7.1.1	Trademarks by origin/bn PPP$ GDP	5.9	110	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.0	111	○
7.1.3	ICTs & business model creation†	66.8	42	
7.1.4	ICTs & organizational model creation†	58.2	45	
7.2	Creative goods & services	18.6	63	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69 ⓓ	0.0	104	○
7.2.3	Global ent. & media market/th pop. 15–69	8.0	39	
7.2.4	Printing & publishing manufactures, % ⓓ	1.5	34	
7.2.5	Creative goods exports, % total trade	1.3	34	
7.3	Online creativity	24.7	51	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	5.4	53	
7.3.2	Country-code TLDs/th pop. 15–69	1.2	76	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	5.1	61	
7.3.4	Video uploads on YouTube/pop. 15–69	42.9	27	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Bangladesh

Key indicators

Population (millions)	162.9
GDP (US$ billions)	226.8
GDP per capita, PPP$	3,606.6
Income group	Lower-middle income
Region	Central and Southern Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**23.7**	**114**
Innovation Output Sub-Index	16.8	108
Innovation Input Sub-Index	30.6	113
Innovation Efficiency Ratio	0.5	93
Global Innovation Index 2016 (out of 128)	22.9	117

		Score	Rank	
1	**Institutions**	**40.3**	**122**	○
1.1	Political environment	29.6	117	
1.1.1	Political stability & safety*	35.8	116	
1.1.2	Government effectiveness*	23.5	111	
1.2	Regulatory environment	36.6	117	
1.2.1	Regulatory quality*	18.4	118	
1.2.2	Rule of law*	19.0	102	
1.2.3	Cost of redundancy dismissal, salary weeks	31.0	119	
1.3	Business environment	54.8	116	
1.3.1	Ease of starting a business*	81.7	93	
1.3.2	Ease of resolving insolvency*	27.0	121	
1.3.3	Ease of paying taxes*	55.6	104	
2	**Human capital & research**	**12.0**	**124**	○
2.1	Education	16.1	126	○
2.1.1	Expenditure on education, % GDP	2.2	111	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	8.4	100	
2.1.3	School life expectancy, years ⓐ	9.9	103	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓐ	35.2	106	○
2.2	Tertiary education	17.0	106	
2.2.1	Tertiary enrolment, % gross ⓐ	13.4	99	
2.2.2	Graduates in science & engineering, % ⓐ	15.6	82	
2.2.3	Tertiary inbound mobility, % ⓐ	0.1	106	○
2.3	Research & development (R&D)	2.8	88	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	5.6	69	
3	**Infrastructure**	**37.0**	**95**	
3.1	Information & communication technologies (ICTs)	39.0	95	
3.1.1	ICT access*	30.6	109	
3.1.2	ICT use*	10.6	113	
3.1.3	Government's online service*	62.3	60	●
3.1.4	E-participation*	52.5	82	
3.2	General infrastructure	35.5	71	
3.2.1	Electricity output, kWh/cap	351.0	107	
3.2.2	Logistics performance*	27.8	86	
3.2.3	Gross capital formation, % GDP	28.5	25	●
3.3	Ecological sustainability	36.4	96	
3.3.1	GDP/unit of energy use	13.2	18	●
3.3.2	Environmental performance*	41.8	120	○
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	112	
4	**Market sophistication**	**38.3**	**103**	
4.1	Credit	25.4	96	
4.1.1	Ease of getting credit*	25.0	119	
4.1.2	Domestic credit to private sector, % GDP	43.9	77	
4.1.3	Microfinance gross loans, % GDP	1.9	16	●
4.2	Investment	32.4	99	
4.2.1	Ease of protecting minority investors*	56.7	67	
4.2.2	Market capitalization, % GDP ⓐ	37.1	40	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	91	○
4.3	Trade, competition, & market scale	57.1	82	
4.3.1	Applied tariff rate, weighted mean, %	11.9	121	○
4.3.2	Intensity of local competition†	68.5	69	
4.3.3	Domestic market scale, bn PPP$	628.4	32	●
5	**Business sophistication**	**25.6**	**99**	
5.1	Knowledge workers	29.4	[84]	
5.1.1	Knowledge-intensive employment, % ⓐ	20.0	74	
5.1.2	Firms offering formal training, % firms	21.9	72	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	23.5	81	
5.2.1	University/industry research collaboration†	25.7	116	
5.2.2	State of cluster development†	44.0	72	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	84	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	116	○
5.3	Knowledge absorption	24.0	105	
5.3.1	Intellectual property payments, % total trade ⓐ	0.1	104	
5.3.2	High-tech imports less re-imports, % total trade ⓐ	9.4	48	●
5.3.3	ICT services imports, % total trade ⓐ	0.1	119	
5.3.4	FDI net inflows, % GDP	1.6	91	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**16.0**	**96**	
6.1	Knowledge creation	4.5	95	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	110	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.9	110	
6.1.5	Citable documents H index	9.8	63	●
6.2	Knowledge impact	29.2	72	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.8	16	●
6.2.2	New businesses/th pop. 15–64 ⓐ	0.1	101	○
6.2.3	Computer software spending, % GDP	0.2	77	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.8	114	
6.2.5	High- & medium-high-tech manufactures, % ⓐ	0.1	84	
6.3	Knowledge diffusion	14.4	112	
6.3.1	Intellectual property receipts, % total trade ⓐ	0.0	98	
6.3.2	High-tech exports less re-exports, % total trade ⓐ	0.1	107	
6.3.3	ICT services exports, % total trade ⓐ	1.1	78	
6.3.4	FDI net outflows, % GDP	0.1	90	
7	**Creative outputs**	**17.6**	**110**	
7.1	Intangible assets	30.1	104	
7.1.1	Trademarks by origin/bn PPP$ GDP	16.1	92	
7.1.2	Industrial designs by origin/bn PPP$ GDP	2.2	42	●
7.1.3	ICTs & business model creation†	49.5	103	
7.1.4	ICTs & organizational model creation†	42.0	104	
7.2	Creative goods & services	1.1	125	○
7.2.1	Cultural & creative services exports, % of total trade	0.0	83	
7.2.2	National feature films/mn pop. 15–69 ⓐ	0.7	87	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓐ	0.2	99	○
7.2.5	Creative goods exports, % total trade ⓐ	0.1	100	
7.3	Online creativity	8.9	102	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.4	111	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	123	○
7.3.3	Wikipedia edits/mn pop. 15–69	2.7	103	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Belarus

Key indicators

Population (millions)	9.5
GDP (US$ billions)	48.1
GDP per capita, PPP$	17,654.2
Income group	Upper-middle income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**30.0**	**88**	
	Innovation Output Sub-Index	16.7	109	○
	Innovation Input Sub-Index	43.2	63	
	Innovation Efficiency Ratio	0.4	120	○
	Global Innovation Index 2016 (out of 128)	30.4	79	
1	**Institutions**	**54.1**	**81**	
1.1	Political environment	46.9	77	
1.1.1	Political stability & safety*	63.8	61	
1.1.2	Government effectiveness*	29.9	93	
1.2	Regulatory environment	44.7	109	○
1.2.1	Regulatory quality*	16.5	120	○
1.2.2	Rule of law*	16.4	107	○
1.2.3	Cost of redundancy dismissal, salary weeks	21.7	90	
1.3	Business environment	70.8	64	
1.3.1	Ease of starting a business*	92.9	28	●
1.3.2	Ease of resolving insolvency*	49.1	64	
1.3.3	Ease of paying taxes*	70.4	74	
2	**Human capital & research**	**41.9**	**36**	
2.1	Education	64.5	12	●
2.1.1	Expenditure on education, % GDP	4.9	52	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.7	34	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	8.4	12	●
2.2	Tertiary education	51.8	17	●
2.2.1	Tertiary enrolment, % gross	87.9	6	●
2.2.2	Graduates in science & engineering, %	28.6	12	●
2.2.3	Tertiary inbound mobility, %	3.3	54	
2.3	Research & development (R&D)	9.4	60	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.5	63	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	16.4	55	
3	**Infrastructure**	**46.1**	**67**	
3.1	Information & communication technologies (ICTs)	60.3	59	
3.1.1	ICT access*	78.0	32	
3.1.2	ICT use*	58.8	39	
3.1.3	Government's online service*	48.6	87	
3.1.4	E-participation*	55.9	74	
3.2	General infrastructure	33.7	79	
3.2.1	Electricity output, kWh/cap	3,667.9	56	
3.2.2	Logistics performance*	15.6	112	○
3.2.3	Gross capital formation, % GDP	26.9	32	
3.3	Ecological sustainability	44.3	65	
3.3.1	GDP/unit of energy use	5.8	94	
3.3.2	Environmental performance*	82.3	35	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.6	44	
4	**Market sophistication**	**41.9**	**90**	
4.1	Credit	19.2	114	○
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	2.9	126	○
4.1.3	Microfinance gross loans, % GDP	0.7	30	
4.2	Investment	42.8	51	
4.2.1	Ease of protecting minority investors*	63.3	41	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	82	○
4.3	Trade, competition, & market scale	63.7	54	
4.3.1	Applied tariff rate, weighted mean, %	1.8	52	
4.3.2	Intensity of local competition†	n/a	n/a	
4.3.3	Domestic market scale, bn PPP$	165.4	65	
5	**Business sophistication**	**32.2**	**65**	
5.1	Knowledge workers	59.1	25	●
5.1.1	Knowledge-intensive employment, %ⓓ	35.9	34	
5.1.2	Firms offering formal training, % firms	51.1	21	●
5.1.3	GERD performed by business, % of GDP	0.3	41	
5.1.4	GERD financed by business, %	41.3	32	
5.1.5	Females employed w/advanced degrees, % totalⓓ	33.9	1	●
5.2	Innovation linkages	13.9	124	○
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, %	12.7	39	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	53	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.4	39	
5.3	Knowledge absorption	23.6	107	○
5.3.1	Intellectual property payments, % total trade	0.4	69	
5.3.2	High-tech imports less re-imports, % total trade	5.2	105	○
5.3.3	ICT services imports, % total trade	0.6	89	
5.3.4	FDI net inflows, % GDP	2.8	63	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**21.7**	**61**	
6.1	Knowledge creation	23.8	39	
6.1.1	Patents by origin/bn PPP$ GDP	4.2	27	●
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	63	
6.1.3	Utility models by origin/bn PPP$ GDP	2.3	11	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.5	85	
6.1.5	Citable documents H index	9.7	64	
6.2	Knowledge impact	21.1	105	
6.2.1	Growth rate of PPP$ GDP/worker, %	(2.4)	104	○
6.2.2	New businesses/th pop. 15–64	1.1	68	
6.2.3	Computer software spending, % GDP	0.0	108	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	21.7	17	●
6.2.5	High- & medium-high-tech manufactures, %	0.3	41	
6.3	Knowledge diffusion	20.2	76	
6.3.1	Intellectual property receipts, % total trade	0.1	61	
6.3.2	High-tech exports less re-exports, % total trade	1.8	57	
6.3.3	ICT services exports, % total trade	3.1	29	●
6.3.4	FDI net outflows, % GDP	0.2	84	
7	**Creative outputs**	**11.7**	**123**	○
7.1	Intangible assets	11.0	124	○
7.1.1	Trademarks by origin/bn PPP$ GDP	26.7	76	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.2	57	
7.1.3	ICTs & business model creation†	n/a	n/a	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	Creative goods & services	4.2	113	○
7.2.1	Cultural & creative services exports, % of total trade	0.0	67	
7.2.2	National feature films/mn pop. 15–69ⓓ	0.1	100	○
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.2	74	
7.3	Online creativity	20.8	61	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.8	82	
7.3.2	Country-code TLDs/th pop. 15–69	5.2	48	
7.3.3	Wikipedia edits/mn pop. 15–69	5.7	46	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Belgium

Key indicators

Population (millions)	11.4
GDP (US$ billions)	470.2
GDP per capita, PPP$	43,585.0
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**49.9**	**27**
Innovation Output Sub-Index	40.2	27
Innovation Input Sub-Index	59.5	22
Innovation Efficiency Ratio	0.7	47
Global Innovation Index 2016 (out of 128)	52.0	23

		Score/Value	Rank	
1	**Institutions**	**80.5**	**26**	
1.1	Political environment	78.8	23	
1.1.1	Political stability & safety*	78.5	37	
1.1.2	Government effectiveness*	79.2	22	
1.2	Regulatory environment	77.4	32	
1.2.1	Regulatory quality*	74.8	21	
1.2.2	Rule of law*	80.9	20	
1.2.3	Cost of redundancy dismissal, salary weeks	19.7	81	○
1.3	Business environment	85.4	22	
1.3.1	Ease of starting a business*	94.5	16	
1.3.2	Ease of resolving insolvency*	84.3	9	●
1.3.3	Ease of paying taxes*	77.3	56	
2	**Human capital & research**	**59.7**	**11**	●
2.1	Education	72.8	6	●
2.1.1	Expenditure on education, % GDPⓐ	6.4	17	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/capⓐ	37.6	8	●
2.1.3	School life expectancy, years	19.9	2	●
2.1.4	PISA scales in reading, maths, & science	502.5	18	
2.1.5	Pupil-teacher ratio, secondaryⓐ	9.4	19	
2.2	Tertiary education	45.6	31	
2.2.1	Tertiary enrolment, % grossⓐ	73.3	22	
2.2.2	Graduates in science & engineering, %ⓐ	16.4	76	○
2.2.3	Tertiary inbound mobility, %ⓐ	11.2	14	
2.3	Research & development (R&D)	60.6	16	
2.3.1	Researchers, FTE/mn pop.	4,875.3	12	
2.3.2	Gross expenditure on R&D, % GDP	2.5	11	●
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	66.7	20	
2.3.4	QS university ranking, average score top 3*	59.6	16	
3	**Infrastructure**	**57.2**	**32**	
3.1	Information & communication technologies (ICTs)	72.5	32	
3.1.1	ICT access*	83.4	16	
3.1.2	ICT use*	71.0	22	
3.1.3	Government's online service*	71.0	43	
3.1.4	E-participation*	64.4	54	○
3.2	General infrastructure	51.9	17	
3.2.1	Electricity output, kWh/cap	5,969.5	34	
3.2.2	Logistics performance*	94.6	6	●
3.2.3	Gross capital formation, % GDP	23.7	51	
3.3	Ecological sustainability	47.3	54	
3.3.1	GDP/unit of energy use	8.5	63	○
3.3.2	Environmental performance*	80.2	41	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.3	46	
4	**Market sophistication**	**51.8**	**40**	
4.1	Credit	34.5	66	○
4.1.1	Ease of getting credit*	45.0	84	○
4.1.2	Domestic credit to private sector, % GDP	61.5	51	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	46.7	37	
4.2.1	Ease of protecting minority investors*	58.3	62	○
4.2.2	Market capitalization, % GDP	91.1	11	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	19	
4.3	Trade, competition, & market scale	74.1	24	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	80.8	12	●
4.3.3	Domestic market scale, bn PPP$	508.6	35	
5	**Business sophistication**	**48.5**	**22**	
5.1	Knowledge workers	71.1	6	●
5.1.1	Knowledge-intensive employment, %	45.6	11	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	1.8	11	
5.1.4	GERD financed by business, %ⓐ	61.3	10	
5.1.5	Females employed w/advanced degrees, % total	23.3	14	
5.2	Innovation linkages	41.8	24	
5.2.1	University/industry research collaboration†	71.0	9	●
5.2.2	State of cluster development†	60.1	24	
5.2.3	GERD financed by abroad, %ⓐ	13.2	35	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	29	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	3.8	17	
5.3	Knowledge absorption	32.4	67	○
5.3.1	Intellectual property payments, % total trade	0.9	38	
5.3.2	High-tech imports less re-imports, % total trade	10.3	42	
5.3.3	ICT services imports, % total trade	2.3	16	
5.3.4	FDI net inflows, % GDP	(4.6)	127	○
5.3.5	Research talent, % in business enterprise	48.3	27	
6	**Knowledge & technology outputs**	**33.2**	**31**	
6.1	Knowledge creation	43.3	17	
6.1.1	Patents by origin/bn PPP$ GDP	6.0	20	
6.1.2	PCT patent applications/bn PPP$ GDP	2.4	16	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	40.1	16	
6.1.5	Citable documents H index	52.7	13	
6.2	Knowledge impact	37.4	41	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.5	71	○
6.2.2	New businesses/th pop. 15–64ⓐ	2.1	47	
6.2.3	Computer software spending, % GDP	0.6	8	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.2	51	
6.2.5	High- & medium-high-tech manufactures, %	0.3	31	
6.3	Knowledge diffusion	19.1	87	○
6.3.1	Intellectual property receipts, % total trade	0.8	19	
6.3.2	High-tech exports less re-exports, % total trade	11.1	19	
6.3.3	ICT services exports, % total trade	3.0	30	
6.3.4	FDI net outflows, % GDP	(3.1)	124	○
7	**Creative outputs**	**47.1**	**19**	
7.1	Intangible assets	51.3	34	
7.1.1	Trademarks by origin/bn PPP$ GDP	49.3	53	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	2.9	38	
7.1.3	ICTs & business model creation†	76.4	19	
7.1.4	ICTs & organizational model creation†	70.4	22	
7.2	Creative goods & services	39.8	12	●
7.2.1	Cultural & creative services exports, % of total tradeⓐ	1.6	4	●
7.2.2	National feature films/mn pop. 15–69	8.7	18	
7.2.3	Global ent. & media market/th pop. 15–69	52.8	16	
7.2.4	Printing & publishing manufactures, %	1.2	45	
7.2.5	Creative goods exports, % total trade	1.8	28	
7.3	Online creativity	46.1	20	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	22.1	27	
7.3.2	Country-code TLDs/th pop. 15–69	58.0	12	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.2	33	
7.3.4	Video uploads on YouTube/pop. 15–69	44.1	25	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Benin

Key indicators

Population (millions)	11.2
GDP (US$ billions)	8.9
GDP per capita, PPP$	2,113.2
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**23.0**	**116**	
Innovation Output Sub-Index	14.8	120	
Innovation Input Sub-Index	31.3	110	
Innovation Efficiency Ratio	0.5	110	
Global Innovation Index 2016 (out of 128)	22.2	121	

		Score	Rank	
1	**Institutions**	**54.0**	**82**	
1.1	Political environment	45.1	83	
1.1.1	Political stability & safety*	63.9	60	
1.1.2	Government effectiveness*	26.3	102	
1.2	Regulatory environment	59.0	74	
1.2.1	Regulatory quality*	27.9	103	
1.2.2	Rule of law*	22.4	95	
1.2.3	Cost of redundancy dismissal, salary weeks	11.6	41	●
1.3	Business environment	58.0	106	
1.3.1	Ease of starting a business*	90.6	48	●
1.3.2	Ease of resolving insolvency*	38.7	101	
1.3.3	Ease of paying taxes*	44.6	119	
2	**Human capital & research**	**21.1**	**97**	
2.1	Education	39.0	90	
2.1.1	Expenditure on education, % GDP	4.3	72	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	11.4	92	
2.1.3	School life expectancy, years ⓓ	12.1	85	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	10.3	28	●
2.2	Tertiary education	24.4	94	
2.2.1	Tertiary enrolment, % gross ⓓ	15.4	97	
2.2.2	Graduates in science & engineering, % ⓓ	12.7	92	
2.2.3	Tertiary inbound mobility, % ⓓ	7.9	22	●
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**23.3**	**123**	○
3.1	Information & communication technologies (ICTs)	16.0	123	○
3.1.1	ICT access*	28.6	113	
3.1.2	ICT use*	4.0	124	○
3.1.3	Government's online service*	14.5	119	○
3.1.4	E-participation*	16.9	117	
3.2	General infrastructure	30.0	93	
3.2.1	Electricity output, kWh/cap	17.4	119	○
3.2.2	Logistics performance*	16.9	109	
3.2.3	Gross capital formation, % GDP	26.2	34	●
3.3	Ecological sustainability	23.7	121	○
3.3.1	GDP/unit of energy use	4.7	107	
3.3.2	Environmental performance*	43.7	117	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.0	124	○
4	**Market sophistication**	**30.6**	**120**	
4.1	Credit	21.4	109	
4.1.1	Ease of getting credit*	30.0	108	
4.1.2	Domestic credit to private sector, % GDP	21.5	111	
4.1.3	Microfinance gross loans, % GDP	1.5	21	●
4.2	Investment	40.0	[64]	
4.2.1	Ease of protecting minority investors*	40.0	111	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	30.3	125	○
4.3.1	Applied tariff rate, weighted mean, %	17.2	126	○
4.3.2	Intensity of local competition†	63.7	84	
4.3.3	Domestic market scale, bn PPP$	24.3	116	
5	**Business sophistication**	**27.5**	**[88]**	
5.1	Knowledge workers	21.9	[107]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	20.0	76	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	37.6	[38]	
5.2.1	University/industry research collaboration†	35.6	91	
5.2.2	State of cluster development†	38.6	90	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	Knowledge absorption	23.1	108	
5.3.1	Intellectual property payments, % total trade ⓓ	0.1	106	
5.3.2	High-tech imports less re-imports, % total trade	2.6	124	○
5.3.3	ICT services imports, % total trade ⓓ	1.3	55	●
5.3.4	FDI net inflows, % GDP	3.6	45	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**8.5**	**122**	○
6.1	Knowledge creation	5.1	87	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	96	
6.1.2	PCT patent applications/bn PPP$ GDP ⓓ	0.0	83	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	11.3	62	
6.1.5	Citable documents H index	3.4	108	
6.2	Knowledge impact	3.8	[122]	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.1	101	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.2	89	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	16.6	103	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	105	○
6.3.2	High-tech exports less re-exports, % total trade	0.1	118	
6.3.3	ICT services exports, % total trade ⓓ	1.8	55	●
6.3.4	FDI net outflows, % GDP	0.4	74	
7	**Creative outputs**	**21.0**	**99**	
7.1	Intangible assets	28.6	109	
7.1.1	Trademarks by origin/bn PPP$ GDP	7.5	108	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.3	88	
7.1.3	ICTs & business model creation†	50.1	98	
7.1.4	ICTs & organizational model creation†	45.7	87	
7.2	Creative goods & services	19.6	[60]	
7.2.1	Cultural & creative services exports, % of total trade	1.2	11	●
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	117	
7.3	Online creativity	7.4	105	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.6	104	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	121	○
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	2.2	106	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Bolivia, Plurinational State of

Key indicators

Population (millions)	10.9
GDP (US$ billions)	35.7
GDP per capita, PPP$	6,465.3
Income group	Lower-middle income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**25.6**	**106**
Innovation Output Sub-Index	18.7	99
Innovation Input Sub-Index	32.6	107
Innovation Efficiency Ratio	0.6	85
Global Innovation Index 2016 (out of 128)	25.2	109

1	**Institutions**	**29.8**	**127**	○
1.1	Political environment	41.1	92	
1.1.1	Political stability & safety*	57.0	77	
1.1.2	Government effectiveness*	25.3	106	
1.2	Regulatory environment	6.2	127	○
1.2.1	Regulatory quality*	18.9	117	
1.2.2	Rule of law*	5.8	124	○
1.2.3	Cost of redundancy dismissal, salary weeks ⓓ	82.3	126	○
1.3	Business environment	42.2	127	○
1.3.1	Ease of starting a business*	62.9	124	○
1.3.2	Ease of resolving insolvency*	42.3	85	
1.3.3	Ease of paying taxes*	21.4	127	○
2	**Human capital & research**	**25.8**	**85**	
2.1	Education	50.3	52	●
2.1.1	Expenditure on education, % GDP	7.3	11	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	18.4	57	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	18.2	76	
2.2	Tertiary education	n/a	n/a	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	1.3	99	
2.3.1	Researchers, FTE/mn pop. ⓓ	166.0	79	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.2	93	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**35.3**	**102**	
3.1	Information & communication technologies (ICTs)	44.5	88	
3.1.1	ICT access*	43.7	95	
3.1.2	ICT use*	27.2	92	
3.1.3	Government's online service*	49.3	86	
3.1.4	E-participation*	57.6	70	
3.2	General infrastructure	20.8	117	
3.2.1	Electricity output, kWh/cap	829.1	98	
3.2.2	Logistics performance*	8.7	120	○
3.2.3	Gross capital formation, % GDP	19.2	92	
3.3	Ecological sustainability	40.6	80	
3.3.1	GDP/unit of energy use	7.9	72	
3.3.2	Environmental performance*	71.1	69	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	74	
4	**Market sophistication**	**46.2**	**63**	
4.1	Credit	52.5	24	●
4.1.1	Ease of getting credit*	35.0	104	
4.1.2	Domestic credit to private sector, % GDP	58.1	52	●
4.1.3	Microfinance gross loans, % GDP	19.6	1	●
4.2	Investment	30.1	112	
4.2.1	Ease of protecting minority investors*	41.7	105	
4.2.2	Market capitalization, % GDP ⓓ	16.4	65	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	55.9	89	
4.3.1	Applied tariff rate, weighted mean, %	4.8	87	
4.3.2	Intensity of local competition†	65.6	79	
4.3.3	Domestic market scale, bn PPP$	78.4	81	
5	**Business sophistication**	**26.0**	**98**	
5.1	Knowledge workers	40.0	56	●
5.1.1	Knowledge-intensive employment, % ⓓ	15.2	86	
5.1.2	Firms offering formal training, % firms ⓓ	57.1	11	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⓓ	5.2	77	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	13.6	125	○
5.2.1	University/industry research collaboration†	23.8	120	○
5.2.2	State of cluster development†	30.8	119	○
5.2.3	GERD financed by abroad, % ⓓ	1.9	76	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	85	
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.0	108	
5.3	Knowledge absorption	24.3	102	
5.3.1	Intellectual property payments, % total trade	0.6	57	●
5.3.2	High-tech imports less re-imports, % total trade	10.0	45	●
5.3.3	ICT services imports, % total trade	0.8	80	
5.3.4	FDI net inflows, % GDP	3.0	55	●
5.3.5	Research talent, % in business enterprise ⓓ	0.4	83	○
6	**Knowledge & technology outputs**	**15.6**	**99**	
6.1	Knowledge creation	3.2	111	
6.1.1	Patents by origin/bn PPP$ GDP ⓓ	0.1	104	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP ⓓ	0.2	44	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.2	109	
6.1.5	Citable documents H index	5.5	91	
6.2	Knowledge impact	27.9	79	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.8	23	●
6.2.2	New businesses/th pop. 15–64	0.6	84	
6.2.3	Computer software spending, % GDP	0.2	71	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.1	77	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	85	
6.3	Knowledge diffusion	15.8	110	
6.3.1	Intellectual property receipts, % total trade	0.2	36	●
6.3.2	High-tech exports less re-exports, % total trade	0.2	97	
6.3.3	ICT services exports, % total trade	1.0	85	
6.3.4	FDI net outflows, % GDP	0.0	109	
7	**Creative outputs**	**21.7**	**96**	
7.1	Intangible assets	29.2	107	
7.1.1	Trademarks by origin/bn PPP$ GDP ⓓ	35.1	65	
7.1.2	Industrial designs by origin/bn PPP$ GDP ⓓ	0.4	85	
7.1.3	ICTs & business model creation†	47.4	110	
7.1.4	ICTs & organizational model creation†	36.1	115	
7.2	Creative goods & services	16.2	72	
7.2.1	Cultural & creative services exports, % of total trade	0.1	61	
7.2.2	National feature films/mn pop. 15–69	0.9	81	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	1.1	56	
7.2.5	Creative goods exports, % total trade	1.3	35	●
7.3	Online creativity	12.3	93	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.8	80	
7.3.2	Country-code TLDs/th pop. 15–69	0.5	89	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	3.6	93	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Bosnia and Herzegovina

Key indicators

Population (millions)	3.8
GDP (US$ billions)	16.5
GDP per capita, PPP$	10,491.8
Income group	Upper-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**30.2**	**86**	
Innovation Output Sub-Index	19.3	96	
Innovation Input Sub-Index	41.1	75	
Innovation Efficiency Ratio	0.5	112	○
Global Innovation Index 2016 (out of 128)	29.6	87	

		Score	Rank	
1	**Institutions**	**56.8**	**71**	
1.1	Political environment	40.5	94	
1.1.1	Political stability & safety*	52.9	86	
1.1.2	Government effectiveness*	28.2	97	
1.2	Regulatory environment	65.9	59	
1.2.1	Regulatory quality*	37.5	80	
1.2.2	Rule of law*	30.9	75	
1.2.3	Cost of redundancy dismissal, salary weeks	9.2	26	●
1.3	Business environment	64.0	80	
1.3.1	Ease of starting a business*	65.1	122	○
1.3.2	Ease of resolving insolvency*	66.9	38	●
1.3.3	Ease of paying taxes*	60.1	95	
2	**Human capital & research**	**41.3**	**39**	
2.1	Education	90.2	[1]	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	10.1	26	●
2.2	Tertiary education	31.4	76	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	15.4	84	
2.2.3	Tertiary inbound mobility, %	7.5	25	●
2.3	Research & development (R&D)	2.2	92	
2.3.1	Researchers, FTE/mn pop.	328.7	69	
2.3.2	Gross expenditure on R&D, % GDP	0.2	88	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**36.9**	**96**	
3.1	Information & communication technologies (ICTs)	48.9	81	
3.1.1	ICT access*	57.8	74	
3.1.2	ICT use*	42.1	66	
3.1.3	Government's online service*	44.9	94	
3.1.4	E-participation*	50.8	87	
3.2	General infrastructure	25.5	106	
3.2.1	Electricity output, kWh/cap	4,230.4	50	
3.2.2	Logistics performance*	24.7	95	
3.2.3	Gross capital formation, % GDP	17.1	103	
3.3	Ecological sustainability	36.2	99	
3.3.1	GDP/unit of energy use	4.5	108	○
3.3.2	Environmental performance*	63.3	98	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.7	28	●
4	**Market sophistication**	**43.4**	**79**	
4.1	Credit	36.0	60	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	53.7	64	
4.1.3	Microfinance gross loans, % GDP	1.2	23	●
4.2	Investment	38.4	73	
4.2.1	Ease of protecting minority investors*	55.0	75	
4.2.2	Market capitalization, % GDP ◴	12.2	74	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	55.8	91	
4.3.1	Applied tariff rate, weighted mean, %	1.1	14	●
4.3.2	Intensity of local competition†	57.6	110	○
4.3.3	Domestic market scale, bn PPP$	42.5	96	
5	**Business sophistication**	**27.4**	**90**	
5.1	Knowledge workers	37.7	61	
5.1.1	Knowledge-intensive employment, %	24.0	60	
5.1.2	Firms offering formal training, % firms	52.4	18	●
5.1.3	GERD performed by business, % of GDP	0.1	66	
5.1.4	GERD financed by business, %	31.4	48	
5.1.5	Females employed w/advanced degrees, % total	3.2	81	○
5.2	Innovation linkages	23.9	80	
5.2.1	University/industry research collaboration†	29.6	105	
5.2.2	State of cluster development†	35.8	99	
5.2.3	GERD financed by abroad, %	16.9	25	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	56	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	56	
5.3	Knowledge absorption	20.6	120	○
5.3.1	Intellectual property payments, % total trade	0.1	90	
5.3.2	High-tech imports less re-imports, % total trade	6.5	84	
5.3.3	ICT services imports, % total trade	0.8	79	
5.3.4	FDI net inflows, % GDP	2.1	80	
5.3.5	Research talent, % in business enterprise	6.5	71	
6	**Knowledge & technology outputs**	**17.2**	**92**	
6.1	Knowledge creation	5.9	84	
6.1.1	Patents by origin/bn PPP$ GDP ◴	1.0	62	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	66	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.2	66	
6.1.5	Citable documents H index	3.0	110	○
6.2	Knowledge impact	27.2	82	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.3	46	
6.2.2	New businesses/th pop. 15–64	0.8	77	
6.2.3	Computer software spending, % GDP	0.1	89	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	19.4	20	●
6.2.5	High- & medium-high-tech manufactures, % ◴	0.1	79	
6.3	Knowledge diffusion	18.5	94	
6.3.1	Intellectual property receipts, % total trade	0.2	42	
6.3.2	High-tech exports less re-exports, % total trade	1.4	63	
6.3.3	ICT services exports, % total trade	1.7	60	
6.3.4	FDI net outflows, % GDP	0.3	79	
7	**Creative outputs**	**21.4**	**98**	
7.1	Intangible assets	26.5	118	○
7.1.1	Trademarks by origin/bn PPP$ GDP	16.9	88	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.6	75	
7.1.3	ICTs & business model creation†	44.7	116	○
7.1.4	ICTs & organizational model creation†	38.4	110	○
7.2	Creative goods & services	11.2	85	
7.2.1	Cultural & creative services exports, % of total trade	0.0	81	○
7.2.2	National feature films/mn pop. 15–69	4.8	40	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ◴	1.1	63	
7.2.5	Creative goods exports, % total trade	0.3	65	
7.3	Online creativity	21.5	58	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.4	73	
7.3.2	Country-code TLDs/th pop. 15–69	2.0	67	
7.3.3	Wikipedia edits/mn pop. 15–69	6.0	43	
7.3.4	Video uploads on YouTube/pop. 15–69	23.2	55	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◴ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Botswana

Key indicators

Population (millions)	2.3
GDP (US$ billions)	10.9
GDP per capita, PPP$	16,368.2
Income group	Upper-middle income
Region	Sub-Saharan Africa

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**30.0**	**89**	
	Innovation Output Sub-Index	16.4	111	
	Innovation Input Sub-Index	43.6	59	
	Innovation Efficiency Ratio	0.4	121	○
	Global Innovation Index 2016 (out of 128)	29.0	90	
1	**Institutions**	**68.6**	**46**	
1.1	Political environment	72.1	36	
1.1.1	Political stability & safety*	88.8	12	●
1.1.2	Government effectiveness*	55.3	43	
1.2	Regulatory environment	64.6	65	
1.2.1	Regulatory quality*	54.5	50	
1.2.2	Rule of law*	57.9	39	
1.2.3	Cost of redundancy dismissal, salary weeks	21.7	93	
1.3	Business environment	69.1	71	
1.3.1	Ease of starting a business*	76.2	113	○
1.3.2	Ease of resolving insolvency*	50.5	59	
1.3.3	Ease of paying taxes*	80.6	46	
2	**Human capital & research**	**32.0**	**65**	
2.1	Education	68.3	9	●
2.1.1	Expenditure on education, % GDPⓓ	9.6	1	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/capⓓ	42.0	3	●
2.1.3	School life expectancy, yearsⓓ	12.1	87	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondaryⓓ	13.8	56	
2.2	Tertiary education	24.1	96	
2.2.1	Tertiary enrolment, % grossⓓ	27.5	84	
2.2.2	Graduates in science & engineering, %	17.5	70	
2.2.3	Tertiary inbound mobility, %ⓓ	1.6	76	
2.3	Research & development (R&D)	3.6	82	
2.3.1	Researchers, FTE/mn pop.ⓓ	175.5	78	
2.3.2	Gross expenditure on R&D, % GDPⓓ	0.5	60	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**41.0**	**83**	
3.1	Information & communication technologies (ICTs)	33.2	103	
3.1.1	ICT access*	43.3	96	
3.1.2	ICT use*	32.6	81	
3.1.3	Government's online service*	28.3	109	
3.1.4	E-participation*	28.8	107	
3.2	General infrastructure	42.8	45	
3.2.1	Electricity output, kWh/cap	1,064.4	91	
3.2.2	Logistics performance*	45.4	56	
3.2.3	Gross capital formation, % GDP	30.4	17	●
3.3	Ecological sustainability	46.8	57	
3.3.1	GDP/unit of energy use	12.3	25	●
3.3.2	Environmental performance*	70.7	72	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	103	
4	**Market sophistication**	**49.3**	**52**	
4.1	Credit	33.8	68	
4.1.1	Ease of getting credit*	55.0	67	
4.1.2	Domestic credit to private sector, % GDP	33.9	95	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	55.0	[23]	
4.2.1	Ease of protecting minority investors*	55.0	75	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	59.0	75	
4.3.1	Applied tariff rate, weighted mean, %	0.5	6	●
4.3.2	Intensity of local competition†	71.2	49	
4.3.3	Domestic market scale, bn PPP$	36.5	103	
5	**Business sophistication**	**27.1**	**91**	
5.1	Knowledge workers	34.4	76	
5.1.1	Knowledge-intensive employment, %ⓓ	17.8	80	
5.1.2	Firms offering formal training, % firmsⓓ	51.9	19	●
5.1.3	GERD performed by business, % of GDPⓓ	0.1	62	
5.1.4	GERD financed by business, %ⓓ	17.7	65	
5.1.5	Females employed w/advanced degrees, % totalⓓ	9.1	67	
5.2	Innovation linkages	31.2	54	
5.2.1	University/industry research collaboration†	40.2	69	
5.2.2	State of cluster development†	40.6	84	
5.2.3	GERD financed by abroad, %ⓓ	21.7	18	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	20	●
5.2.5	Patent families 2+ offices/bn PPP$ GDPⓓ	0.1	72	
5.3	Knowledge absorption	15.7	126	○
5.3.1	Intellectual property payments, % total tradeⓓ	0.1	99	
5.3.2	High-tech imports less re-imports, % total trade	3.7	117	○
5.3.3	ICT services imports, % total tradeⓓ	0.5	98	
5.3.4	FDI net inflows, % GDP	2.9	60	
5.3.5	Research talent, % in business enterpriseⓓ	1.0	77	○
6	**Knowledge & technology outputs**	**15.6**	**102**	
6.1	Knowledge creation	2.8	115	○
6.1.1	Patents by origin/bn PPP$ GDPⓓ	0.1	105	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	91	
6.1.3	Utility models by origin/bn PPP$ GDPⓓ	0.0	61	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.2	73	
6.1.5	Citable documents H index	4.7	97	
6.2	Knowledge impact	29.0	73	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	13.1	8	●
6.2.3	Computer software spending, % GDP	0.1	85	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.4	119	○
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	15.0	111	
6.3.1	Intellectual property receipts, % total tradeⓓ	0.0	99	○
6.3.2	High-tech exports less re-exports, % total trade	0.5	82	
6.3.3	ICT services exports, % total tradeⓓ	0.3	111	○
6.3.4	FDI net outflows, % GDP	0.6	65	
7	**Creative outputs**	**17.1**	**114**	○
7.1	Intangible assets	28.4	110	
7.1.1	Trademarks by origin/bn PPP$ GDPⓓ	10.4	102	○
7.1.2	Industrial designs by origin/bn PPP$ GDPⓓ	0.3	89	
7.1.3	ICTs & business model creation†	52.5	92	
7.1.4	ICTs & organizational model creation†	41.3	106	
7.2	Creative goods & services	6.1	[102]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.2	76	
7.3	Online creativity	5.5	109	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.0	94	
7.3.2	Country-code TLDs/th pop. 15–69	1.4	73	
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	1.5	111	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Brazil

Key indicators

Population (millions)	209.6
GDP (US$ billions)	1,769.6
GDP per capita, PPP$	15,614.5
Income group	Upper-middle income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**33.1**	**69**
Innovation Output Sub-Index	22.7	80
Innovation Input Sub-Index	43.5	60
Innovation Efficiency Ratio	0.5	99
Global Innovation Index 2016 (out of 128)	33.2	69

		Score/Value	Rank	
1	**Institutions**	**51.8**	**91**	
1.1	Political environment	46.0	80	
1.1.1	Political stability & safety*	54.6	80	
1.1.2	Government effectiveness*	37.3	81	
1.2	Regulatory environment	60.2	72	
1.2.1	Regulatory quality*	36.7	83	
1.2.2	Rule of law*	33.8	71	
1.2.3	Cost of redundancy dismissal, salary weeks	15.4	62	
1.3	Business environment	49.1	123	○
1.3.1	Ease of starting a business*	65.0	123	○
1.3.2	Ease of resolving insolvency*	49.2	62	
1.3.3	Ease of paying taxes*	33.0	124	○
2	**Human capital & research**	**35.9**	**50**	
2.1	Education	49.3	56	
2.1.1	Expenditure on education, % GDP	6.0	21	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	21.6	48	
2.1.3	School life expectancy, years	15.3	41	
2.1.4	PISA scales in reading, maths, & science	395.0	64	○
2.1.5	Pupil-teacher ratio, secondary◷	16.7	73	
2.2	Tertiary education	21.1	101	○
2.2.1	Tertiary enrolment, % gross◷	49.3	53	
2.2.2	Graduates in science & engineering, %◷	12.0	96	○
2.2.3	Tertiary inbound mobility, %◷	0.2	100	○
2.3	Research & development (R&D)	37.2	29	●
2.3.1	Researchers, FTE/mn pop.◷	698.1	55	
2.3.2	Gross expenditure on R&D, % GDP◷	1.2	32	●
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	66.1	21	●
2.3.4	QS university ranking, average score top 3*	47.4	24	●
3	**Infrastructure**	**48.3**	**57**	
3.1	Information & communication technologies (ICTs)	66.6	41	
3.1.1	ICT access*	64.2	66	
3.1.2	ICT use*	56.0	47	
3.1.3	Government's online service*	73.2	37	●
3.1.4	E-participation*	72.9	37	●
3.2	General infrastructure	30.9	91	
3.2.1	Electricity output, kWh/cap	2,866.0	63	
3.2.2	Logistics performance*	47.4	54	
3.2.3	Gross capital formation, % GDP	18.0	98	○
3.3	Ecological sustainability	47.5	52	
3.3.1	GDP/unit of energy use	10.1	47	
3.3.2	Environmental performance*	78.9	45	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.0	65	
4	**Market sophistication**	**44.2**	**74**	
4.1	Credit	24.1	102	○
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	67.9	44	
4.1.3	Microfinance gross loans, % GDP	0.0	62	
4.2	Investment	37.3	78	
4.2.1	Ease of protecting minority investors*	65.0	31	
4.2.2	Market capitalization, % GDP	27.6	51	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	48	
4.3	Trade, competition, & market scale	71.1	32	●
4.3.1	Applied tariff rate, weighted mean, %	8.3	108	○
4.3.2	Intensity of local competition†	71.0	51	
4.3.3	Domestic market scale, bn PPP$	3,134.9	7	●
5	**Business sophistication**	**37.2**	**43**	
5.1	Knowledge workers	41.7	52	
5.1.1	Knowledge-intensive employment, %◷	21.6	67	
5.1.2	Firms offering formal training, % firms◷	42.2	29	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %◷	36.4	42	
5.1.5	Females employed w/advanced degrees, % total◷	9.1	66	
5.2	Innovation linkages	28.0	63	
5.2.1	University/industry research collaboration†	37.4	84	
5.2.2	State of cluster development†	49.3	43	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	90	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	61	
5.3	Knowledge absorption	41.9	29	●
5.3.1	Intellectual property payments, % total trade	2.3	8	●
5.3.2	High-tech imports less re-imports, % total trade	12.4	22	●
5.3.3	ICT services imports, % total trade	1.4	45	
5.3.4	FDI net inflows, % GDP	3.7	41	
5.3.5	Research talent, % in business enterprise◷	25.9	49	
6	**Knowledge & technology outputs**	**18.9**	**85**	
6.1	Knowledge creation	16.7	50	
6.1.1	Patents by origin/bn PPP$ GDP	1.5	56	
6.1.2	PCT patent applications/bn PPP$ GDP	0.2	52	
6.1.3	Utility models by origin/bn PPP$ GDP	0.8	29	
6.1.4	Scientific & technical articles/bn PPP$ GDP	13.5	55	
6.1.5	Citable documents H index	35.8	23	●
6.2	Knowledge impact	18.8	106	○
6.2.1	Growth rate of PPP$ GDP/worker, %	(4.1)	109	○
6.2.2	New businesses/th pop. 15–64	2.9	39	
6.2.3	Computer software spending, % GDP	0.2	72	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.5	60	
6.2.5	High- & medium-high-tech manufactures, %◷	0.4	21	●
6.3	Knowledge diffusion	21.1	67	
6.3.1	Intellectual property receipts, % total trade	0.3	34	
6.3.2	High-tech exports less re-exports, % total trade	4.1	38	
6.3.3	ICT services exports, % total trade	0.7	92	
6.3.4	FDI net outflows, % GDP	0.8	57	
7	**Creative outputs**	**26.6**	**83**	
7.1	Intangible assets	38.0	81	
7.1.1	Trademarks by origin/bn PPP$ GDP	40.9	57	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.0	61	
7.1.3	ICTs & business model creation†	58.2	71	
7.1.4	ICTs & organizational model creation†	51.3	69	
7.2	Creative goods & services	7.0	99	
7.2.1	Cultural & creative services exports, % of total trade	0.1	56	
7.2.2	National feature films/mn pop. 15–69	0.9	82	○
7.2.3	Global ent. & media market/th pop. 15–69	7.9	40	
7.2.4	Printing & publishing manufactures, %◷	0.8	77	
7.2.5	Creative goods exports, % total trade	0.2	72	
7.3	Online creativity	23.4	55	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.6	86	
7.3.2	Country-code TLDs/th pop. 15–69	7.7	43	
7.3.3	Wikipedia edits/mn pop. 15–69	4.6	67	
7.3.4	Video uploads on YouTube/pop. 15–69	39.7	29	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Brunei Darussalam

Key indicators

Population (millions)	0.4
GDP (US$ billions)	10.5
GDP per capita, PPP$	79,587.0
Income group	High income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**32.9**	**71**	
Innovation Output Sub-Index	16.5	110	○
Innovation Input Sub-Index	49.3	40	
Innovation Efficiency Ratio	0.3	124	○
Global Innovation Index 2016 (out of 128)	n/a	n/a	

		Score/Value	Rank	
1	**Institutions**	**77.2**	**31**	
1.1	Political environment	81.2	20	●
1.1.1	Political stability & safety*	93.1	7	●
1.1.2	Government effectiveness*	69.2	30	●
1.2	Regulatory environment	79.0	27	●
1.2.1	Regulatory quality*	63.7	36	
1.2.2	Rule of law*	52.4	46	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	71.4	62	
1.3.1	Ease of starting a business*	86.7	68	
1.3.2	Ease of resolving insolvency*	55.1	54	
1.3.3	Ease of paying taxes*	72.4	68	
2	**Human capital & research**	**31.1**	**69**	
2.1	Education	46.3	68	
2.1.1	Expenditure on education, % GDP	3.7	88	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	20.1	52	
2.1.3	School life expectancy, years	14.7	56	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	8.8	15	●
2.2	Tertiary education	47.0	27	●
2.2.1	Tertiary enrolment, % gross	30.8	78	
2.2.2	Graduates in science & engineering, %	34.0	6	●
2.2.3	Tertiary inbound mobility, %	4.9	37	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**49.4**	**55**	
3.1	Information & communication technologies (ICTs)	47.5	85	
3.1.1	ICT access*	72.1	47	
3.1.2	ICT use*	29.7	85	
3.1.3	Government's online service*	50.7	83	
3.1.4	E-participation*	37.3	101	
3.2	General infrastructure	61.3	6	●
3.2.1	Electricity output, kWh/cap	10,728.6	12	●
3.2.2	Logistics performance*	37.3	69	
3.2.3	Gross capital formation, % GDP	40.9	5	●
3.3	Ecological sustainability	39.4	84	
3.3.1	GDP/unit of energy use	7.8	73	
3.3.2	Environmental performance*	67.9	86	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.9	66	
4	**Market sophistication**	**48.5**	**54**	
4.1	Credit	37.9	55	
4.1.1	Ease of getting credit*	60.0	55	
4.1.2	Domestic credit to private sector, % GDP	41.4	81	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	51.7	[28]	
4.2.1	Ease of protecting minority investors*	51.7	86	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	55.9	90	
4.3.1	Applied tariff rate, weighted mean, % ⓓ	0.5	5	●
4.3.2	Intensity of local competition†	60.0	102	
4.3.3	Domestic market scale, bn PPP$	33.7	106	
5	**Business sophistication**	**40.2**	**34**	
5.1	Knowledge workers	71.0	[7]	
5.1.1	Knowledge-intensive employment, % ⓓ	40.5	25	●
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	28.0	64	
5.2.1	University/industry research collaboration†	38.4	79	
5.2.2	State of cluster development†	48.9	47	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	93	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	63	
5.3	Knowledge absorption	21.7	115	○
5.3.1	Intellectual property payments, % total trade ⓓ	0.1	91	
5.3.2	High-tech imports less re-imports, % total trade	6.0	96	
5.3.3	ICT services imports, % total trade ⓓ	0.3	113	○
5.3.4	FDI net inflows, % GDP	3.0	56	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**13.6**	**114**	○
6.1	Knowledge creation	4.1	98	
6.1.1	Patents by origin/bn PPP$ GDP ⓓ	0.8	68	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	56	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.1	88	
6.1.5	Citable documents H index	2.1	116	○
6.2	Knowledge impact	2.9	[125]	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	n/a	n/a	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.1	79	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.0	99	○
6.3	Knowledge diffusion	33.9	31	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	1.4	62	
6.3.3	ICT services exports, % total trade ⓓ	0.4	107	○
6.3.4	FDI net outflows, % GDP	3.6	15	●
7	**Creative outputs**	**19.4**	**105**	
7.1	Intangible assets	28.7	108	○
7.1.1	Trademarks by origin/bn PPP$ GDP ⓓ	2.5	115	○
7.1.2	Industrial designs by origin/bn PPP$ GDP ⓓ	0.1	104	○
7.1.3	ICTs & business model creation†	51.9	93	
7.1.4	ICTs & organizational model creation†	47.7	81	
7.2	Creative goods & services	4.5	[110]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	0.5	91	○
7.2.5	Creative goods exports, % total trade	0.1	85	
7.3	Online creativity	15.6	78	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	7.0	47	
7.3.2	Country-code TLDs/th pop. 15–69	0.9	82	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	4.0	81	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Bulgaria

Key indicators

Population (millions)	7.1
GDP (US$ billions)	50.4
GDP per capita, PPP$	19,097.3
Income group	Upper-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**42.8**	**36**	
Innovation Output Sub-Index	38.1	32	
Innovation Input Sub-Index	47.6	45	
Innovation Efficiency Ratio	0.8	15	●
Global Innovation Index 2016 (out of 128)	41.4	38	

1	**Institutions**	**67.1**	**52**	
1.1	Political environment	56.0	55	
1.1.1	Political stability & safety*	64.2	58	
1.1.2	Government effectiveness*	47.7	58	
1.2	Regulatory environment	72.4	40	
1.2.1	Regulatory quality*	56.3	47	
1.2.2	Rule of law*	35.8	67	
1.2.3	Cost of redundancy dismissal, salary weeks	8.6	20	●
1.3	Business environment	73.0	59	
1.3.1	Ease of starting a business*	86.8	67	
1.3.2	Ease of resolving insolvency*	59.4	45	
1.3.3	Ease of paying taxes*	72.8	65	
2	**Human capital & research**	**33.7**	**56**	
2.1	Education	47.1	63	
2.1.1	Expenditure on education, % GDP	4.1	80	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	22.2	44	
2.1.3	School life expectancy, years	14.9	51	
2.1.4	PISA scales in reading, maths, & science	439.6	45	○
2.1.5	Pupil-teacher ratio, secondary◷	13.2	52	
2.2	Tertiary education	40.7	45	
2.2.1	Tertiary enrolment, % gross	73.9	21	●
2.2.2	Graduates in science & engineering, %	20.1	56	
2.2.3	Tertiary inbound mobility, %	4.2	44	
2.3	Research & development (R&D)	13.2	52	
2.3.1	Researchers, FTE/mn pop.	1,989.4	39	
2.3.2	Gross expenditure on R&D, % GDP	1.0	38	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	6.2	66	
3	**Infrastructure**	**51.9**	**48**	
3.1	Information & communication technologies (ICTs)	63.3	50	
3.1.1	ICT access*	68.6	53	
3.1.2	ICT use*	58.4	42	
3.1.3	Government's online service*	56.5	74	
3.1.4	E-participation*	69.5	43	
3.2	General infrastructure	35.4	72	
3.2.1	Electricity output, kWh/cap	6,499.6	30	
3.2.2	Logistics performance*	34.4	72	
3.2.3	Gross capital formation, % GDP	22.0	65	
3.3	Ecological sustainability	57.1	24	
3.3.1	GDP/unit of energy use	6.5	87	○
3.3.2	Environmental performance*	83.4	33	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	10.8	6	●
4	**Market sophistication**	**43.9**	**76**	○
4.1	Credit	30.5	76	○
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	55.4	58	
4.1.3	Microfinance gross loans, % GDP	0.0	75	○
4.2	Investment	38.7	70	
4.2.1	Ease of protecting minority investors*	73.3	13	●
4.2.2	Market capitalization, % GDP◷	14.4	69	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	76	○
4.3	Trade, competition, & market scale	62.5	60	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	60.3	98	○
4.3.3	Domestic market scale, bn PPP$	143.1	69	
5	**Business sophistication**	**41.4**	**32**	
5.1	Knowledge workers	46.1	43	
5.1.1	Knowledge-intensive employment, %	32.3	43	
5.1.2	Firms offering formal training, % firms	42.7	28	
5.1.3	GERD performed by business, % of GDP	0.7	26	
5.1.4	GERD financed by business, %◷	22.3	59	○
5.1.5	Females employed w/advanced degrees, % total	19.7	24	
5.2	Innovation linkages	44.6	21	●
5.2.1	University/industry research collaboration†	39.7	71	
5.2.2	State of cluster development†	43.8	73	○
5.2.3	GERD financed by abroad, %◷	50.9	3	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	42	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	46	
5.3	Knowledge absorption	33.6	61	
5.3.1	Intellectual property payments, % total trade	0.6	55	
5.3.2	High-tech imports less re-imports, % total trade	7.4	72	
5.3.3	ICT services imports, % total trade	1.1	65	
5.3.4	FDI net inflows, % GDP	3.6	44	
5.3.5	Research talent, % in business enterprise	38.6	35	
6	**Knowledge & technology outputs**	**32.0**	**35**	
6.1	Knowledge creation	23.1	40	
6.1.1	Patents by origin/bn PPP$ GDP	2.3	43	
6.1.2	PCT patent applications/bn PPP$ GDP	0.4	40	
6.1.3	Utility models by origin/bn PPP$ GDP	1.9	15	
6.1.4	Scientific & technical articles/bn PPP$ GDP	15.3	50	
6.1.5	Citable documents H index	14.5	50	
6.2	Knowledge impact	49.5	12	●
6.2.1	Growth rate of PPP$ GDP/worker, %	2.6	27	
6.2.2	New businesses/th pop. 15–64	8.9	13	●
6.2.3	Computer software spending, % GDP	0.3	48	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	39.7	3	●
6.2.5	High- & medium-high-tech manufactures, %	0.2	57	
6.3	Knowledge diffusion	23.5	60	
6.3.1	Intellectual property receipts, % total trade	0.1	45	
6.3.2	High-tech exports less re-exports, % total trade	3.7	42	
6.3.3	ICT services exports, % total trade	2.7	39	
6.3.4	FDI net outflows, % GDP	0.8	61	
7	**Creative outputs**	**44.1**	**29**	
7.1	Intangible assets	59.4	16	●
7.1.1	Trademarks by origin/bn PPP$ GDP	113.6	8	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	10.8	12	●
7.1.3	ICTs & business model creation†	62.0	56	
7.1.4	ICTs & organizational model creation†	58.6	44	
7.2	Creative goods & services	26.5	41	
7.2.1	Cultural & creative services exports, % of total trade◷	1.1	13	●
7.2.2	National feature films/mn pop. 15–69	4.8	39	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	1.3	38	
7.2.5	Creative goods exports, % total trade	1.0	43	
7.3	Online creativity	31.2	38	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	22.7	26	
7.3.2	Country-code TLDs/th pop. 15–69	2.0	65	
7.3.3	Wikipedia edits/mn pop. 15–69	6.5	26	
7.3.4	Video uploads on YouTube/pop. 15–69	36.8	36	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Burkina Faso

Key indicators

Population (millions)	18.6
GDP (US$ billions)	12.0
GDP per capita, PPP$	1,723.6
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**21.9**	**120**	○
Innovation Output Sub-Index	8.4	126	○
Innovation Input Sub-Index	35.3	101	
Innovation Efficiency Ratio	0.2	127	○
Global Innovation Index 2016 (out of 128)	21.0	122	

		Score/Value	Rank	
1	**Institutions**	**53.4**	**86**	
1.1	Political environment	37.6	101	
1.1.1	Political stability & safety*	48.1	96	
1.1.2	Government effectiveness*	27.1	99	
1.2	Regulatory environment	61.7	70	
1.2.1	Regulatory quality*	32.9	91	
1.2.2	Rule of law*	23.9	94	
1.2.3	Cost of redundancy dismissal, salary weeks	10.5	35	●
1.3	Business environment	61.0	93	
1.3.1	Ease of starting a business*	88.1	59	●
1.3.2	Ease of resolving insolvency*	39.3	99	
1.3.3	Ease of paying taxes*	55.8	103	
2	**Human capital & research**	**15.8**	**110**	
2.1	Education	25.3	118	
2.1.1	Expenditure on education, % GDP	3.9	82	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	16.2	73	
2.1.3	School life expectancy, years ⓓ	7.7	114	○
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	25.2	94	
2.2	Tertiary education	20.8	102	
2.2.1	Tertiary enrolment, % gross ⓓ	4.8	114	○
2.2.2	Graduates in science & engineering, %	17.6	69	
2.2.3	Tertiary inbound mobility, % ⓓ	2.9	57	
2.3	Research & development (R&D)	1.2	102	
2.3.1	Researchers, FTE/mn pop. ⓓ	47.5	90	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.2	90	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**25.4**	**118**	
3.1	Information & communication technologies (ICTs)	20.1	115	
3.1.1	ICT access*	28.7	112	
3.1.2	ICT use*	9.0	115	
3.1.3	Government's online service*	18.8	116	
3.1.4	E-participation*	23.7	111	
3.2	General infrastructure	26.8	103	
3.2.1	Electricity output, kWh/cap	n/a	n/a	
3.2.2	Logistics performance*	30.9	80	
3.2.3	Gross capital formation, % GDP	14.3	114	
3.3	Ecological sustainability	29.3	117	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	43.7	116	○
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	119	○
4	**Market sophistication**	**29.7**	**121**	○
4.1	Credit	22.4	108	
4.1.1	Ease of getting credit*	30.0	108	
4.1.2	Domestic credit to private sector, % GDP	27.2	101	
4.1.3	Microfinance gross loans, % GDP	1.5	19	●
4.2	Investment	30.0	114	
4.2.1	Ease of protecting minority investors*	40.0	111	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP ⓓ	0.0	39	●
4.3	Trade, competition, & market scale	36.6	122	○
4.3.1	Applied tariff rate, weighted mean, %	9.6	112	
4.3.2	Intensity of local competition†	n/a	n/a	
4.3.3	Domestic market scale, bn PPP$	33.0	107	
5	**Business sophistication**	**52.2**	**[14]**	
5.1	Knowledge workers	23.9	[100]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms ⓓ	24.8	65	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⓓ	11.9	70	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	100.0	[1]	
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, % ⓓ	59.6	1	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	Knowledge absorption	32.6	66	
5.3.1	Intellectual property payments, % total trade ⓓ	0.0	114	○
5.3.2	High-tech imports less re-imports, % total trade	6.4	91	
5.3.3	ICT services imports, % total trade ⓓ	2.4	14	●
5.3.4	FDI net inflows, % GDP	2.9	62	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**15.1**	**106**	
6.1	Knowledge creation	5.1	86	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	94	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP ⓓ	0.1	47	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.6	63	●
6.1.5	Citable documents H index	5.0	94	
6.2	Knowledge impact	24.1	93	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.9	38	●
6.2.2	New businesses/th pop. 15–64 ⓓ	0.2	96	
6.2.3	Computer software spending, % GDP	0.0	110	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.6	100	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	16.2	109	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	80	
6.3.2	High-tech exports less re-exports, % total trade	0.2	101	
6.3.3	ICT services exports, % total trade ⓓ	1.3	72	
6.3.4	FDI net outflows, % GDP	0.4	71	
7	**Creative outputs**	**1.8**	**127**	○
7.1	Intangible assets	1.0	126	○
7.1.1	Trademarks by origin/bn PPP$ GDP	3.2	114	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	100	
7.1.3	ICTs & business model creation†	n/a	n/a	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	Creative goods & services	4.7	109	
7.2.1	Cultural & creative services exports, % of total trade	0.3	40	●
7.2.2	National feature films/mn pop. 15–69	0.5	92	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	109	
7.3	Online creativity	0.4	125	○
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.1	122	○
7.3.2	Country-code TLDs/th pop. 15–69	0.0	119	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	0.1	125	○
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Burundi

Key indicators

Population (millions)	11.6
GDP (US$ billions)	2.7
GDP per capita, PPP$	818.5
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**21.3**	**122**
Innovation Output Sub-Index	12.4	122
Innovation Input Sub-Index	30.2	115
Innovation Efficiency Ratio	0.4	117
Global Innovation Index 2016 (out of 128)	20.9	123

		Score	Rank	
1	**Institutions**	**43.2**	**118**	
1.1	Political environment	17.3	124	
1.1.1	Political stability & safety*	21.9	123	
1.1.2	Government effectiveness*	12.7	123	
1.2	Regulatory environment	49.8	98	
1.2.1	Regulatory quality*	24.0	107	
1.2.2	Rule of law*	6.7	123	
1.2.3	Cost of redundancy dismissal, salary weeks	15.9	67	
1.3	Business environment	62.4	85	
1.3.1	Ease of starting a business*	94.5	17	●
1.3.2	Ease of resolving insolvency*	30.5	114	
1.3.3	Ease of paying taxes*	62.2	88	
2	**Human capital & research**	**14.9**	**114**	
2.1	Education	37.7	95	
2.1.1	Expenditure on education, % GDP	5.4	35	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	31.0	13	●
2.1.3	School life expectancy, years◷	10.6	98	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	35.8	107	
2.2	Tertiary education	6.1	119	
2.2.1	Tertiary enrolment, % gross◷	4.4	117	
2.2.2	Graduates in science & engineering, %	6.4	100	
2.2.3	Tertiary inbound mobility, %◷	1.0	81	
2.3	Research & development (R&D)	0.8	105	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP◷	0.1	99	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**21.9**	**124**	
3.1	Information & communication technologies (ICTs)	14.0	125	○
3.1.1	ICT access*	21.4	123	
3.1.2	ICT use*	4.2	123	
3.1.3	Government's online service*	15.2	118	
3.1.4	E-participation*	15.3	119	
3.2	General infrastructure	8.3	126	○
3.2.1	Electricity output, kWh/cap	n/a	n/a	
3.2.2	Logistics performance*	20.7	101	
3.2.3	Gross capital formation, % GDP	4.2	123	○
3.3	Ecological sustainability	43.4	[70]	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	43.4	118	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	n/a	n/a	
4	**Market sophistication**	**32.7**	**114**	
4.1	Credit	25.1	97	
4.1.1	Ease of getting credit*	10.0	124	○
4.1.2	Domestic credit to private sector, % GDP	14.3	120	
4.1.3	Microfinance gross loans, % GDP	3.4	13	●
4.2	Investment	41.7	[55]	
4.2.1	Ease of protecting minority investors*	41.7	105	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	31.2	124	
4.3.1	Applied tariff rate, weighted mean, %	5.4	94	
4.3.2	Intensity of local competition†	56.1	113	
4.3.3	Domestic market scale, bn PPP$	7.9	127	○
5	**Business sophistication**	**38.4**	**36**	●
5.1	Knowledge workers	37.7	[60]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	32.0	46	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	38.1	36	●
5.2.1	University/industry research collaboration†	30.2	104	
5.2.2	State of cluster development†	31.3	117	
5.2.3	GERD financed by abroad, %◷	39.9	10	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP◷	0.2	54	●
5.3	Knowledge absorption	39.5	33	●
5.3.1	Intellectual property payments, % total trade◷	0.0	115	○
5.3.2	High-tech imports less re-imports, % total trade◷	10.8	35	●
5.3.3	ICT services imports, % total trade◷	2.6	11	●
5.3.4	FDI net inflows, % GDP	2.8	64	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**7.9**	**124**	
6.1	Knowledge creation	2.5	[118]	
6.1.1	Patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.9	104	
6.1.5	Citable documents H index	0.3	125	○
6.2	Knowledge impact	3.2	124	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.1	94	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.0	127	○
6.2.5	High- & medium-high-tech manufactures, %◷	0.0	98	
6.3	Knowledge diffusion	17.9	95	
6.3.1	Intellectual property receipts, % total trade◷	0.0	87	
6.3.2	High-tech exports less re-exports, % total trade◷	0.1	114	
6.3.3	ICT services exports, % total trade◷	3.2	27	●
6.3.4	FDI net outflows, % GDP	0.0	108	
7	**Creative outputs**	**16.9**	**115**	
7.1	Intangible assets	29.2	106	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	31.9	122	○
7.1.4	ICTs & organizational model creation†	26.5	122	○
7.2	Creative goods & services	8.4	94	
7.2.1	Cultural & creative services exports, % of total trade◷	0.3	33	●
7.2.2	National feature films/mn pop. 15–69	0.2	99	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %◷	1.2	52	
7.2.5	Creative goods exports, % total trade◷	0.0	113	
7.3	Online creativity	1.0	122	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.0	125	○
7.3.2	Country-code TLDs/th pop. 15–69	0.1	107	
7.3.3	Wikipedia edits/mn pop. 15–69◷	0.3	122	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Cambodia

Key indicators

Population (millions)	15.8
GDP (US$ billions)	19.4
GDP per capita, PPP$	3,487.5
Income group	Lower-middle income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**27.0**	**101**
Innovation Output Sub-Index	20.9	87
Innovation Input Sub-Index	33.2	104
Innovation Efficiency Ratio	0.6	61
Global Innovation Index 2016 (out of 128)	27.9	95

		Score/Value	Rank	
1	**Institutions**	**49.1**	**98**	
1.1	Political environment	42.9	88	
1.1.1	Political stability & safety*	61.5	68	
1.1.2	Government effectiveness*	24.4	109	
1.2	Regulatory environment	49.3	101	
1.2.1	Regulatory quality*	29.8	98	
1.2.2	Rule of law*	12.5	114	
1.2.3	Cost of redundancy dismissal, salary weeks	19.4	80	
1.3	Business environment	55.0	115	
1.3.1	Ease of starting a business*	54.9	126	○
1.3.2	Ease of resolving insolvency*	48.1	66	
1.3.3	Ease of paying taxes*	62.0	89	
2	**Human capital & research**	**14.2**	**118**	
2.1	Education	24.6	119	
2.1.1	Expenditure on education, % GDP	1.9	115	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⓐ	10.5	99	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓐ	28.9	103	
2.2	Tertiary education	17.9	105	
2.2.1	Tertiary enrolment, % gross	13.1	100	
2.2.2	Graduates in science & engineering, % ⓐ	12.5	93	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**26.9**	**113**	
3.1	Information & communication technologies (ICTs)	18.7	118	
3.1.1	ICT access*	42.1	99	
3.1.2	ICT use*	20.9	97	
3.1.3	Government's online service*	5.1	126	○
3.1.4	E-participation*	6.8	125	○
3.2	General infrastructure	30.7	92	
3.2.1	Electricity output, kWh/cap	199.5	112	○
3.2.2	Logistics performance*	34.1	73	
3.2.3	Gross capital formation, % GDP	22.9	57	●
3.3	Ecological sustainability	31.3	113	
3.3.1	GDP/unit of energy use	7.4	81	
3.3.2	Environmental performance*	51.2	110	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	92	
4	**Market sophistication**	**52.4**	**37**	●
4.1	Credit	69.9	7	●
4.1.1	Ease of getting credit*	85.0	7	●
4.1.2	Domestic credit to private sector, % GDP	63.1	50	●
4.1.3	Microfinance gross loans, % GDP	29.6	1	●
4.2	Investment	34.1	88	
4.2.1	Ease of protecting minority investors*	48.3	92	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP ⓐ	0.0	54	
4.3	Trade, competition, & market scale	53.3	98	
4.3.1	Applied tariff rate, weighted mean, % ⓐ	4.9	90	
4.3.2	Intensity of local competition†	62.1	93	
4.3.3	Domestic market scale, bn PPP$	58.9	90	
5	**Business sophistication**	**23.3**	**111**	
5.1	Knowledge workers	15.4	[117]	
5.1.1	Knowledge-intensive employment, % ⓐ	4.1	102	○
5.1.2	Firms offering formal training, % firms	22.2	69	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	30.7	55	●
5.2.1	University/industry research collaboration†	34.7	95	
5.2.2	State of cluster development†	49.1	44	●
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	25	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓐ	0.0	93	
5.3	Knowledge absorption	23.9	106	
5.3.1	Intellectual property payments, % total trade	0.1	102	
5.3.2	High-tech imports less re-imports, % total trade	2.9	122	○
5.3.3	ICT services imports, % total trade	0.7	87	
5.3.4	FDI net inflows, % GDP	9.5	11	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**17.4**	**90**	
6.1	Knowledge creation	3.5	105	
6.1.1	Patents by origin/bn PPP$ GDP ⓐ	0.0	118	○
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.0	99	
6.1.5	Citable documents H index	4.0	103	
6.2	Knowledge impact	34.4	49	●
6.2.1	Growth rate of PPP$ GDP/worker, %	5.0	7	●
6.2.2	New businesses/th pop. 15–64 ⓐ	0.2	95	
6.2.3	Computer software spending, % GDP	0.0	112	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.7	115	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	14.2	116	
6.3.1	Intellectual property receipts, % total trade	0.0	92	
6.3.2	High-tech exports less re-exports, % total trade	0.9	69	
6.3.3	ICT services exports, % total trade	0.4	103	
6.3.4	FDI net outflows, % GDP	0.3	80	
7	**Creative outputs**	**24.4**	**92**	
7.1	Intangible assets	36.7	89	
7.1.1	Trademarks by origin/bn PPP$ GDP ⓐ	23.5	80	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	99	
7.1.3	ICTs & business model creation†	60.7	61	
7.1.4	ICTs & organizational model creation†	55.6	52	●
7.2	Creative goods & services	14.7	[74]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	3.1	55	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.6	56	●
7.3	Online creativity	9.8	99	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.1	92	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	113	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓐ	2.9	102	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Cameroon

Key indicators

Population (millions)	23.9
GDP (US$ billions)	30.9
GDP per capita, PPP$	3,143.7
Income group	Lower-middle income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**22.6**	**117**
Innovation Output Sub-Index	16.1	113
Innovation Input Sub-Index	29.0	117
Innovation Efficiency Ratio	0.6	92
Global Innovation Index 2016 (out of 128)	22.8	118

1	**Institutions**	**42.3**	**119**	○
1.1	Political environment	31.2	115	
1.1.1	Political stability & safety*	39.8	110	
1.1.2	Government effectiveness*	22.5	114	
1.2	Regulatory environment	45.8	108	
1.2.1	Regulatory quality*	19.0	116	
1.2.2	Rule of law*	11.3	117	
1.2.3	Cost of redundancy dismissal, salary weeks	19.9	82	
1.3	Business environment	49.8	122	○
1.3.1	Ease of starting a business*	77.0	110	
1.3.2	Ease of resolving insolvency*	36.6	104	
1.3.3	Ease of paying taxes*	35.9	123	○
2	**Human capital & research**	**19.8**	**101**	
2.1	Education	34.4	100	
2.1.1	Expenditure on education, % GDP	3.0	98	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	19.7	54	●
2.1.3	School life expectancy, years	12.2	84	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	19.9	80	
2.2	Tertiary education	25.1	93	
2.2.1	Tertiary enrolment, % gross	17.5	95	
2.2.2	Graduates in science & engineering, % ⓓ	21.0	49	●
2.2.3	Tertiary inbound mobility, % ⓓ	1.1	80	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**25.3**	**119**	○
3.1	Information & communication technologies (ICTs)	18.7	119	○
3.1.1	ICT access*	27.7	115	
3.1.2	ICT use*	8.4	117	
3.1.3	Government's online service*	21.7	113	
3.1.4	E-participation*	16.9	117	
3.2	General infrastructure	22.2	114	
3.2.1	Electricity output, kWh/cap	304.0	108	
3.2.2	Logistics performance*	4.1	125	○
3.2.3	Gross capital formation, % GDP	21.9	66	●
3.3	Ecological sustainability	35.1	102	
3.3.1	GDP/unit of energy use	8.3	66	●
3.3.2	Environmental performance*	57.1	106	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	102	
4	**Market sophistication**	**33.7**	**113**	
4.1	Credit	20.0	112	
4.1.1	Ease of getting credit*	35.0	104	
4.1.2	Domestic credit to private sector, % GDP	16.4	114	
4.1.3	Microfinance gross loans, % GDP	1.1	25	●
4.2	Investment	41.7	[55]	
4.2.1	Ease of protecting minority investors*	41.7	105	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	39.4	121	○
4.3.1	Applied tariff rate, weighted mean, % ⓓ	15.8	125	○
4.3.2	Intensity of local competition†	63.8	83	
4.3.3	Domestic market scale, bn PPP$	77.2	82	
5	**Business sophistication**	**24.0**	**109**	
5.1	Knowledge workers	29.2	[86]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms ⓓ	25.5	62	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	22.5	83	
5.2.1	University/industry research collaboration†	37.2	85	
5.2.2	State of cluster development†	36.8	96	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	96	
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.0	107	
5.3	Knowledge absorption	20.4	121	○
5.3.1	Intellectual property payments, % total trade ⓓ	0.1	100	
5.3.2	High-tech imports less re-imports, % total trade	5.1	108	
5.3.3	ICT services imports, % total trade ⓓ	0.5	102	
5.3.4	FDI net inflows, % GDP	1.9	84	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**15.6**	**101**	
6.1	Knowledge creation	5.6	85	
6.1.1	Patents by origin/bn PPP$ GDP	0.4	82	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	94	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.6	64	●
6.1.5	Citable documents H index	6.1	86	
6.2	Knowledge impact	28.5	75	●
6.2.1	Growth rate of PPP$ GDP/worker, %	2.4	33	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.2	76	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.9	110	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.0	96	○
6.3	Knowledge diffusion	12.7	122	○
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	96	
6.3.2	High-tech exports less re-exports, % total trade	0.2	102	
6.3.3	ICT services exports, % total trade ⓓ	1.3	74	●
6.3.4	FDI net outflows, % GDP	(0.4)	119	○
7	**Creative outputs**	**16.7**	**117**	
7.1	Intangible assets	28.3	111	
7.1.1	Trademarks by origin/bn PPP$ GDP	7.3	109	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.4	87	
7.1.3	ICTs & business model creation†	51.3	95	
7.1.4	ICTs & organizational model creation†	43.7	98	
7.2	Creative goods & services	7.6	97	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.1	64	
7.2.2	National feature films/mn pop. 15–69 ⓓ	1.8	63	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	1.3	41	●
7.2.5	Creative goods exports, % total trade	0.0	118	○
7.3	Online creativity	2.4	120	○
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	116	
7.3.2	Country-code TLDs/th pop. 15–69	0.3	100	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	0.7	119	○
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Canada

Key indicators

Population (millions)	36.3
GDP (US$ billions)	1,532.3
GDP per capita, PPP$	45,552.6
Income group	High income
Region	Northern America

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**53.7**	**18**	
Innovation Output Sub-Index	41.7	23	
Innovation Input Sub-Index	65.6	10	
Innovation Efficiency Ratio	0.6	59	
Global Innovation Index 2016 (out of 128)	54.7	15	

		Score/Value	Rank	
1	**Institutions**	**91.0**	**7**	
1.1	Political environment	90.7	6	●
1.1.1	Political stability & safety*	94.0	5	●
1.1.2	Government effectiveness*	87.5	11	
1.2	Regulatory environment	92.7	10	
1.2.1	Regulatory quality*	85.8	12	
1.2.2	Rule of law*	93.1	11	
1.2.3	Cost of redundancy dismissal, salary weeks	10.0	31	
1.3	Business environment	89.5	7	
1.3.1	Ease of starting a business*	98.2	2	●
1.3.2	Ease of resolving insolvency*	81.4	14	
1.3.3	Ease of paying taxes*	88.9	16	
2	**Human capital & research**	**53.3**	**20**	
2.1	Education	44.9	74	○
2.1.1	Expenditure on education, % GDPⓓ	5.3	40	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/capⓓ	18.3	60	○
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	523.3	5	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	n/a	n/a	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	61.8	15	
2.3.1	Researchers, FTE/mn pop.ⓓ	4,518.5	16	
2.3.2	Gross expenditure on R&D, % GDPⓓ	1.6	22	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	73.2	16	
2.3.4	QS university ranking, average score top 3*	82.0	5	●
3	**Infrastructure**	**62.1**	**18**	
3.1	Information & communication technologies (ICTs)	83.9	12	
3.1.1	ICT access*	79.9	25	
3.1.2	ICT use*	68.5	24	
3.1.3	Government's online service*	95.7	4	●
3.1.4	E-participation*	91.5	8	
3.2	General infrastructure	59.7	7	
3.2.1	Electricity output, kWh/cap	17,594.1	5	●
3.2.2	Logistics performance*	86.4	14	
3.2.3	Gross capital formation, % GDP	23.1	56	
3.3	Ecological sustainability	42.6	75	○
3.3.1	GDP/unit of energy use	5.6	97	○
3.3.2	Environmental performance*	85.1	25	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.8	73	○
4	**Market sophistication**	**73.7**	**3**	●
4.1	Credit	67.3	8	
4.1.1	Ease of getting credit*	85.0	7	
4.1.2	Domestic credit to private sector, % GDPⓓ	124.4	18	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	74.3	2	●
4.2.1	Ease of protecting minority investors*	76.7	7	
4.2.2	Market capitalization, % GDP	102.8	8	
4.2.3	Venture capital deals/bn PPP$ GDP	0.5	1	●
4.3	Trade, competition, & market scale	79.4	9	
4.3.1	Applied tariff rate, weighted mean, %	1.0	11	
4.3.2	Intensity of local competition†	74.1	31	
4.3.3	Domestic market scale, bn PPP$	1,674.3	16	
5	**Business sophistication**	**47.8**	**24**	
5.1	Knowledge workers	56.7	27	
5.1.1	Knowledge-intensive employment, %ⓓ	43.7	18	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDPⓓ	0.8	24	
5.1.4	GERD financed by business, %ⓓ	45.4	27	
5.1.5	Females employed w/advanced degrees, % total	17.0	30	
5.2	Innovation linkages	41.5	27	
5.2.1	University/industry research collaboration†	59.6	22	
5.2.2	State of cluster development†	61.9	19	
5.2.3	GERD financed by abroad, %ⓓ	6.0	61	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	5	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.9	18	
5.3	Knowledge absorption	45.3	21	
5.3.1	Intellectual property payments, % total trade	1.8	12	
5.3.2	High-tech imports less re-imports, % total trade	11.1	32	
5.3.3	ICT services imports, % total trade	0.9	70	○
5.3.4	FDI net inflows, % GDP	3.7	42	
5.3.5	Research talent, % in business enterpriseⓓ	56.0	18	
6	**Knowledge & technology outputs**	**38.7**	**19**	
6.1	Knowledge creation	40.6	21	
6.1.1	Patents by origin/bn PPP$ GDP	2.6	39	
6.1.2	PCT patent applications/bn PPP$ GDP	1.4	24	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	37.2	17	
6.1.5	Citable documents H index	77.9	5	●
6.2	Knowledge impact	36.2	44	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.3	75	○
6.2.2	New businesses/th pop. 15–64	1.3	61	○
6.2.3	Computer software spending, % GDP	0.8	3	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.9	70	○
6.2.5	High- & medium-high-tech manufactures, %	0.3	38	
6.3	Knowledge diffusion	39.1	23	
6.3.1	Intellectual property receipts, % total trade	0.8	18	
6.3.2	High-tech exports less re-exports, % total trade	5.6	32	
6.3.3	ICT services exports, % total trade	1.5	69	
6.3.4	FDI net outflows, % GDP	3.8	13	
7	**Creative outputs**	**44.8**	**27**	
7.1	Intangible assets	50.8	35	
7.1.1	Trademarks by origin/bn PPP$ GDP	51.1	45	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.5	79	○
7.1.3	ICTs & business model creation†	75.8	23	
7.1.4	ICTs & organizational model creation†	74.8	12	
7.2	Creative goods & services	20.7	57	
7.2.1	Cultural & creative services exports, % of total tradeⓓ	0.7	23	
7.2.2	National feature films/mn pop. 15–69	3.9	50	
7.2.3	Global ent. & media market/th pop. 15–69	55.6	14	
7.2.4	Printing & publishing manufactures, %	0.4	94	○
7.2.5	Creative goods exports, % total trade	0.6	54	
7.3	Online creativity	56.9	11	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	76.4	6	●
7.3.2	Country-code TLDs/th pop. 15–69	28.7	21	
7.3.3	Wikipedia edits/mn pop. 15–69	6.6	23	
7.3.4	Video uploads on YouTube/pop. 15–69	58.6	9	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Chile

Key indicators

Population (millions)	18.1
GDP (US$ billions)	234.9
GDP per capita, PPP$	23,459.6
Income group	High income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**38.7**	**46**
Innovation Output Sub-Index	29.1	53
Innovation Input Sub-Index	48.3	42
Innovation Efficiency Ratio	0.6	77
Global Innovation Index 2016 (out of 128)	38.4	44

		Score	Rank	
1	**Institutions**	**70.3**	**41**	
1.1	Political environment	71.8	38	
1.1.1	Political stability & safety*	73.6	44	
1.1.2	Government effectiveness*	69.9	29	
1.2	Regulatory environment	69.6	45	
1.2.1	Regulatory quality*	76.7	18	●
1.2.2	Rule of law*	78.4	22	●
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	107	○
1.3	Business environment	69.7	68	
1.3.1	Ease of starting a business*	89.8	50	
1.3.2	Ease of resolving insolvency*	55.5	52	
1.3.3	Ease of paying taxes*	63.9	87	
2	**Human capital & research**	**32.8**	**61**	
2.1	Education	46.5	65	
2.1.1	Expenditure on education, % GDP	4.8	60	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	15.2	80	○
2.1.3	School life expectancy, years	16.5	22	
2.1.4	PISA scales in reading, maths, & science	442.7	44	
2.1.5	Pupil-teacher ratio, secondary ⓓ	21.0	83	○
2.2	Tertiary education	37.7	55	
2.2.1	Tertiary enrolment, % gross	88.6	5	●
2.2.2	Graduates in science & engineering, % ⓓ	19.2	62	
2.2.3	Tertiary inbound mobility, %	0.3	96	○
2.3	Research & development (R&D)	14.1	50	
2.3.1	Researchers, FTE/mn pop.	455.5	64	
2.3.2	Gross expenditure on R&D, % GDP	0.4	71	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	42.5	31	
3	**Infrastructure**	**52.1**	**47**	
3.1	Information & communication technologies (ICTs)	67.3	40	
3.1.1	ICT access*	68.1	56	
3.1.2	ICT use*	49.1	59	
3.1.3	Government's online service*	77.5	28	
3.1.4	E-participation*	74.6	32	
3.2	General infrastructure	38.8	54	
3.2.1	Electricity output, kWh/cap	4,118.8	52	
3.2.2	Logistics performance*	54.8	45	
3.2.3	Gross capital formation, % GDP	22.3	63	
3.3	Ecological sustainability	50.1	46	
3.3.1	GDP/unit of energy use	10.4	43	
3.3.2	Environmental performance*	77.7	51	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.9	39	
4	**Market sophistication**	**49.8**	**50**	
4.1	Credit	35.8	61	
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	111.0	24	●
4.1.3	Microfinance gross loans, % GDP	0.7	28	
4.2	Investment	41.6	58	
4.2.1	Ease of protecting minority investors*	65.0	31	
4.2.2	Market capitalization, % GDP	79.1	20	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	71	○
4.3	Trade, competition, & market scale	72.0	30	
4.3.1	Applied tariff rate, weighted mean, %	0.6	8	●
4.3.2	Intensity of local competition†	70.0	61	
4.3.3	Domestic market scale, bn PPP$	436.1	41	
5	**Business sophistication**	**36.5**	**46**	
5.1	Knowledge workers	46.0	44	
5.1.1	Knowledge-intensive employment, %	25.0	54	
5.1.2	Firms offering formal training, % firms ⓓ	57.5	10	●
5.1.3	GERD performed by business, % of GDP	0.1	58	
5.1.4	GERD financed by business, %	32.8	46	
5.1.5	Females employed w/advanced degrees, % total	15.9	38	
5.2	Innovation linkages	24.9	74	
5.2.1	University/industry research collaboration†	41.1	61	
5.2.2	State of cluster development†	39.8	85	○
5.2.3	GERD financed by abroad, %	12.9	37	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	54	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	49	
5.3	Knowledge absorption	38.7	37	
5.3.1	Intellectual property payments, % total trade ⓓ	1.8	11	●
5.3.2	High-tech imports less re-imports, % total trade	10.3	40	
5.3.3	ICT services imports, % total trade ⓓ	0.8	75	
5.3.4	FDI net inflows, % GDP	8.0	16	●
5.3.5	Research talent, % in business enterprise	27.4	48	
6	**Knowledge & technology outputs**	**26.0**	**49**	
6.1	Knowledge creation	11.1	61	
6.1.1	Patents by origin/bn PPP$ GDP	1.0	63	
6.1.2	PCT patent applications/bn PPP$ GDP	0.5	39	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	42	
6.1.4	Scientific & technical articles/bn PPP$ GDP	18.5	41	
6.1.5	Citable documents H index	21.3	37	
6.2	Knowledge impact	33.8	52	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.3	77	○
6.2.2	New businesses/th pop. 15–64	8.0	14	●
6.2.3	Computer software spending, % GDP	0.3	49	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	12.5	28	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.2	63	
6.3	Knowledge diffusion	33.3	34	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.1	52	
6.3.2	High-tech exports less re-exports, % total trade	0.8	70	
6.3.3	ICT services exports, % total trade ⓓ	0.5	99	○
6.3.4	FDI net outflows, % GDP	5.0	10	●
7	**Creative outputs**	**32.1**	**59**	
7.1	Intangible assets	46.3	51	
7.1.1	Trademarks by origin/bn PPP$ GDP	68.3	27	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.1	106	○
7.1.3	ICTs & business model creation†	71.5	28	
7.1.4	ICTs & organizational model creation†	55.4	54	
7.2	Creative goods & services	10.1	89	○
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	2.9	56	
7.2.3	Global ent. & media market/th pop. 15–69	11.2	33	
7.2.4	Printing & publishing manufactures, % ⓓ	1.1	61	
7.2.5	Creative goods exports, % total trade	0.2	82	
7.3	Online creativity	26.0	45	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.2	75	
7.3.2	Country-code TLDs/th pop. 15–69	11.8	37	
7.3.3	Wikipedia edits/mn pop. 15–69	5.6	49	
7.3.4	Video uploads on YouTube/pop. 15–69	36.0	38	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

China

Key indicators

Population (millions)	1,382.3
GDP (US$ billions)	11,391.6
GDP per capita, PPP$	14,107.4
Income group	Upper-middle income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**52.5**	**22**	
Innovation Output Sub-Index	50.9	11	
Innovation Input Sub-Index	54.2	31	
Innovation Efficiency Ratio	0.9	3	●
Global Innovation Index 2016 (out of 128)	50.6	25	

		Score	Rank	
1	**Institutions**	**54.8**	**78**	
1.1	Political environment	51.6	64	
1.1.1	Political stability & safety*	50.2	90	
1.1.2	Government effectiveness*	53.0	47	
1.2	Regulatory environment	47.0	107	○
1.2.1	Regulatory quality*	35.3	87	
1.2.2	Rule of law*	29.6	78	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	107	○
1.3	Business environment	65.8	75	
1.3.1	Ease of starting a business*	81.0	96	
1.3.2	Ease of resolving insolvency*	55.8	50	
1.3.3	Ease of paying taxes*	60.5	94	
2	**Human capital & research**	**49.2**	**25**	
2.1	Education	69.6	8	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	14.1	62	
2.1.4	PISA scales in reading, maths, & science	514.3	8	
2.1.5	Pupil-teacher ratio, secondary	13.8	55	
2.2	Tertiary education	19.5	104	○
2.2.1	Tertiary enrolment, % gross	43.4	62	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	0.3	98	○
2.3	Research & development (R&D)	58.5	17	
2.3.1	Researchers, FTE/mn pop.	1,176.6	45	
2.3.2	Gross expenditure on R&D, % GDP	2.1	17	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	89.1	6	
2.3.4	QS university ranking, average score top 3*	82.2	4	●
3	**Infrastructure**	**57.9**	**27**	
3.1	Information & communication technologies (ICTs)	64.6	48	
3.1.1	ICT access*	54.5	77	
3.1.2	ICT use*	45.8	61	
3.1.3	Government's online service*	76.8	31	
3.1.4	E-participation*	81.4	22	
3.2	General infrastructure	67.5	3	●
3.2.1	Electricity output, kWh/cap	4,152.9	51	
3.2.2	Logistics performance*	73.9	26	
3.2.3	Gross capital formation, % GDP	43.7	3	●
3.3	Ecological sustainability	41.4	78	
3.3.1	GDP/unit of energy use	5.5	98	○
3.3.2	Environmental performance*	65.1	93	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	5.8	18	
4	**Market sophistication**	**54.7**	**28**	
4.1	Credit	40.5	48	
4.1.1	Ease of getting credit*	60.0	55	
4.1.2	Domestic credit to private sector, % GDP	153.3	7	
4.1.3	Microfinance gross loans, % GDP	0.0	73	○
4.2	Investment	35.0	85	
4.2.1	Ease of protecting minority investors*	45.0	98	○
4.2.2	Market capitalization, % GDP	74.4	21	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	26	
4.3	Trade, competition, & market scale	88.4	2	●
4.3.1	Applied tariff rate, weighted mean, %	3.4	76	
4.3.2	Intensity of local competition†	73.5	35	
4.3.3	Domestic market scale, bn PPP$	21,269.0	1	●
5	**Business sophistication**	**54.5**	**9**	
5.1	Knowledge workers	84.9	1	●
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms ◔	79.2	1	●
5.1.3	GERD performed by business, % of GDP	1.6	13	
5.1.4	GERD financed by business, %	74.7	2	●
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	28.6	62	
5.2.1	University/industry research collaboration†	55.3	29	
5.2.2	State of cluster development†	60.9	20	
5.2.3	GERD financed by abroad, %	0.7	90	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	45	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.9	29	
5.3	Knowledge absorption	50.1	13	
5.3.1	Intellectual property payments, % total trade	1.0	32	
5.3.2	High-tech imports less re-imports, % total trade	19.3	6	
5.3.3	ICT services imports, % total trade	0.5	99	○
5.3.4	FDI net inflows, % GDP	2.6	68	
5.3.5	Research talent, % in business enterprise	62.7	9	
6	**Knowledge & technology outputs**	**56.4**	**4**	●
6.1	Knowledge creation	66.0	5	
6.1.1	Patents by origin/bn PPP$ GDP	49.2	1	●
6.1.2	PCT patent applications/bn PPP$ GDP	2.0	17	
6.1.3	Utility models by origin/bn PPP$ GDP	56.9	1	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	14.1	54	
6.1.5	Citable documents H index	49.9	14	
6.2	Knowledge impact	64.3	1	●
6.2.1	Growth rate of PPP$ GDP/worker, %	6.6	2	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.4	26	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	14.9	25	
6.2.5	High- & medium-high-tech manufactures, % ◔	0.4	14	
6.3	Knowledge diffusion	38.8	24	
6.3.1	Intellectual property receipts, % total trade	0.0	67	
6.3.2	High-tech exports less re-exports, % total trade	29.4	1	●
6.3.3	ICT services exports, % total trade	1.1	77	
6.3.4	FDI net outflows, % GDP	1.2	45	
7	**Creative outputs**	**45.3**	**26**	
7.1	Intangible assets	71.1	2	●
7.1.1	Trademarks by origin/bn PPP$ GDP	135.0	4	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	28.0	1	●
7.1.3	ICTs & business model creation†	65.4	46	
7.1.4	ICTs & organizational model creation†	64.4	29	
7.2	Creative goods & services	31.3	29	
7.2.1	Cultural & creative services exports, % of total trade	0.0	70	
7.2.2	National feature films/mn pop. 15–69	0.6	88	○
7.2.3	Global ent. & media market/th pop. 15–69	5.0	44	
7.2.4	Printing & publishing manufactures, % ◔	0.5	89	○
7.2.5	Creative goods exports, % total trade	12.8	1	●
7.3	Online creativity	7.8	104	○
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.4	74	
7.3.2	Country-code TLDs/th pop. 15–69	5.8	46	
7.3.3	Wikipedia edits/mn pop. 15–69	1.6	110	○
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◔ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Colombia

Key indicators

Population (millions)	48.7
GDP (US$ billions)	274.1
GDP per capita, PPP$	13,846.5
Income group	Upper-middle income
Region	Latin America and the Caribbean

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**34.8**	**65**	
	Innovation Output Sub-Index	23.8	75	
	Innovation Input Sub-Index	45.8	52	
	Innovation Efficiency Ratio	0.5	100	○
	Global Innovation Index 2016 (out of 128)	34.2	63	
1	**Institutions**	**58.5**	**69**	
1.1	Political environment	39.7	98	○
1.1.1	Political stability & safety*	38.1	113	○
1.1.2	Government effectiveness*	41.3	72	
1.2	Regulatory environment	62.4	68	
1.2.1	Regulatory quality*	53.7	52	
1.2.2	Rule of law*	30.4	76	
1.2.3	Cost of redundancy dismissal, salary weeks	16.7	68	
1.3	Business environment	73.4	57	
1.3.1	Ease of starting a business*	89.6	52	
1.3.2	Ease of resolving insolvency*	71.7	31	
1.3.3	Ease of paying taxes*	58.9	97	
2	**Human capital & research**	**31.7**	**66**	
2.1	Education	39.0	91	
2.1.1	Expenditure on education, % GDP	4.5	68	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	16.0	75	
2.1.3	School life expectancy, years	14.4	59	
2.1.4	PISA scales in reading, maths, & science	410.1	59	○
2.1.5	Pupil-teacher ratio, secondary	25.6	95	○
2.2	Tertiary education	34.1	69	
2.2.1	Tertiary enrolment, % gross	55.6	47	
2.2.2	Graduates in science & engineering, %	22.7	38	
2.2.3	Tertiary inbound mobility, %	0.2	101	○
2.3	Research & development (R&D)	22.1	43	
2.3.1	Researchers, FTE/mn pop.ⓓ	114.9	84	○
2.3.2	Gross expenditure on R&D, % GDP	0.2	86	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	46.0	33	
2.3.4	QS university ranking, average score top 3*	35.9	34	
3	**Infrastructure**	**52.5**	**44**	
3.1	Information & communication technologies (ICTs)	63.0	52	
3.1.1	ICT access*	58.3	73	
3.1.2	ICT use*	38.5	72	
3.1.3	Government's online service*	79.0	27	
3.1.4	E-participation*	76.3	27	
3.2	General infrastructure	32.1	86	
3.2.1	Electricity output, kWh/cap	1,463.1	89	
3.2.2	Logistics performance*	25.4	92	
3.2.3	Gross capital formation, % GDP	25.0	44	
3.3	Ecological sustainability	62.4	13	●
3.3.1	GDP/unit of energy use	17.5	4	●
3.3.2	Environmental performance*	75.9	55	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	4.2	23	●
4	**Market sophistication**	**53.1**	**31**	
4.1	Credit	48.0	33	
4.1.1	Ease of getting credit*	95.0	2	●
4.1.2	Domestic credit to private sector, % GDP	47.1	74	
4.1.3	Microfinance gross loans, % GDP	1.7	17	●
4.2	Investment	40.6	61	
4.2.1	Ease of protecting minority investors*	73.3	13	●
4.2.2	Market capitalization, % GDP	29.4	49	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	69	
4.3	Trade, competition, & market scale	70.7	33	
4.3.1	Applied tariff rate, weighted mean, %ⓓ	4.2	81	
4.3.2	Intensity of local competition†	76.3	23	●
4.3.3	Domestic market scale, bn PPP$	690.4	30	
5	**Business sophistication**	**32.9**	**64**	
5.1	Knowledge workers	43.0	48	
5.1.1	Knowledge-intensive employment, %ⓓ	16.8	83	○
5.1.2	Firms offering formal training, % firmsⓓ	65.1	4	●
5.1.3	GERD performed by business, % of GDP	0.1	63	
5.1.4	GERD financed by business, %	33.6	44	
5.1.5	Females employed w/advanced degrees, % totalⓓ	12.1	58	
5.2	Innovation linkages	20.5	103	○
5.2.1	University/industry research collaboration†	44.3	46	
5.2.2	State of cluster development†	43.5	75	
5.2.3	GERD financed by abroad, %	2.4	72	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	88	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	66	
5.3	Knowledge absorption	35.3	52	
5.3.1	Intellectual property payments, % total trade	0.8	42	
5.3.2	High-tech imports less re-imports, % total trade	18.7	8	●
5.3.3	ICT services imports, % total trade	0.9	71	
5.3.4	FDI net inflows, % GDP	4.2	35	
5.3.5	Research talent, % in business enterpriseⓓ	0.6	80	○
6	**Knowledge & technology outputs**	**19.1**	**81**	
6.1	Knowledge creation	6.5	78	
6.1.1	Patents by origin/bn PPP$ GDP	0.5	77	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	58	
6.1.3	Utility models by origin/bn PPP$ GDP	0.3	39	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.0	91	
6.1.5	Citable documents H index	14.7	48	
6.2	Knowledge impact	30.4	69	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.7	68	
6.2.2	New businesses/th pop. 15–64ⓓ	2.0	48	
6.2.3	Computer software spending, % GDP	0.2	69	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	18.5	21	●
6.2.5	High- & medium-high-tech manufactures, %ⓓ	0.2	58	
6.3	Knowledge diffusion	20.3	75	
6.3.1	Intellectual property receipts, % total trade	0.1	56	
6.3.2	High-tech exports less re-exports, % total trade	1.5	60	
6.3.3	ICT services exports, % total trade	0.5	100	○
6.3.4	FDI net outflows, % GDP	1.5	40	
7	**Creative outputs**	**28.6**	**73**	
7.1	Intangible assets	39.5	76	
7.1.1	Trademarks by origin/bn PPP$ GDP	36.2	62	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.5	76	
7.1.3	ICTs & business model creation†	61.5	58	
7.1.4	ICTs & organizational model creation†	57.2	47	
7.2	Creative goods & services	14.1	75	
7.2.1	Cultural & creative services exports, % of total tradeⓓ	0.1	51	
7.2.2	National feature films/mn pop. 15–69	1.6	66	
7.2.3	Global ent. & media market/th pop. 15–69	4.7	47	
7.2.4	Printing & publishing manufactures, %ⓓ	2.2	18	●
7.2.5	Creative goods exports, % total trade	0.2	71	
7.3	Online creativity	21.1	59	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.9	67	
7.3.2	Country-code TLDs/th pop. 15–69	17.2	31	
7.3.3	Wikipedia edits/mn pop. 15–69	4.2	76	
7.3.4	Video uploads on YouTube/pop. 15–69	23.4	54	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Costa Rica

Key indicators

Population (millions)	4.9
GDP (US$ billions)	57.7
GDP per capita, PPP$	15,482.3
Income group	Upper-middle income
Region	Latin America and the Caribbean

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**37.1**	**53**	
	Innovation Output Sub-Index	30.2	50	
	Innovation Input Sub-Index	44.0	57	
	Innovation Efficiency Ratio	0.7	43	
	Global Innovation Index 2016 (out of 128)	38.4	45	
1	**Institutions**	**66.0**	**56**	
1.1	Political environment	64.9	44	
1.1.1	Political stability & safety*	77.9	38	
1.1.2	Government effectiveness*	51.9	49	
1.2	Regulatory environment	66.4	56	
1.2.1	Regulatory quality*	54.7	49	
1.2.2	Rule of law*	53.4	42	
1.2.3	Cost of redundancy dismissal, salary weeks	18.7	76	
1.3	Business environment	66.7	72	
1.3.1	Ease of starting a business*	81.6	95	
1.3.2	Ease of resolving insolvency*	39.6	95	
1.3.3	Ease of paying taxes*	79.0	53	
2	**Human capital & research**	**32.7**	**62**	
2.1	Education	57.9	33	
2.1.1	Expenditure on education, % GDP	7.6	8	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	26.7	21	
2.1.3	School life expectancy, years	15.2	43	
2.1.4	PISA scales in reading, maths, & science	415.8	54	
2.1.5	Pupil-teacher ratio, secondary	14.0	57	
2.2	Tertiary education	30.7	78	
2.2.1	Tertiary enrolment, % gross	53.6	49	
2.2.2	Graduates in science & engineering, %	13.1	91	○
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	9.5	59	
2.3.1	Researchers, FTE/mn pop.ⓓ	573.0	62	
2.3.2	Gross expenditure on R&D, % GDPⓓ	0.6	57	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	18.1	52	
3	**Infrastructure**	**47.6**	**61**	
3.1	Information & communication technologies (ICTs)	62.6	54	
3.1.1	ICT access*	64.4	65	
3.1.2	ICT use*	58.0	43	
3.1.3	Government's online service*	63.8	55	
3.1.4	E-participation*	64.4	54	
3.2	General infrastructure	26.2	104	○
3.2.1	Electricity output, kWh/cap	2,146.4	76	
3.2.2	Logistics performance*	27.1	87	
3.2.3	Gross capital formation, % GDP	18.8	93	
3.3	Ecological sustainability	54.0	33	
3.3.1	GDP/unit of energy use	13.5	15	●
3.3.2	Environmental performance*	80.0	42	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.5	57	
4	**Market sophistication**	**38.4**	**101**	
4.1	Credit	35.8	62	
4.1.1	Ease of getting credit*	85.0	7	●
4.1.2	Domestic credit to private sector, % GDP	56.8	55	
4.1.3	Microfinance gross loans, % GDP	0.0	67	○
4.2	Investment	18.8	127	○
4.2.1	Ease of protecting minority investors*	35.0	121	○
4.2.2	Market capitalization, % GDPⓓ	3.5	83	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	62	
4.3	Trade, competition, & market scale	60.5	65	
4.3.1	Applied tariff rate, weighted mean, %ⓓ	2.7	61	
4.3.2	Intensity of local competition†	71.6	48	
4.3.3	Domestic market scale, bn PPP$	79.3	80	
5	**Business sophistication**	**35.2**	**52**	
5.1	Knowledge workers	36.5	68	
5.1.1	Knowledge-intensive employment, %	21.6	66	
5.1.2	Firms offering formal training, % firmsⓓ	54.7	16	●
5.1.3	GERD performed by business, % of GDPⓓ	0.2	51	
5.1.4	GERD financed by business, %ⓓ	1.5	85	○
5.1.5	Females employed w/advanced degrees, % total	13.0	48	
5.2	Innovation linkages	21.3	92	
5.2.1	University/industry research collaboration†	40.9	62	
5.2.2	State of cluster development†	48.7	48	
5.2.3	GERD financed by abroad, %ⓓ	1.4	83	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	69	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	97	○
5.3	Knowledge absorption	47.6	17	●
5.3.1	Intellectual property payments, % total trade	1.1	27	
5.3.2	High-tech imports less re-imports, % total trade	11.8	24	
5.3.3	ICT services imports, % total trade	0.7	84	
5.3.4	FDI net inflows, % GDP	6.0	22	●
5.3.5	Research talent, % in business enterpriseⓓ	69.2	5	●
6	**Knowledge & technology outputs**	**22.1**	**59**	
6.1	Knowledge creation	4.3	96	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	93	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	77	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	52	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.5	75	
6.1.5	Citable documents H index	10.1	61	
6.2	Knowledge impact	22.4	99	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.0)	88	
6.2.2	New businesses/th pop. 15–64	1.1	66	
6.2.3	Computer software spending, % GDP	0.3	52	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.7	71	
6.2.5	High- & medium-high-tech manufactures, %ⓓ	0.1	77	
6.3	Knowledge diffusion	39.6	22	●
6.3.1	Intellectual property receipts, % total tradeⓓ	0.0	79	
6.3.2	High-tech exports less re-exports, % total trade	5.1	33	
6.3.3	ICT services exports, % total trade	14.6	1	●
6.3.4	FDI net outflows, % GDP	1.1	50	
7	**Creative outputs**	**38.3**	**40**	
7.1	Intangible assets	48.6	44	
7.1.1	Trademarks by origin/bn PPP$ GDP	79.8	22	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.1	103	○
7.1.3	ICTs & business model creation†	67.0	41	
7.1.4	ICTs & organizational model creation†	62.3	33	
7.2	Creative goods & services	36.4	15	●
7.2.1	Cultural & creative services exports, % of total trade	10.1	1	●
7.2.2	National feature films/mn pop. 15–69	4.0	48	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %ⓓ	2.4	16	●
7.2.5	Creative goods exports, % total trade	0.5	57	
7.3	Online creativity	19.5	62	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	11.5	37	
7.3.2	Country-code TLDs/th pop. 15–69	1.6	68	
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	4.7	65	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Côte d'Ivoire

Key indicators

Population (millions)	23.3
GDP (US$ billions)	34.6
GDP per capita, PPP$	3,315.8
Income group	Lower-middle income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**24.0**	**112**	
Innovation Output Sub-Index	19.5	94	
Innovation Input Sub-Index	28.4	121	○
Innovation Efficiency Ratio	0.7	40	●
Global Innovation Index 2016 (out of 128)	25.8	108	

		Score/Value	Rank	
1	**Institutions**	**51.0**	**94**	
1.1	Political environment	34.2	107	
1.1.1	Political stability & safety*	43.0	99	
1.1.2	Government effectiveness*	25.4	105	
1.2	Regulatory environment	57.5	77	
1.2.1	Regulatory quality*	28.9	101	
1.2.2	Rule of law*	21.3	99	
1.2.3	Cost of redundancy dismissal, salary weeks	13.1	50	●
1.3	Business environment	61.3	91	
1.3.1	Ease of starting a business*	91.4	43	●
1.3.2	Ease of resolving insolvency*	49.1	63	●
1.3.3	Ease of paying taxes*	43.4	121	○
2	**Human capital & research**	**14.4**	**117**	
2.1	Education	35.0	99	
2.1.1	Expenditure on education, % GDP	4.7	61	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	27.4	18	●
2.1.3	School life expectancy, years	9.2	105	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	26.6	98	
2.2	Tertiary education	8.3	113	
2.2.1	Tertiary enrolment, % gross	9.2	108	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	1.8	72	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**26.5**	**114**	
3.1	Information & communication technologies (ICTs)	23.2	114	
3.1.1	ICT access*	37.9	101	
3.1.2	ICT use*	20.8	98	
3.1.3	Government's online service*	18.8	116	○
3.1.4	E-participation*	15.3	119	○
3.2	General infrastructure	25.6	105	
3.2.1	Electricity output, kWh/cap	373.9	106	
3.2.2	Logistics performance*	25.0	93	
3.2.3	Gross capital formation, % GDP	20.2	79	
3.3	Ecological sustainability	30.8	114	
3.3.1	GDP/unit of energy use	4.9	104	
3.3.2	Environmental performance*	59.9	101	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	100	
4	**Market sophistication**	**29.1**	**123**	○
4.1	Credit	14.9	119	○
4.1.1	Ease of getting credit*	30.0	108	○
4.1.2	Domestic credit to private sector, % GDP	23.1	106	
4.1.3	Microfinance gross loans, % GDP	0.4	37	●
4.2	Investment	25.2	123	○
4.2.1	Ease of protecting minority investors*	40.0	111	○
4.2.2	Market capitalization, % GDP	39.3	39	●
4.2.3	Venture capital deals/bn PPP$ GDPⓓ	0.0	61	
4.3	Trade, competition, & market scale	47.3	110	
4.3.1	Applied tariff rate, weighted mean, %	10.6	115	
4.3.2	Intensity of local competition†	62.9	90	
4.3.3	Domestic market scale, bn PPP$	87.1	75	
5	**Business sophistication**	**20.9**	**121**	○
5.1	Knowledge workers	20.7	[110]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firmsⓓ	19.1	77	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	20.2	104	
5.2.1	University/industry research collaboration†	38.2	81	
5.2.2	State of cluster development†	30.8	120	○
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	100	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	94	
5.3	Knowledge absorption	21.7	116	
5.3.1	Intellectual property payments, % total tradeⓓ	0.0	110	○
5.3.2	High-tech imports less re-imports, % total trade	5.6	101	
5.3.3	ICT services imports, % total tradeⓓ	0.7	81	
5.3.4	FDI net inflows, % GDP	1.3	100	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**20.4**	**75**	
6.1	Knowledge creation	2.7	117	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	86	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	96	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.9	111	
6.1.5	Citable documents H index	5.6	90	
6.2	Knowledge impact	44.8	16	●
6.2.1	Growth rate of PPP$ GDP/worker, %	5.4	4	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	120	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.0	91	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	13.6	117	
6.3.1	Intellectual property receipts, % total tradeⓓ	0.0	91	
6.3.2	High-tech exports less re-exports, % total trade	0.6	76	
6.3.3	ICT services exports, % total tradeⓓ	0.7	90	
6.3.4	FDI net outflows, % GDP	0.0	103	
7	**Creative outputs**	**18.7**	**108**	
7.1	Intangible assets	33.1	96	
7.1.1	Trademarks by origin/bn PPP$ GDP	9.5	104	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.6	50	●
7.1.3	ICTs & business model creation†	56.3	81	
7.1.4	ICTs & organizational model creation†	50.8	72	●
7.2	Creative goods & services	2.8	[117]	
7.2.1	Cultural & creative services exports, % of total trade	0.0	72	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.1	90	
7.3	Online creativity	5.7	108	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	106	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	104	
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	1.7	108	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Croatia

Key indicators

Population (millions)	4.2
GDP (US$ billions)	49.9
GDP per capita, PPP$	21,581.4
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**39.8**	**41**	
	Innovation Output Sub-Index	31.6	46	
	Innovation Input Sub-Index	48.0	44	
	Innovation Efficiency Ratio	0.7	52	
	Global Innovation Index 2016 (out of 128)	38.3	47	
1	**Institutions**	**69.3**	**42**	
1.1	Political environment	66.5	43	
1.1.1	Political stability & safety*	77.8	39	
1.1.2	Government effectiveness*	55.2	44	
1.2	Regulatory environment	67.1	51	
1.2.1	Regulatory quality*	51.4	57	
1.2.2	Rule of law*	45.3	52	
1.2.3	Cost of redundancy dismissal, salary weeks	15.1	60	
1.3	Business environment	74.3	55	
1.3.1	Ease of starting a business*	85.6	76	
1.3.2	Ease of resolving insolvency*	55.6	51	
1.3.3	Ease of paying taxes*	81.7	42	
2	**Human capital & research**	**37.4**	**47**	
2.1	Education	62.3	15	●
2.1.1	Expenditure on education, % GDP	4.6	65	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.3	42	
2.1.4	PISA scales in reading, maths, & science	475.4	34	
2.1.5	Pupil-teacher ratio, secondary ◷	8.0	7	●
2.2	Tertiary education	38.7	52	
2.2.1	Tertiary enrolment, % gross ◷	69.5	27	
2.2.2	Graduates in science & engineering, % ◷	23.8	33	
2.2.3	Tertiary inbound mobility, % ◷	0.4	93	○
2.3	Research & development (R&D)	11.0	56	
2.3.1	Researchers, FTE/mn pop.	1,501.5	43	
2.3.2	Gross expenditure on R&D, % GDP	0.9	42	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	6.4	65	
3	**Infrastructure**	**55.9**	**33**	
3.1	Information & communication technologies (ICTs)	72.4	33	
3.1.1	ICT access*	75.8	36	
3.1.2	ICT use*	61.3	37	
3.1.3	Government's online service*	74.6	33	
3.1.4	E-participation*	78.0	25	●
3.2	General infrastructure	32.9	83	
3.2.1	Electricity output, kWh/cap	3,168.9	61	
3.2.2	Logistics performance*	50.8	50	
3.2.3	Gross capital formation, % GDP	18.7	95	○
3.3	Ecological sustainability	62.4	12	●
3.3.1	GDP/unit of energy use	10.0	50	
3.3.2	Environmental performance*	87.0	15	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	9.7	8	●
4	**Market sophistication**	**42.1**	**88**	
4.1	Credit	26.9	92	○
4.1.1	Ease of getting credit*	55.0	67	
4.1.2	Domestic credit to private sector, % GDP	65.5	47	
4.1.3	Microfinance gross loans, % GDP ◷	0.0	70	○
4.2	Investment	38.0	76	
4.2.1	Ease of protecting minority investors*	66.7	26	
4.2.2	Market capitalization, % GDP ◷	36.2	41	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	68	○
4.3	Trade, competition, & market scale	61.4	62	
4.3.1	Applied tariff rate, weighted mean, % ◷	1.3	18	●
4.3.2	Intensity of local competition†	63.3	87	○
4.3.3	Domestic market scale, bn PPP$	94.2	73	
5	**Business sophistication**	**35.1**	**53**	
5.1	Knowledge workers	52.0	32	
5.1.1	Knowledge-intensive employment, %	35.6	36	
5.1.2	Firms offering formal training, % firms	49.3	23	
5.1.3	GERD performed by business, % of GDP	0.4	37	
5.1.4	GERD financed by business, %	46.6	23	
5.1.5	Females employed w/advanced degrees, % total	16.0	37	
5.2	Innovation linkages	21.6	89	
5.2.1	University/industry research collaboration†	31.1	103	○
5.2.2	State of cluster development†	32.7	113	○
5.2.3	GERD financed by abroad, %	14.5	33	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	74	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	62	
5.3	Knowledge absorption	31.7	70	
5.3.1	Intellectual property payments, % total trade	1.2	24	●
5.3.2	High-tech imports less re-imports, % total trade	7.5	70	
5.3.3	ICT services imports, % total trade	1.6	36	
5.3.4	FDI net inflows, % GDP	3.0	57	
5.3.5	Research talent, % in business enterprise	16.7	58	
6	**Knowledge & technology outputs**	**25.4**	**51**	
6.1	Knowledge creation	19.3	48	
6.1.1	Patents by origin/bn PPP$ GDP	2.0	46	
6.1.2	PCT patent applications/bn PPP$ GDP	0.4	41	
6.1.3	Utility models by origin/bn PPP$ GDP	0.8	31	
6.1.4	Scientific & technical articles/bn PPP$ GDP	35.2	19	●
6.1.5	Citable documents H index	15.4	44	
6.2	Knowledge impact	31.5	60	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.0)	89	○
6.2.2	New businesses/th pop. 15–64	4.6	25	
6.2.3	Computer software spending, % GDP	0.1	98	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	27.7	10	●
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	25.4	52	
6.3.1	Intellectual property receipts, % total trade	0.2	38	
6.3.2	High-tech exports less re-exports, % total trade	3.9	40	
6.3.3	ICT services exports, % total trade	2.5	45	
6.3.4	FDI net outflows, % GDP	1.2	47	
7	**Creative outputs**	**37.9**	**43**	
7.1	Intangible assets	43.6	60	
7.1.1	Trademarks by origin/bn PPP$ GDP	50.6	47	
7.1.2	Industrial designs by origin/bn PPP$ GDP	5.5	21	●
7.1.3	ICTs & business model creation†	57.8	74	
7.1.4	ICTs & organizational model creation†	54.3	60	
7.2	Creative goods & services	36.0	17	●
7.2.1	Cultural & creative services exports, % of total trade ◷	1.5	6	●
7.2.2	National feature films/mn pop. 15–69	4.6	44	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.9	44	
7.3	Online creativity	28.3	42	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	14.1	32	
7.3.2	Country-code TLDs/th pop. 15–69	9.5	40	
7.3.3	Wikipedia edits/mn pop. 15–69	6.2	37	
7.3.4	Video uploads on YouTube/pop. 15–69	30.3	43	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Cyprus

Key indicators

Population (millions)	1.2
GDP (US$ billions)	19.9
GDP per capita, PPP$	32,785.5
Income group	High income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank
	Global Innovation Index (out of 127)	**46.8**	**30**
	Innovation Output Sub-Index	39.7	28
	Innovation Input Sub-Index	53.9	32
	Innovation Efficiency Ratio	0.7	28
	Global Innovation Index 2016 (out of 128)	46.3	31
1	**Institutions**	**81.0**	**21**
1.1	Political environment	72.9	34
1.1.1	Political stability & safety*	77.0	41
1.1.2	Government effectiveness*	68.8	32
1.2	Regulatory environment	84.6	20
1.2.1	Regulatory quality*	69.2	32
1.2.2	Rule of law*	69.0	28
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1
1.3	Business environment	85.7	20
1.3.1	Ease of starting a business*	91.2	45
1.3.2	Ease of resolving insolvency*	81.4	15
1.3.3	Ease of paying taxes*	84.5	30
2	**Human capital & research**	**39.9**	**40**
2.1	Education	60.2	21
2.1.1	Expenditure on education, % GDP	6.4	16
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	37.9	7
2.1.3	School life expectancy, years	14.6	57
2.1.4	PISA scales in reading, maths, & science	437.5	46
2.1.5	Pupil-teacher ratio, secondary	10.4	29
2.2	Tertiary education	53.7	16
2.2.1	Tertiary enrolment, % gross	60.1	42
2.2.2	Graduates in science & engineering, %	19.0	65
2.2.3	Tertiary inbound mobility, %	17.6	8
2.3	Research & development (R&D)	5.6	74
2.3.1	Researchers, FTE/mn pop.	1,013.8	48
2.3.2	Gross expenditure on R&D, % GDP	0.5	67
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43
2.3.4	QS university ranking, average score top 3*	0.0	75
3	**Infrastructure**	**48.1**	**59**
3.1	Information & communication technologies (ICTs)	57.7	65
3.1.1	ICT access*	70.2	51
3.1.2	ICT use*	54.6	50
3.1.3	Government's online service*	53.6	78
3.1.4	E-participation*	52.5	82
3.2	General infrastructure	23.4	113
3.2.1	Electricity output, kWh/cap	5,058.1	41
3.2.2	Logistics performance*	43.3	58
3.2.3	Gross capital formation, % GDP	10.4	121
3.3	Ecological sustainability	63.2	10
3.3.1	GDP/unit of energy use	13.0	20
3.3.2	Environmental performance*	80.2	40
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	8.8	9
4	**Market sophistication**	**57.9**	**19**
4.1	Credit	80.0	2
4.1.1	Ease of getting credit*	60.0	55
4.1.2	Domestic credit to private sector, % GDP	247.6	1
4.1.3	Microfinance gross loans, % GDP	n/a	n/a
4.2	Investment	37.5	77
4.2.1	Ease of protecting minority investors*	66.7	26
4.2.2	Market capitalization, % GDP	13.8	71
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	38
4.3	Trade, competition, & market scale	56.3	86
4.3.1	Applied tariff rate, weighted mean, %	1.6	23
4.3.2	Intensity of local competition†	71.9	42
4.3.3	Domestic market scale, bn PPP$	29.3	109
5	**Business sophistication**	**42.7**	**31**
5.1	Knowledge workers	42.7	49
5.1.1	Knowledge-intensive employment, %	35.2	38
5.1.2	Firms offering formal training, % firms	n/a	n/a
5.1.3	GERD performed by business, % of GDP	0.1	65
5.1.4	GERD financed by business, % ⓓ	13.7	67
5.1.5	Females employed w/advanced degrees, % total	24.0	11
5.2	Innovation linkages	41.7	26
5.2.1	University/industry research collaboration†	39.2	73
5.2.2	State of cluster development†	46.7	55
5.2.3	GERD financed by abroad, % ⓓ	23.7	17
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	6
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.4	22
5.3	Knowledge absorption	43.7	26
5.3.1	Intellectual property payments, % total trade	0.6	53
5.3.2	High-tech imports less re-imports, % total trade	3.5	118
5.3.3	ICT services imports, % total trade	7.7	1
5.3.4	FDI net inflows, % GDP	4.2	34
5.3.5	Research talent, % in business enterprise	21.5	53
6	**Knowledge & technology outputs**	**41.3**	**17**
6.1	Knowledge creation	22.8	42
6.1.1	Patents by origin/bn PPP$ GDP	1.5	55
6.1.2	PCT patent applications/bn PPP$ GDP	1.2	26
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a
6.1.4	Scientific & technical articles/bn PPP$ GDP	41.0	15
6.1.5	Citable documents H index	9.2	70
6.2	Knowledge impact	42.7	23
6.2.1	Growth rate of PPP$ GDP/worker, %	0.7	66
6.2.2	New businesses/th pop. 15–64	13.7	7
6.2.3	Computer software spending, % GDP	0.2	78
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	29.2	9
6.2.5	High- & medium-high-tech manufactures, %	0.1	66
6.3	Knowledge diffusion	58.5	7
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	86
6.3.2	High-tech exports less re-exports, % total trade	0.5	86
6.3.3	ICT services exports, % total trade ⓓ	9.6	6
6.3.4	FDI net outflows, % GDP	17.2	1
7	**Creative outputs**	**38.2**	**41**
7.1	Intangible assets	44.0	59
7.1.1	Trademarks by origin/bn PPP$ GDP	75.4	23
7.1.2	Industrial designs by origin/bn PPP$ GDP	5.4	22
7.1.3	ICTs & business model creation†	54.3	86
7.1.4	ICTs & organizational model creation†	46.6	86
7.2	Creative goods & services	20.4	58
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.5	28
7.2.2	National feature films/mn pop. 15–69	4.6	43
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a
7.2.4	Printing & publishing manufactures, %	2.6	13
7.2.5	Creative goods exports, % total trade	0.0	107
7.3	Online creativity	44.4	23
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	68.2	8
7.3.2	Country-code TLDs/th pop. 15–69	4.7	52
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	6.2	32
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Key indicators

Population (millions)	10.5
GDP (US$ billions)	193.5
GDP per capita, PPP$	31,549.5
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**51.0**	**24**	
Innovation Output Sub-Index	46.2	16	●
Innovation Input Sub-Index	55.7	27	
Innovation Efficiency Ratio	0.8	13	●
Global Innovation Index 2016 (out of 128)	49.4	27	

		Score/Value	Rank	
1	**Institutions**	**77.6**	**30**	
1.1	Political environment	78.1	24	
1.1.1	Political stability & safety*	87.1	18	
1.1.2	Government effectiveness*	69.2	31	
1.2	Regulatory environment	73.4	37	
1.2.1	Regulatory quality*	69.9	31	
1.2.2	Rule of law*	72.2	27	
1.2.3	Cost of redundancy dismissal, salary weeks	20.2	83	○
1.3	Business environment	81.3	28	
1.3.1	Ease of starting a business*	86.9	66	
1.3.2	Ease of resolving insolvency*	76.4	24	
1.3.3	Ease of paying taxes*	80.7	45	
2	**Human capital & research**	**47.6**	**30**	
2.1	Education	54.5	43	
2.1.1	Expenditure on education, % GDP	4.1	78	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	23.7	36	
2.1.3	School life expectancy, years	16.8	17	
2.1.4	PISA scales in reading, maths, & science	490.8	28	
2.1.5	Pupil-teacher ratio, secondary◷	11.5	37	
2.2	Tertiary education	49.6	21	
2.2.1	Tertiary enrolment, % gross◷	66.0	34	
2.2.2	Graduates in science & engineering, %	23.2	36	
2.2.3	Tertiary inbound mobility, %◷	9.8	21	
2.3	Research & development (R&D)	38.7	28	
2.3.1	Researchers, FTE/mn pop.	3,611.9	25	
2.3.2	Gross expenditure on R&D, % GDP	2.0	19	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	37.5	40	
2.3.4	QS university ranking, average score top 3*	27.6	42	
3	**Infrastructure**	**57.3**	**30**	
3.1	Information & communication technologies (ICTs)	61.0	56	
3.1.1	ICT access*	74.6	38	
3.1.2	ICT use*	65.5	28	
3.1.3	Government's online service*	47.8	89	○
3.1.4	E-participation*	55.9	74	○
3.2	General infrastructure	51.2	20	
3.2.1	Electricity output, kWh/cap	7,823.0	24	
3.2.2	Logistics performance*	74.5	25	
3.2.3	Gross capital formation, % GDP	26.1	36	
3.3	Ecological sustainability	59.8	17	●
3.3.1	GDP/unit of energy use	7.5	78	○
3.3.2	Environmental performance*	84.7	27	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	11.3	5	●
4	**Market sophistication**	**50.2**	**47**	
4.1	Credit	44.7	41	
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	50.3	70	○
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	34.1	89	○
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDP◷	17.4	63	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	42	
4.3	Trade, competition, & market scale	71.9	31	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	79.4	14	●
4.3.3	Domestic market scale, bn PPP$	350.9	46	
5	**Business sophistication**	**45.9**	**26**	
5.1	Knowledge workers	53.6	30	
5.1.1	Knowledge-intensive employment, %	37.6	31	
5.1.2	Firms offering formal training, % firms	55.1	14	
5.1.3	GERD performed by business, % of GDP	1.1	21	
5.1.4	GERD financed by business, %	34.5	43	
5.1.5	Females employed w/advanced degrees, % total	11.6	59	○
5.2	Innovation linkages	36.8	40	
5.2.1	University/industry research collaboration†	44.4	45	
5.2.2	State of cluster development†	46.7	56	
5.2.3	GERD financed by abroad, %	32.5	14	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	92	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.7	31	
5.3	Knowledge absorption	47.2	19	
5.3.1	Intellectual property payments, % total trade	0.7	47	
5.3.2	High-tech imports less re-imports, % total trade	17.7	10	●
5.3.3	ICT services imports, % total trade	1.1	62	
5.3.4	FDI net inflows, % GDP	2.9	59	
5.3.5	Research talent, % in business enterprise	50.3	24	
6	**Knowledge & technology outputs**	**45.8**	**14**	●
6.1	Knowledge creation	46.8	14	●
6.1.1	Patents by origin/bn PPP$ GDP	3.2	32	
6.1.2	PCT patent applications/bn PPP$ GDP	0.6	35	
6.1.3	Utility models by origin/bn PPP$ GDP	4.0	6	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	34.7	21	
6.1.5	Citable documents H index	27.4	32	
6.2	Knowledge impact	52.0	8	●
6.2.1	Growth rate of PPP$ GDP/worker, %	3.0	20	
6.2.2	New businesses/th pop. 15–64	3.4	35	
6.2.3	Computer software spending, % GDP	0.3	41	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	31.5	7	●
6.2.5	High- & medium-high-tech manufactures, %	0.5	7	●
6.3	Knowledge diffusion	38.7	25	
6.3.1	Intellectual property receipts, % total trade	0.3	32	
6.3.2	High-tech exports less re-exports, % total trade	16.7	7	●
6.3.3	ICT services exports, % total trade	1.8	57	
6.3.4	FDI net outflows, % GDP	2.5	25	
7	**Creative outputs**	**46.7**	**22**	
7.1	Intangible assets	51.4	33	
7.1.1	Trademarks by origin/bn PPP$ GDP	66.2	29	
7.1.2	Industrial designs by origin/bn PPP$ GDP	5.1	25	
7.1.3	ICTs & business model creation†	68.7	34	
7.1.4	ICTs & organizational model creation†	63.6	30	
7.2	Creative goods & services	39.9	9	●
7.2.1	Cultural & creative services exports, % of total trade◷	0.5	27	
7.2.2	National feature films/mn pop. 15–69	7.2	22	
7.2.3	Global ent. & media market/th pop. 15–69	20.3	26	
7.2.4	Printing & publishing manufactures, %	1.0	65	○
7.2.5	Creative goods exports, % total trade	9.8	4	●
7.3	Online creativity	44.0	24	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	17.1	30	
7.3.2	Country-code TLDs/th pop. 15–69	49.6	15	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.7	22	
7.3.4	Video uploads on YouTube/pop. 15–69	44.8	23	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Denmark

Key indicators

Population (millions)	5.7
GDP (US$ billions)	302.6
GDP per capita, PPP$	45,709.4
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**58.7**	**6**	●
	Innovation Output Sub-Index	48.7	12	
	Innovation Input Sub-Index	68.7	6	●
	Innovation Efficiency Ratio	0.7	34	
	Global Innovation Index 2016 (out of 128)	58.5	8	
1	**Institutions**	**91.4**	**6**	●
1.1	Political environment	87.6	13	
1.1.1	Political stability & safety*	85.5	25	
1.1.2	Government effectiveness*	89.7	6	●
1.2	Regulatory environment	96.4	4	●
1.2.1	Regulatory quality*	86.5	11	
1.2.2	Rule of law*	99.0	3	●
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	90.3	4	●
1.3.1	Ease of starting a business*	94.1	22	
1.3.2	Ease of resolving insolvency*	84.9	8	
1.3.3	Ease of paying taxes*	92.1	7	
2	**Human capital & research**	**66.1**	**3**	●
2.1	Education	74.1	4	●
2.1.1	Expenditure on education, % GDP	8.6	2	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	28.2	15	
2.1.3	School life expectancy, years	19.2	6	●
2.1.4	PISA scales in reading, maths, & science	504.3	16	
2.1.5	Pupil-teacher ratio, secondary ⓓ	11.3	34	
2.2	Tertiary education	50.0	19	
2.2.1	Tertiary enrolment, % gross ⓓ	81.5	14	
2.2.2	Graduates in science & engineering, %	20.4	53	○
2.2.3	Tertiary inbound mobility, % ⓓ	9.9	18	
2.3	Research & development (R&D)	74.2	7	
2.3.1	Researchers, FTE/mn pop.	7,483.6	2	●
2.3.2	Gross expenditure on R&D, % GDP	3.0	6	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	72.3	17	
2.3.4	QS university ranking, average score top 3*	63.8	15	
3	**Infrastructure**	**63.2**	**15**	
3.1	Information & communication technologies (ICTs)	83.3	14	
3.1.1	ICT access*	85.2	14	
3.1.2	ICT use*	89.1	1	●
3.1.3	Government's online service*	77.5	28	
3.1.4	E-participation*	81.4	22	
3.2	General infrastructure	43.1	44	
3.2.1	Electricity output, kWh/cap	5,076.0	40	
3.2.2	Logistics performance*	81.0	17	
3.2.3	Gross capital formation, % GDP	19.6	86	○
3.3	Ecological sustainability	63.2	11	
3.3.1	GDP/unit of energy use	14.9	11	
3.3.2	Environmental performance*	89.2	4	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.9	24	
4	**Market sophistication**	**70.2**	**6**	●
4.1	Credit	70.0	6	●
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	174.1	5	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	71.4	5	●
4.2.1	Ease of protecting minority investors*	71.7	19	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	6	
4.3	Trade, competition, & market scale	69.1	37	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	74.2	30	
4.3.3	Domestic market scale, bn PPP$	264.8	56	○
5	**Business sophistication**	**52.5**	**12**	
5.1	Knowledge workers	70.3	8	
5.1.1	Knowledge-intensive employment, %	45.1	12	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	1.9	10	
5.1.4	GERD financed by business, %	59.4	13	
5.1.5	Females employed w/advanced degrees, % total	21.8	18	
5.2	Innovation linkages	46.1	17	
5.2.1	University/industry research collaboration†	64.0	14	
5.2.2	State of cluster development†	60.7	21	
5.2.3	GERD financed by abroad, %	6.5	59	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	15	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	8.0	9	
5.3	Knowledge absorption	41.1	30	
5.3.1	Intellectual property payments, % total trade	0.8	41	
5.3.2	High-tech imports less re-imports, % total trade	6.5	86	○
5.3.3	ICT services imports, % total trade	2.4	13	
5.3.4	FDI net inflows, % GDP	0.0	123	○
5.3.5	Research talent, % in business enterprise	58.0	15	
6	**Knowledge & technology outputs**	**43.9**	**16**	
6.1	Knowledge creation	50.3	12	
6.1.1	Patents by origin/bn PPP$ GDP	13.1	8	
6.1.2	PCT patent applications/bn PPP$ GDP	5.1	10	
6.1.3	Utility models by origin/bn PPP$ GDP	0.5	37	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	66.8	2	●
6.1.5	Citable documents H index	49.4	15	
6.2	Knowledge impact	39.8	34	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	87	○
6.2.2	New businesses/th pop. 15–64	4.4	28	
6.2.3	Computer software spending, % GDP	0.6	12	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.2	50	
6.2.5	High- & medium-high-tech manufactures, %	0.4	17	
6.3	Knowledge diffusion	41.7	17	
6.3.1	Intellectual property receipts, % total trade	1.4	12	
6.3.2	High-tech exports less re-exports, % total trade	6.8	27	
6.3.3	ICT services exports, % total trade	2.5	46	
6.3.4	FDI net outflows, % GDP	3.0	20	
7	**Creative outputs**	**53.5**	**9**	
7.1	Intangible assets	53.8	25	
7.1.1	Trademarks by origin/bn PPP$ GDP	36.6	61	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	7.6	16	
7.1.3	ICTs & business model creation†	75.3	24	
7.1.4	ICTs & organizational model creation†	74.1	15	
7.2	Creative goods & services	39.8	11	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.7	21	
7.2.2	National feature films/mn pop. 15–69	17.7	6	
7.2.3	Global ent. & media market/th pop. 15–69	76.0	4	
7.2.4	Printing & publishing manufactures, %	1.0	64	○
7.2.5	Creative goods exports, % total trade	1.8	29	
7.3	Online creativity	66.5	6	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	48.4	15	
7.3.2	Country-code TLDs/th pop. 15–69	98.4	4	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.6	25	
7.3.4	Video uploads on YouTube/pop. 15–69	56.1	11	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Dominican Republic

Key indicators

Population (millions)	10.6
GDP (US$ billions)	71.5
GDP per capita, PPP$	14,983.7
Income group	Upper-middle income
Region	Latin America and the Caribbean

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**31.2**	**79**	
	Innovation Output Sub-Index	24.5	72	
	Innovation Input Sub-Index	37.8	88	
	Innovation Efficiency Ratio	0.6	54	●
	Global Innovation Index 2016 (out of 128)	30.6	76	
1	**Institutions**	**51.8**	**90**	
1.1	Political environment	50.6	69	
1.1.1	Political stability & safety*	68.0	53	●
1.1.2	Government effectiveness*	33.3	88	
1.2	Regulatory environment	48.8	104	
1.2.1	Regulatory quality*	41.2	73	
1.2.2	Rule of law*	26.1	89	
1.2.3	Cost of redundancy dismissal, salary weeks	26.2	103	
1.3	Business environment	55.9	112	
1.3.1	Ease of starting a business*	83.3	89	
1.3.2	Ease of resolving insolvency*	23.6	125	○
1.3.3	Ease of paying taxes*	60.7	93	
2	**Human capital & research**	**17.6**	**109**	
2.1	Education	26.6	115	
2.1.1	Expenditure on education, % GDP◷	2.1	113	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	15.0	83	
2.1.3	School life expectancy, years	13.2	70	
2.1.4	PISA scales in reading, maths, & science	339.0	70	○
2.1.5	Pupil-teacher ratio, secondary	22.1	87	
2.2	Tertiary education	26.1	91	
2.2.1	Tertiary enrolment, % gross◷	47.5	55	
2.2.2	Graduates in science & engineering, %	14.4	87	
2.2.3	Tertiary inbound mobility, %◷	2.3	65	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**42.4**	**78**	
3.1	Information & communication technologies (ICTs)	44.4	89	
3.1.1	ICT access*	43.8	94	
3.1.2	ICT use*	34.1	78	
3.1.3	Government's online service*	50.7	83	
3.1.4	E-participation*	49.2	89	
3.2	General infrastructure	27.0	102	
3.2.1	Electricity output, kWh/cap	1,784.1	80	
3.2.2	Logistics performance*	26.1	89	
3.2.3	Gross capital formation, % GDP	20.1	80	
3.3	Ecological sustainability	55.7	28	●
3.3.1	GDP/unit of energy use	16.9	7	●
3.3.2	Environmental performance*	75.3	56	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	108	
4	**Market sophistication**	**45.4**	**70**	
4.1	Credit	22.6	107	
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	27.1	102	
4.1.3	Microfinance gross loans, % GDP	0.7	29	●
4.2	Investment	53.3	[24]	
4.2.1	Ease of protecting minority investors*	53.3	80	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	60.3	67	
4.3.1	Applied tariff rate, weighted mean, %	6.3	100	
4.3.2	Intensity of local competition†	76.6	20	●
4.3.3	Domestic market scale, bn PPP$	160.9	66	
5	**Business sophistication**	**31.9**	**67**	
5.1	Knowledge workers	48.1	36	●
5.1.1	Knowledge-intensive employment, %	17.9	79	
5.1.2	Firms offering formal training, % firms◷	57.0	12	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	12.7	52	
5.2	Innovation linkages	24.8	75	
5.2.1	University/industry research collaboration†	31.8	101	
5.2.2	State of cluster development†	45.9	60	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	109	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	100	
5.3	Knowledge absorption	22.8	109	
5.3.1	Intellectual property payments, % total trade◷	0.4	65	
5.3.2	High-tech imports less re-imports, % total trade	5.7	99	
5.3.3	ICT services imports, % total trade◷	0.3	115	
5.3.4	FDI net inflows, % GDP	3.2	52	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**17.2**	**91**	
6.1	Knowledge creation	0.9	126	○
6.1.1	Patents by origin/bn PPP$ GDP	0.1	102	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	71	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	57	
6.1.4	Scientific & technical articles/bn PPP$ GDP	0.5	126	○
6.1.5	Citable documents H index	2.1	117	○
6.2	Knowledge impact	33.2	56	
6.2.1	Growth rate of PPP$ GDP/worker, %	4.3	13	●
6.2.2	New businesses/th pop. 15–64	1.2	62	
6.2.3	Computer software spending, % GDP	0.0	117	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.3	103	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	17.6	98	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	1.1	68	
6.3.3	ICT services exports, % total trade◷	1.1	81	
6.3.4	FDI net outflows, % GDP	(0.1)	117	○
7	**Creative outputs**	**31.9**	**60**	
7.1	Intangible assets	41.4	68	
7.1.1	Trademarks by origin/bn PPP$ GDP	45.6	54	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.3	91	
7.1.3	ICTs & business model creation†	65.6	44	●
7.1.4	ICTs & organizational model creation†	55.6	53	●
7.2	Creative goods & services	30.2	[30]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69◷	1.0	79	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	2.2	21	●
7.3	Online creativity	14.4	81	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.9	66	
7.3.2	Country-code TLDs/th pop. 15–69	1.1	80	
7.3.3	Wikipedia edits/mn pop. 15–69◷	4.1	80	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Ecuador

Key indicators

Population (millions)	16.4
GDP (US$ billions)	99.1
GDP per capita, PPP$	11,263.6
Income group	Upper-middle income
Region	Latin America and the Caribbean

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**29.1**	**92**	
	Innovation Output Sub-Index	22.2	83	
	Innovation Input Sub-Index	36.1	95	
	Innovation Efficiency Ratio	0.6	66	
	Global Innovation Index 2016 (out of 128)	27.1	100	
1	**Institutions**	**43.3**	**116**	
1.1	Political environment	46.2	78	
1.1.1	Political stability & safety*	61.4	70	
1.1.2	Government effectiveness*	31.0	91	
1.2	Regulatory environment	32.0	122	○
1.2.1	Regulatory quality*	12.9	124	○
1.2.2	Rule of law*	9.4	121	○
1.2.3	Cost of redundancy dismissal, salary weeks	31.8	120	
1.3	Business environment	51.7	119	
1.3.1	Ease of starting a business*	70.6	118	
1.3.2	Ease of resolving insolvency*	25.2	124	○
1.3.3	Ease of paying taxes*	59.3	96	
2	**Human capital & research**	**22.8**	**93**	
2.1	Education	39.1	89	
2.1.1	Expenditure on education, % GDP	4.9	56	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	5.0	106	○
2.1.3	School life expectancy, years ◷	15.1	45	●
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	22.3	88	
2.2	Tertiary education	22.8	99	
2.2.1	Tertiary enrolment, % gross ◷	40.5	65	
2.2.2	Graduates in science & engineering, %	14.9	86	
2.2.3	Tertiary inbound mobility, % ◷	0.6	89	
2.3	Research & development (R&D)	6.5	71	
2.3.1	Researchers, FTE/mn pop. ◷	400.7	66	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.4	68	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	11.1	62	
3	**Infrastructure**	**43.4**	**76**	
3.1	Information & communication technologies (ICTs)	50.7	77	
3.1.1	ICT access*	49.0	84	
3.1.2	ICT use*	33.1	80	
3.1.3	Government's online service*	63.0	57	
3.1.4	E-participation*	57.6	70	
3.2	General infrastructure	33.8	78	
3.2.1	Electricity output, kWh/cap	1,528.7	85	
3.2.2	Logistics performance*	33.1	74	
3.2.3	Gross capital formation, % GDP	24.7	46	●
3.3	Ecological sustainability	45.7	60	
3.3.1	GDP/unit of energy use	11.9	28	●
3.3.2	Environmental performance*	66.6	88	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.2	60	
4	**Market sophistication**	**45.8**	**68**	
4.1	Credit	46.2	38	●
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	26.9	103	
4.1.3	Microfinance gross loans, % GDP	4.7	8	●
4.2	Investment	31.6	103	
4.2.1	Ease of protecting minority investors*	46.7	95	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP ◷	0.0	85	
4.3	Trade, competition, & market scale	59.5	72	
4.3.1	Applied tariff rate, weighted mean, %	5.6	96	
4.3.2	Intensity of local competition†	66.9	73	
4.3.3	Domestic market scale, bn PPP$	182.4	59	
5	**Business sophistication**	**25.1**	**103**	
5.1	Knowledge workers	35.9	73	
5.1.1	Knowledge-intensive employment, %	14.7	88	
5.1.2	Firms offering formal training, % firms ◷	65.9	3	●
5.1.3	GERD performed by business, % of GDP ◷	0.2	53	
5.1.4	GERD financed by business, % ◷	0.1	93	○
5.1.5	Females employed w/advanced degrees, % total	10.6	62	
5.2	Innovation linkages	17.0	120	
5.2.1	University/industry research collaboration†	35.1	94	
5.2.2	State of cluster development†	37.7	92	
5.2.3	GERD financed by abroad, % ◷	2.5	71	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	111	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	114	○
5.3	Knowledge absorption	22.6	110	
5.3.1	Intellectual property payments, % total trade	0.3	73	
5.3.2	High-tech imports less re-imports, % total trade	9.7	47	●
5.3.3	ICT services imports, % total trade	0.0	124	○
5.3.4	FDI net inflows, % GDP	0.9	106	
5.3.5	Research talent, % in business enterprise ◷	15.0	61	
6	**Knowledge & technology outputs**	**14.3**	**109**	
6.1	Knowledge creation	3.5	104	
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.0	121	○
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	78	
6.1.3	Utility models by origin/bn PPP$ GDP ◷	0.1	50	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.0	89	
6.1.5	Citable documents H index	7.7	79	
6.2	Knowledge impact	23.1	96	
6.2.1	Growth rate of PPP$ GDP/worker, %	(1.1)	99	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.2	63	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.9	54	●
6.2.5	High- & medium-high-tech manufactures, % ◷	0.1	70	
6.3	Knowledge diffusion	16.3	107	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.5	87	
6.3.3	ICT services exports, % total trade	0.4	106	
6.3.4	FDI net outflows, % GDP	0.1	97	
7	**Creative outputs**	**30.1**	**66**	
7.1	Intangible assets	47.4	48	●
7.1.1	Trademarks by origin/bn PPP$ GDP ◷	63.9	31	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	57.4	76	
7.1.4	ICTs & organizational model creation†	52.2	67	
7.2	Creative goods & services	12.0	82	
7.2.1	Cultural & creative services exports, % of total trade	0.3	37	●
7.2.2	National feature films/mn pop. 15–69	2.1	60	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ◷	1.6	33	●
7.2.5	Creative goods exports, % total trade	0.1	104	
7.3	Online creativity	13.7	83	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.1	76	
7.3.2	Country-code TLDs/th pop. 15–69	1.1	78	
7.3.3	Wikipedia edits/mn pop. 15–69 ◷	3.9	86	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Egypt

Key indicators

Population (millions)	93.4
GDP (US$ billions)	330.2
GDP per capita, PPP$	11,849.6
Income group	Lower-middle income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**26.0**	**105**
Innovation Output Sub-Index	19.3	97
Innovation Input Sub-Index	32.7	106
Innovation Efficiency Ratio	0.6	81
Global Innovation Index 2016 (out of 128)	26.0	107

		Score/Value	Rank	
1	**Institutions**	**40.4**	**121**	○
1.1	Political environment	26.9	119	
1.1.1	Political stability & safety*	31.3	119	
1.1.2	Government effectiveness*	22.6	113	
1.2	Regulatory environment	33.1	120	○
1.2.1	Regulatory quality*	21.8	111	
1.2.2	Rule of law*	24.7	92	
1.2.3	Cost of redundancy dismissal, salary weeks	36.8	122	○
1.3	Business environment	61.3	90	
1.3.1	Ease of starting a business*	92.4	33	●
1.3.2	Ease of resolving insolvency*	39.5	97	
1.3.3	Ease of paying taxes*	52.0	111	
2	**Human capital & research**	**26.9**	**82**	
2.1	Education	48.6	58	
2.1.1	Expenditure on education, % GDP◷	3.8	86	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	13.1	71	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary◷	14.4	60	
2.2	Tertiary education	20.2	103	
2.2.1	Tertiary enrolment, % gross	36.2	72	
2.2.2	Graduates in science & engineering, %	11.8	97	○
2.2.3	Tertiary inbound mobility, %◷	1.9	70	
2.3	Research & development (R&D)	11.9	54	
2.3.1	Researchers, FTE/mn pop.	679.8	57	
2.3.2	Gross expenditure on R&D, % GDP	0.7	49	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	22.9	48	●
3	**Infrastructure**	**38.4**	**93**	
3.1	Information & communication technologies (ICTs)	43.0	91	
3.1.1	ICT access*	53.0	78	
3.1.2	ICT use*	31.4	84	
3.1.3	Government's online service*	47.1	90	
3.1.4	E-participation*	40.7	97	
3.2	General infrastructure	27.4	100	
3.2.1	Electricity output, kWh/cap	1,917.2	78	
3.2.2	Logistics performance*	51.9	48	●
3.2.3	Gross capital formation, % GDP	14.5	113	
3.3	Ecological sustainability	44.9	63	
3.3.1	GDP/unit of energy use	11.8	29	●
3.3.2	Environmental performance*	66.5	89	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.8	70	
4	**Market sophistication**	**36.7**	**107**	
4.1	Credit	20.2	111	
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	26.5	104	
4.1.3	Microfinance gross loans, % GDP	0.0	61	
4.2	Investment	26.6	121	○
4.2.1	Ease of protecting minority investors*	48.3	92	
4.2.2	Market capitalization, % GDP	16.7	64	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	72	
4.3	Trade, competition, & market scale	63.4	56	
4.3.1	Applied tariff rate, weighted mean, %	7.0	103	
4.3.2	Intensity of local competition†	53.9	117	○
4.3.3	Domestic market scale, bn PPP$	1,105.0	21	●
5	**Business sophistication**	**21.0**	**120**	○
5.1	Knowledge workers	21.2	108	
5.1.1	Knowledge-intensive employment, %	33.9	40	●
5.1.2	Firms offering formal training, % firms	5.2	91	○
5.1.3	GERD performed by business, % of GDP	0.0	72	
5.1.4	GERD financed by business, %	6.2	76	
5.1.5	Females employed w/advanced degrees, % total◷	5.5	76	
5.2	Innovation linkages	19.2	113	
5.2.1	University/industry research collaboration†◷	23.8	121	○
5.2.2	State of cluster development†	54.5	31	●
5.2.3	GERD financed by abroad, %◷	0.1	98	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	103	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	83	
5.3	Knowledge absorption	22.5	111	
5.3.1	Intellectual property payments, % total trade◷	0.4	66	
5.3.2	High-tech imports less re-imports, % total trade	8.6	56	
5.3.3	ICT services imports, % total trade◷	0.7	86	
5.3.4	FDI net inflows, % GDP	1.7	88	
5.3.5	Research talent, % in business enterprise	5.4	73	
6	**Knowledge & technology outputs**	**17.0**	**93**	
6.1	Knowledge creation	8.0	71	
6.1.1	Patents by origin/bn PPP$ GDP◷	0.8	69	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	88	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	9.7	67	
6.1.5	Citable documents H index	14.5	50	
6.2	Knowledge impact	25.3	90	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.7	69	
6.2.2	New businesses/th pop. 15–64◷	0.1	99	○
6.2.3	Computer software spending, % GDP	0.3	46	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.4	87	
6.2.5	High- & medium-high-tech manufactures, %◷	0.2	60	
6.3	Knowledge diffusion	17.6	97	
6.3.1	Intellectual property receipts, % total trade◷	0.3	33	●
6.3.2	High-tech exports less re-exports, % total trade	0.2	104	
6.3.3	ICT services exports, % total trade◷	1.7	59	
6.3.4	FDI net outflows, % GDP	0.1	94	
7	**Creative outputs**	**21.6**	**97**	
7.1	Intangible assets	30.2	103	
7.1.1	Trademarks by origin/bn PPP$ GDP	11.7	99	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.5	51	
7.1.3	ICTs & business model creation†	50.3	97	
7.1.4	ICTs & organizational model creation†	45.7	88	
7.2	Creative goods & services	15.2	73	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	0.6	90	
7.2.3	Global ent. & media market/th pop. 15–69	1.0	56	
7.2.4	Printing & publishing manufactures, %◷	0.4	93	○
7.2.5	Creative goods exports, % total trade	1.9	26	●
7.3	Online creativity	11.0	97	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.2	90	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	120	○
7.3.3	Wikipedia edits/mn pop. 15–69	3.6	91	
7.3.4	Video uploads on YouTube/pop. 15–69	7.9	65	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

El Salvador

Key indicators

Population (millions)	6.1
GDP (US$ billions)	26.6
GDP per capita, PPP$	8,302.5
Income group	Lower-middle income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**26.7**	**103**
Innovation Output Sub-Index	17.3	105
Innovation Input Sub-Index	36.1	96
Innovation Efficiency Ratio	0.5	107
Global Innovation Index 2016 (out of 128)	26.6	104

1	**Institutions**	**53.5**	**85**	
1.1	Political environment	49.3	70	
1.1.1	Political stability & safety*	62.6	64	
1.1.2	Government effectiveness*	35.9	85	
1.2	Regulatory environment	52.6	93	
1.2.1	Regulatory quality*	47.2	64	
1.2.2	Rule of law*	22.1	96	
1.2.3	Cost of redundancy dismissal, salary weeks	22.9	96	
1.3	Business environment	58.7	102	
1.3.1	Ease of starting a business*	80.7	97	
1.3.2	Ease of resolving insolvency*	45.8	73	
1.3.3	Ease of paying taxes*	49.5	114	

2	**Human capital & research**	**20.1**	**100**	
2.1	Education	32.0	106	
2.1.1	Expenditure on education, % GDP	3.4	93	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	10.4	96	
2.1.3	School life expectancy, years	13.2	69	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	24.3	91	
2.2	Tertiary education	28.0	85	
2.2.1	Tertiary enrolment, % gross ⓓ	28.9	81	
2.2.2	Graduates in science & engineering, %	22.2	41	●
2.2.3	Tertiary inbound mobility, % ⓓ	0.4	92	
2.3	Research & development (R&D)	0.5	108	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.1	106	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○

3	**Infrastructure**	**36.2**	**98**	
3.1	Information & communication technologies (ICTs)	43.2	90	
3.1.1	ICT access*	49.5	83	
3.1.2	ICT use*	18.7	101	
3.1.3	Government's online service*	48.6	87	
3.1.4	E-participation*	55.9	74	
3.2	General infrastructure	20.7	118	
3.2.1	Electricity output, kWh/cap	1,018.5	92	
3.2.2	Logistics performance*	29.7	82	
3.2.3	Gross capital formation, % GDP	14.2	116	
3.3	Ecological sustainability	44.8	64	
3.3.1	GDP/unit of energy use	11.8	29	●
3.3.2	Environmental performance*	68.1	85	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	101	

4	**Market sophistication**	**42.2**	**87**	
4.1	Credit	35.0	65	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	44.9	76	
4.1.3	Microfinance gross loans, % GDP	1.3	22	●
4.2	Investment	32.0	101	
4.2.1	Ease of protecting minority investors*	38.3	120	○
4.2.2	Market capitalization, % GDP ⓓ	45.1	36	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	59.6	71	
4.3.1	Applied tariff rate, weighted mean, %	1.8	51	
4.3.2	Intensity of local competition†	71.0	52	
4.3.3	Domestic market scale, bn PPP$	54.8	92	

5	**Business sophistication**	**28.2**	**82**	
5.1	Knowledge workers	29.1	87	
5.1.1	Knowledge-intensive employment, % ⓓ	12.1	92	
5.1.2	Firms offering formal training, % firms	53.8	17	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⓓ	0.7	88	○
5.1.5	Females employed w/advanced degrees, % total ⓓ	0.1	88	○
5.2	Innovation linkages	26.5	70	
5.2.1	University/industry research collaboration†	29.6	106	
5.2.2	State of cluster development†	36.2	98	
5.2.3	GERD financed by abroad, % ⓓ	16.9	26	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	104	
5.3	Knowledge absorption	29.1	81	
5.3.1	Intellectual property payments, % total trade	0.8	43	●
5.3.2	High-tech imports less re-imports, % total trade	9.9	46	●
5.3.3	ICT services imports, % total trade	0.4	104	
5.3.4	FDI net inflows, % GDP	1.7	89	
5.3.5	Research talent, % in business enterprise	n/a	n/a	

6	**Knowledge & technology outputs**	**9.3**	**121**	○
6.1	Knowledge creation	1.4	122	○
6.1.1	Patents by origin/bn PPP$ GDP	0.1	103	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	98	○
6.1.3	Utility models by origin/bn PPP$ GDP ⓓ	0.1	49	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.1	123	○
6.1.5	Citable documents H index	1.4	123	○
6.2	Knowledge impact	4.5	119	○
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	0.5	86	
6.2.3	Computer software spending, % GDP	0.0	105	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.2	68	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	22.0	64	
6.3.1	Intellectual property receipts, % total trade	0.3	30	●
6.3.2	High-tech exports less re-exports, % total trade	2.4	49	●
6.3.3	ICT services exports, % total trade	2.1	51	
6.3.4	FDI net outflows, % GDP	0.5	69	

7	**Creative outputs**	**25.3**	**89**	
7.1	Intangible assets	39.1	77	
7.1.1	Trademarks by origin/bn PPP$ GDP	83.7	18	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	95	
7.1.3	ICTs & business model creation†	49.1	106	
7.1.4	ICTs & organizational model creation†	44.5	95	
7.2	Creative goods & services	9.6	91	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.0	89	○
7.2.2	National feature films/mn pop. 15–69 ⓓ	0.3	97	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.7	52	
7.3	Online creativity	13.6	86	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.6	72	
7.3.2	Country-code TLDs/th pop. 15–69	0.6	88	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	3.9	87	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Estonia

Key indicators

Population (millions)	1.3
GDP (US$ billions)	23.5
GDP per capita, PPP$	28,591.8
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**50.9**	**25**	
	Innovation Output Sub-Index	44.9	19	
	Innovation Input Sub-Index	57.0	26	
	Innovation Efficiency Ratio	0.8	19	
	Global Innovation Index 2016 (out of 128)	51.7	24	
1	**Institutions**	**81.1**	**20**	
1.1	Political environment	74.5	32	
1.1.1	Political stability & safety*	78.9	36	
1.1.2	Government effectiveness*	70.2	28	
1.2	Regulatory environment	85.8	18	
1.2.1	Regulatory quality*	84.5	15	
1.2.2	Rule of law*	78.2	23	
1.2.3	Cost of redundancy dismissal, salary weeks	12.9	44	
1.3	Business environment	82.9	24	
1.3.1	Ease of starting a business*	95.1	13	
1.3.2	Ease of resolving insolvency*	65.5	39	
1.3.3	Ease of paying taxes*	88.0	19	
2	**Human capital & research**	**41.5**	**38**	
2.1	Education	58.8	25	
2.1.1	Expenditure on education, % GDP	4.8	58	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	23.1	40	
2.1.3	School life expectancy, years	16.4	26	
2.1.4	PISA scales in reading, maths, & science	524.3	4	●
2.1.5	Pupil-teacher ratio, secondary ◷	8.1	9	
2.2	Tertiary education	43.1	40	
2.2.1	Tertiary enrolment, % gross	69.6	26	
2.2.2	Graduates in science & engineering, % ◷	22.1	44	
2.2.3	Tertiary inbound mobility, %	5.2	35	
2.3	Research & development (R&D)	22.7	42	
2.3.1	Researchers, FTE/mn pop.	3,189.2	28	
2.3.2	Gross expenditure on R&D, % GDP	1.5	24	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	17.9	53	
3	**Infrastructure**	**63.9**	**11**	
3.1	Information & communication technologies (ICTs)	82.3	17	
3.1.1	ICT access*	80.2	24	
3.1.2	ICT use*	78.7	13	
3.1.3	Government's online service*	89.1	13	
3.1.4	E-participation*	81.4	22	
3.2	General infrastructure	45.5	38	
3.2.1	Electricity output, kWh/cap	7,891.7	22	
3.2.2	Logistics performance*	60.1	37	
3.2.3	Gross capital formation, % GDP	24.0	49	
3.3	Ecological sustainability	63.9	9	●
3.3.1	GDP/unit of energy use	6.1	92	○
3.3.2	Environmental performance*	88.6	8	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	14.8	1	●
4	**Market sophistication**	**55.0**	**26**	
4.1	Credit	48.8	30	
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	70.3	41	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	56.4	20	
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	12	
4.3	Trade, competition, & market scale	59.9	70	○
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	79.2	15	
4.3.3	Domestic market scale, bn PPP$	38.7	98	○
5	**Business sophistication**	**43.4**	**29**	
5.1	Knowledge workers	55.1	28	
5.1.1	Knowledge-intensive employment, %	44.0	17	
5.1.2	Firms offering formal training, % firms	35.2	38	
5.1.3	GERD performed by business, % of GDP	0.7	27	
5.1.4	GERD financed by business, %	41.0	33	
5.1.5	Females employed w/advanced degrees, % total	25.8	7	
5.2	Innovation linkages	36.9	39	
5.2.1	University/industry research collaboration†	51.4	34	
5.2.2	State of cluster development†	46.0	59	
5.2.3	GERD financed by abroad, %	12.2	42	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	3	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.1	27	
5.3	Knowledge absorption	38.3	40	
5.3.1	Intellectual property payments, % total trade	0.2	79	○
5.3.2	High-tech imports less re-imports, % total trade	12.2	23	
5.3.3	ICT services imports, % total trade	2.2	18	
5.3.4	FDI net inflows, % GDP	2.6	69	○
5.3.5	Research talent, % in business enterprise	27.5	47	○
6	**Knowledge & technology outputs**	**36.1**	**27**	
6.1	Knowledge creation	31.3	30	
6.1.1	Patents by origin/bn PPP$ GDP	1.6	52	
6.1.2	PCT patent applications/bn PPP$ GDP	0.6	33	
6.1.3	Utility models by origin/bn PPP$ GDP	2.0	14	
6.1.4	Scientific & technical articles/bn PPP$ GDP	47.6	10	
6.1.5	Citable documents H index	14.6	49	
6.2	Knowledge impact	43.4	20	
6.2.1	Growth rate of PPP$ GDP/worker, %	(1.8)	101	○
6.2.2	New businesses/th pop. 15–64	16.1	4	●
6.2.3	Computer software spending, % GDP	0.2	79	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	30.1	8	●
6.2.5	High- & medium-high-tech manufactures, %	0.4	30	
6.3	Knowledge diffusion	33.6	32	
6.3.1	Intellectual property receipts, % total trade	0.1	65	○
6.3.2	High-tech exports less re-exports, % total trade	11.7	17	
6.3.3	ICT services exports, % total trade	3.2	28	
6.3.4	FDI net outflows, % GDP	1.9	32	
7	**Creative outputs**	**53.6**	**8**	●
7.1	Intangible assets	59.9	15	
7.1.1	Trademarks by origin/bn PPP$ GDP	82.9	19	
7.1.2	Industrial designs by origin/bn PPP$ GDP	4.3	29	
7.1.3	ICTs & business model creation†	75.9	22	
7.1.4	ICTs & organizational model creation†	79.9	5	●
7.2	Creative goods & services	48.8	4	●
7.2.1	Cultural & creative services exports, % of total trade ◷	1.5	7	●
7.2.2	National feature films/mn pop. 15–69	27.2	1	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	2.0	22	
7.2.5	Creative goods exports, % total trade	1.2	38	
7.3	Online creativity	45.9	21	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	9.2	41	
7.3.2	Country-code TLDs/th pop. 15–69	40.7	17	
7.3.3	Wikipedia edits/mn pop. 15–69	7.3	5	●
7.3.4	Video uploads on YouTube/pop. 15–69	63.0	7	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Ethiopia

Key indicators

Population (millions)	101.9
GDP (US$ billions)	69.2
GDP per capita, PPP$	1,800.7
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**24.2**	**110**	
Innovation Output Sub-Index	20.2	91	
Innovation Input Sub-Index	28.2	122	
Innovation Efficiency Ratio	0.7	32	●
Global Innovation Index 2016 (out of 128)	24.8	110	

		Score	Rank	
1	**Institutions**	**43.9**	**114**	
1.1	Political environment	26.8	120	
1.1.1	Political stability & safety*	27.9	120	
1.1.2	Government effectiveness*	25.7	104	
1.2	Regulatory environment	49.7	99	
1.2.1	Regulatory quality*	16.4	121	
1.2.2	Rule of law*	26.7	88	
1.2.3	Cost of redundancy dismissal, salary weeks	19.1	79	
1.3	Business environment	55.2	114	
1.3.1	Ease of starting a business*	56.0	125	○
1.3.2	Ease of resolving insolvency*	37.6	103	
1.3.3	Ease of paying taxes*	72.1	69	
2	**Human capital & research**	**14.8**	**115**	
2.1	Education	26.4	116	
2.1.1	Expenditure on education, % GDP	4.5	67	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	25.7	27	●
2.1.3	School life expectancy, years ⓓ	8.4	110	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	40.4	109	
2.2	Tertiary education	14.6	110	
2.2.1	Tertiary enrolment, % gross ⓓ	8.1	110	
2.2.2	Graduates in science & engineering, % ⓓ	11.2	98	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	3.5	83	
2.3.1	Researchers, FTE/mn pop. ⓓ	45.1	91	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.6	56	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**33.0**	**107**	
3.1	Information & communication technologies (ICTs)	32.8	104	
3.1.1	ICT access*	21.1	124	○
3.1.2	ICT use*	8.2	118	
3.1.3	Government's online service*	52.9	79	
3.1.4	E-participation*	49.2	89	
3.2	General infrastructure	44.6	39	●
3.2.1	Electricity output, kWh/cap	99.2	116	
3.2.2	Logistics performance*	14.5	116	
3.2.3	Gross capital formation, % GDP	39.7	6	●
3.3	Ecological sustainability	21.6	124	
3.3.1	GDP/unit of energy use	2.8	114	
3.3.2	Environmental performance*	45.8	115	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.0	126	○
4	**Market sophistication**	**24.8**	**127**	○
4.1	Credit	7.2	126	○
4.1.1	Ease of getting credit*	15.0	121	
4.1.2	Domestic credit to private sector, % GDP ⓓ	17.7	113	
4.1.3	Microfinance gross loans, % GDP	0.0	66	
4.2	Investment	22.3	125	○
4.2.1	Ease of protecting minority investors*	31.7	126	○
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	66	
4.3	Trade, competition, & market scale	45.1	114	
4.3.1	Applied tariff rate, weighted mean, %	12.1	123	
4.3.2	Intensity of local competition†	48.1	122	○
4.3.3	Domestic market scale, bn PPP$	174.7	61	●
5	**Business sophistication**	**24.2**	**108**	
5.1	Knowledge workers	10.8	121	
5.1.1	Knowledge-intensive employment, % ⓓ	3.8	104	
5.1.2	Firms offering formal training, % firms	20.8	74	
5.1.3	GERD performed by business, % of GDP ⓓ	0.0	82	
5.1.4	GERD financed by business, % ⓓ	0.7	87	
5.1.5	Females employed w/advanced degrees, % total ⓓ	6.0	74	
5.2	Innovation linkages	23.3	82	
5.2.1	University/industry research collaboration†	47.2	38	●
5.2.2	State of cluster development†	42.3	77	
5.2.3	GERD financed by abroad, % ⓓ	2.1	75	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	101	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	Knowledge absorption	38.5	38	●
5.3.1	Intellectual property payments, % total trade ⓓ	0.0	111	
5.3.2	High-tech imports less re-imports, % total trade	22.2	4	●
5.3.3	ICT services imports, % total trade ⓓ	1.6	34	●
5.3.4	FDI net inflows, % GDP	3.1	54	●
5.3.5	Research talent, % in business enterprise ⓓ	0.5	81	
6	**Knowledge & technology outputs**	**15.3**	**105**	
6.1	Knowledge creation	8.0	[72]	
6.1.1	Patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.1	77	
6.1.5	Citable documents H index	6.7	83	
6.2	Knowledge impact	32.7	59	●
6.2.1	Growth rate of PPP$ GDP/worker, %	5.6	3	●
6.2.2	New businesses/th pop. 15–64 ⓓ	0.0	104	○
6.2.3	Computer software spending, % GDP	0.0	125	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.6	116	
6.2.5	High- & medium-high-tech manufactures, %	0.1	71	
6.3	Knowledge diffusion	5.3	127	○
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	93	
6.3.2	High-tech exports less re-exports, % total trade	0.1	108	
6.3.3	ICT services exports, % total trade ⓓ	1.7	63	●
6.3.4	FDI net outflows, % GDP	n/a	n/a	
7	**Creative outputs**	**25.0**	**90**	
7.1	Intangible assets	44.3	57	●
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	44.4	117	
7.1.4	ICTs & organizational model creation†	44.2	96	
7.2	Creative goods & services	10.6	87	
7.2.1	Cultural & creative services exports, % of total trade	0.0	86	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	1.8	26	●
7.2.5	Creative goods exports, % total trade	0.0	111	
7.3	Online creativity	0.9	123	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.0	127	○
7.3.2	Country-code TLDs/th pop. 15–69	0.0	124	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	0.3	123	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Key indicators

Population (millions)	5.5
GDP (US$ billions)	239.2
GDP per capita, PPP$	41,120.0
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**58.5**	**8**	
Innovation Output Sub-Index	48.1	13	
Innovation Input Sub-Index	68.9	4	●
Innovation Efficiency Ratio	0.7	37	
Global Innovation Index 2016 (out of 128)	59.9	5	

		Score	Rank	
1	**Institutions**	**92.2**	**4**	●
1.1	Political environment	89.0	8	
1.1.1	Political stability & safety*	89.0	11	
1.1.2	Government effectiveness*	89.0	8	
1.2	Regulatory environment	95.1	5	●
1.2.1	Regulatory quality*	88.9	5	●
1.2.2	Rule of law*	100.0	1	●
1.2.3	Cost of redundancy dismissal, salary weeks	10.1	33	
1.3	Business environment	92.4	1	●
1.3.1	Ease of starting a business*	93.1	25	
1.3.2	Ease of resolving insolvency*	93.9	1	●
1.3.3	Ease of paying taxes*	90.2	13	
2	**Human capital & research**	**66.4**	**1**	●
2.1	Education	73.0	5	●
2.1.1	Expenditure on education, % GDP	7.2	13	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ◴	34.7	11	
2.1.3	School life expectancy, years	19.3	4	●
2.1.4	PISA scales in reading, maths, & science	522.7	6	
2.1.5	Pupil-teacher ratio, secondary ◴	12.8	48	○
2.2	Tertiary education	56.5	11	
2.2.1	Tertiary enrolment, % gross	87.3	7	
2.2.2	Graduates in science & engineering, %	27.9	16	
2.2.3	Tertiary inbound mobility, %	7.7	24	
2.3	Research & development (R&D)	69.7	9	
2.3.1	Researchers, FTE/mn pop.	6,816.8	5	
2.3.2	Gross expenditure on R&D, % GDP	2.9	8	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	73.5	15	
2.3.4	QS university ranking, average score top 3*	54.8	17	
3	**Infrastructure**	**64.4**	**8**	
3.1	Information & communication technologies (ICTs)	86.1	9	
3.1.1	ICT access*	76.9	33	
3.1.2	ICT use*	81.8	7	
3.1.3	Government's online service*	94.2	5	
3.1.4	E-participation*	91.5	8	
3.2	General infrastructure	53.1	15	
3.2.1	Electricity output, kWh/cap	12,494.7	9	
3.2.2	Logistics performance*	85.9	15	
3.2.3	Gross capital formation, % GDP	21.4	72	○
3.3	Ecological sustainability	53.9	34	
3.3.1	GDP/unit of energy use	6.3	89	○
3.3.2	Environmental performance*	90.7	1	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.5	17	
4	**Market sophistication**	**61.6**	**13**	
4.1	Credit	51.4	26	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	95.5	30	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	67.8	9	
4.2.1	Ease of protecting minority investors*	56.7	67	○
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.3	5	
4.3	Trade, competition, & market scale	65.6	51	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	63.0	89	○
4.3.3	Domestic market scale, bn PPP$	230.0	58	○
5	**Business sophistication**	**60.1**	**6**	
5.1	Knowledge workers	72.6	5	●
5.1.1	Knowledge-intensive employment, %	46.0	10	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	2.0	8	
5.1.4	GERD financed by business, %	54.8	15	
5.1.5	Females employed w/advanced degrees, % total	26.6	6	
5.2	Innovation linkages	56.8	5	●
5.2.1	University/industry research collaboration†	78.6	2	●
5.2.2	State of cluster development†	64.9	17	
5.2.3	GERD financed by abroad, %	14.5	32	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	11	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	9.4	1	●
5.3	Knowledge absorption	50.9	11	
5.3.1	Intellectual property payments, % total trade	1.0	33	
5.3.2	High-tech imports less re-imports, % total trade	8.2	62	○
5.3.3	ICT services imports, % total trade	3.6	5	●
5.3.4	FDI net inflows, % GDP	3.9	38	
5.3.5	Research talent, % in business enterprise	56.8	16	
6	**Knowledge & technology outputs**	**48.8**	**10**	
6.1	Knowledge creation	61.2	8	
6.1.1	Patents by origin/bn PPP$ GDP	14.6	7	
6.1.2	PCT patent applications/bn PPP$ GDP	6.6	6	
6.1.3	Utility models by origin/bn PPP$ GDP	1.8	17	
6.1.4	Scientific & technical articles/bn PPP$ GDP	55.0	5	●
6.1.5	Citable documents H index	42.1	18	
6.2	Knowledge impact	40.3	32	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.9	60	○
6.2.2	New businesses/th pop. 15–64	3.4	34	
6.2.3	Computer software spending, % GDP	0.5	19	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	11.5	33	
6.2.5	High- & medium-high-tech manufactures, %	0.4	22	
6.3	Knowledge diffusion	44.9	14	
6.3.1	Intellectual property receipts, % total trade	2.9	6	
6.3.2	High-tech exports less re-exports, % total trade	5.0	34	
6.3.3	ICT services exports, % total trade	9.9	5	●
6.3.4	FDI net outflows, % GDP	(1.0)	120	○
7	**Creative outputs**	**47.3**	**18**	
7.1	Intangible assets	57.7	20	
7.1.1	Trademarks by origin/bn PPP$ GDP	51.5	44	
7.1.2	Industrial designs by origin/bn PPP$ GDP	5.3	23	
7.1.3	ICTs & business model creation†	83.1	4	●
7.1.4	ICTs & organizational model creation†	78.5	7	
7.2	Creative goods & services	27.1	40	
7.2.1	Cultural & creative services exports, % of total trade ◴	0.3	39	
7.2.2	National feature films/mn pop. 15–69	11.6	12	
7.2.3	Global ent. & media market/th pop. 15–69	62.6	9	
7.2.4	Printing & publishing manufactures, %	1.2	50	○
7.2.5	Creative goods exports, % total trade	0.6	53	
7.3	Online creativity	46.7	19	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	29.3	21	
7.3.2	Country-code TLDs/th pop. 15–69	31.6	19	
7.3.3	Wikipedia edits/mn pop. 15–69	7.3	6	
7.3.4	Video uploads on YouTube/pop. 15–69	56.1	11	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◴ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

France

Key indicators

Population (millions)	64.7
GDP (US$ billions)	2,488.3
GDP per capita, PPP$	41,180.7
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**54.2**	**15**	
	Innovation Output Sub-Index	44.9	18	
	Innovation Input Sub-Index	63.4	15	
	Innovation Efficiency Ratio	0.7	35	
	Global Innovation Index 2016 (out of 128)	54.0	18	
1	**Institutions**	**80.7**	**24**	
1.1	Political environment	74.8	31	
1.1.1	Political stability & safety*	70.5	48	
1.1.2	Government effectiveness*	79.2	21	
1.2	Regulatory environment	84.2	21	
1.2.1	Regulatory quality*	71.7	27	
1.2.2	Rule of law*	80.5	21	
1.2.3	Cost of redundancy dismissal, salary weeks	11.8	42	
1.3	Business environment	82.9	25	
1.3.1	Ease of starting a business*	93.3	24	
1.3.2	Ease of resolving insolvency*	76.6	22	
1.3.3	Ease of paying taxes*	78.7	54	
2	**Human capital & research**	**58.1**	**12**	
2.1	Education	58.6	27	
2.1.1	Expenditure on education, % GDP	5.5	32	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	26.8	20	
2.1.3	School life expectancy, years	16.3	27	
2.1.4	PISA scales in reading, maths, & science	495.7	24	
2.1.5	Pupil-teacher ratio, secondaryⓓ	12.9	50	○
2.2	Tertiary education	50.6	18	
2.2.1	Tertiary enrolment, % grossⓓ	64.4	36	
2.2.2	Graduates in science & engineering, %	24.5	32	
2.2.3	Tertiary inbound mobility, %ⓓ	9.8	20	
2.3	Research & development (R&D)	65.1	12	
2.3.1	Researchers, FTE/mn pop.ⓓ	4,168.8	21	
2.3.2	Gross expenditure on R&D, % GDP	2.2	12	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	87.1	8	●
2.3.4	QS university ranking, average score top 3*	71.4	10	●
3	**Infrastructure**	**63.4**	**12**	
3.1	Information & communication technologies (ICTs)	86.8	8	●
3.1.1	ICT access*	87.0	11	
3.1.2	ICT use*	76.1	16	
3.1.3	Government's online service*	94.2	5	●
3.1.4	E-participation*	89.8	12	
3.2	General infrastructure	50.3	25	
3.2.1	Electricity output, kWh/cap	8,470.6	17	
3.2.2	Logistics performance*	85.0	16	
3.2.3	Gross capital formation, % GDP	22.4	62	○
3.3	Ecological sustainability	53.1	35	
3.3.1	GDP/unit of energy use	9.9	51	○
3.3.2	Environmental performance*	88.2	10	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.6	43	
4	**Market sophistication**	**64.3**	**11**	●
4.1	Credit	44.0	42	
4.1.1	Ease of getting credit*	50.0	72	○
4.1.2	Domestic credit to private sector, % GDP	95.8	29	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	66.7	10	●
4.2.1	Ease of protecting minority investors*	65.0	31	
4.2.2	Market capitalization, % GDP	86.3	16	
4.2.3	Venture capital deals/bn PPP$ GDP	0.3	1	●
4.3	Trade, competition, & market scale	82.3	6	●
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	79.4	13	
4.3.3	Domestic market scale, bn PPP$	2,736.7	10	●
5	**Business sophistication**	**50.6**	**18**	
5.1	Knowledge workers	65.9	13	
5.1.1	Knowledge-intensive employment, %	44.6	14	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	1.5	14	
5.1.4	GERD financed by business, %ⓓ	55.7	14	
5.1.5	Females employed w/advanced degrees, % total	21.1	20	
5.2	Innovation linkages	36.2	41	
5.2.1	University/industry research collaboration†	54.8	31	
5.2.2	State of cluster development†	59.3	25	
5.2.3	GERD financed by abroad, %ⓓ	7.8	51	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	39	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	3.9	16	
5.3	Knowledge absorption	49.7	14	
5.3.1	Intellectual property payments, % total trade	1.8	13	
5.3.2	High-tech imports less re-imports, % total trade	11.4	31	
5.3.3	ICT services imports, % total trade	2.2	17	
5.3.4	FDI net inflows, % GDP	0.8	108	○
5.3.5	Research talent, % in business enterpriseⓓ	60.5	11	
6	**Knowledge & technology outputs**	**38.5**	**20**	
6.1	Knowledge creation	34.6	24	
6.1.1	Patents by origin/bn PPP$ GDP	9.4	14	
6.1.2	PCT patent applications/bn PPP$ GDP	3.0	15	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	55	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	25.3	30	
6.1.5	Citable documents H index	79.3	4	●
6.2	Knowledge impact	39.3	36	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.8	63	○
6.2.2	New businesses/th pop. 15–64	2.3	46	○
6.2.3	Computer software spending, % GDP	0.6	13	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	10.4	36	
6.2.5	High- & medium-high-tech manufactures, %	0.4	23	
6.3	Knowledge diffusion	41.6	18	
6.3.1	Intellectual property receipts, % total trade	1.9	11	
6.3.2	High-tech exports less re-exports, % total trade	14.4	11	●
6.3.3	ICT services exports, % total trade	2.2	49	
6.3.4	FDI net outflows, % GDP	1.2	43	
7	**Creative outputs**	**51.4**	**12**	
7.1	Intangible assets	64.0	7	●
7.1.1	Trademarks by origin/bn PPP$ GDP	109.0	10	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	7.5	17	
7.1.3	ICTs & business model creation†	76.7	17	
7.1.4	ICTs & organizational model creation†	71.4	20	
7.2	Creative goods & services	34.5	19	
7.2.1	Cultural & creative services exports, % of total tradeⓓ	1.2	10	
7.2.2	National feature films/mn pop. 15–69	6.8	25	
7.2.3	Global ent. & media market/th pop. 15–69	53.1	15	
7.2.4	Printing & publishing manufactures, %	1.2	55	○
7.2.5	Creative goods exports, % total trade	1.7	30	
7.3	Online creativity	43.0	26	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	41.3	18	
7.3.2	Country-code TLDs/th pop. 15–69	20.2	27	
7.3.3	Wikipedia edits/mn pop. 15–69	7.0	10	●
7.3.4	Video uploads on YouTube/pop. 15–69	43.3	26	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Georgia

Key indicators

Population (millions)	4.0
GDP (US$ billions)	14.5
GDP per capita, PPP$	9,630.0
Income group	Upper-middle income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**34.4**	**68**
Innovation Output Sub-Index	26.6	62
Innovation Input Sub-Index	42.2	69
Innovation Efficiency Ratio	0.6	60
Global Innovation Index 2016 (out of 128)	33.9	64

1	**Institutions**	**68.6**	**47**	
1.1	Political environment	53.3	61	
1.1.1	Political stability & safety*	54.2	82	
1.1.2	Government effectiveness*	52.5	48	
1.2	Regulatory environment	77.8	30	
1.2.1	Regulatory quality*	65.8	35	
1.2.2	Rule of law*	48.1	48	
1.2.3	Cost of redundancy dismissal, salary weeks	8.6	20	●
1.3	Business environment	74.5	53	
1.3.1	Ease of starting a business*	96.1	8	●
1.3.2	Ease of resolving insolvency*	40.0	94	
1.3.3	Ease of paying taxes*	87.4	20	●
2	**Human capital & research**	**23.6**	**89**	
2.1	Education	39.1	88	
2.1.1	Expenditure on education, % GDPⓓ	2.0	114	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/capⓓ	14.2	85	
2.1.3	School life expectancy, years	15.4	37	
2.1.4	PISA scales in reading, maths, & science	405.4	61	
2.1.5	Pupil-teacher ratio, secondary	7.2	4	●
2.2	Tertiary education	29.5	83	
2.2.1	Tertiary enrolment, % gross	43.4	61	
2.2.2	Graduates in science & engineering, %	16.7	75	
2.2.3	Tertiary inbound mobility, %	3.7	51	
2.3	Research & development (R&D)	2.2	91	
2.3.1	Researchers, FTE/mn pop.ⓓ	585.4	61	
2.3.2	Gross expenditure on R&D, % GDPⓓ	0.1	104	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**43.8**	**74**	
3.1	Information & communication technologies (ICTs)	55.7	69	
3.1.1	ICT access*	62.9	67	
3.1.2	ICT use*	40.0	68	
3.1.3	Government's online service*	63.8	55	
3.1.4	E-participation*	55.9	74	
3.2	General infrastructure	39.3	53	
3.2.1	Electricity output, kWh/cap	2,304.7	74	
3.2.2	Logistics performance*	13.4	118	○
3.2.3	Gross capital formation, % GDP	33.4	10	●
3.3	Ecological sustainability	36.6	93	
3.3.1	GDP/unit of energy use	7.2	83	
3.3.2	Environmental performance*	65.0	94	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	95	
4	**Market sophistication**	**49.2**	**53**	
4.1	Credit	48.3	31	
4.1.1	Ease of getting credit*	85.0	7	●
4.1.2	Domestic credit to private sector, % GDP	49.8	72	
4.1.3	Microfinance gross loans, % GDP	2.3	15	
4.2	Investment	41.0	60	
4.2.1	Ease of protecting minority investors*	76.7	7	●
4.2.2	Market capitalization, % GDPⓓ	6.0	80	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	44	
4.3	Trade, competition, & market scale	58.2	78	
4.3.1	Applied tariff rate, weighted mean, %	0.3	4	●
4.3.2	Intensity of local competition†	66.1	75	
4.3.3	Domestic market scale, bn PPP$	37.4	101	
5	**Business sophistication**	**25.6**	**101**	
5.1	Knowledge workers	28.2	90	
5.1.1	Knowledge-intensive employment, %ⓓ	22.3	65	
5.1.2	Firms offering formal training, % firms	10.5	89	○
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	15.4	39	
5.2	Innovation linkages	20.9	98	
5.2.1	University/industry research collaboration†	28.7	107	○
5.2.2	State of cluster development†	32.9	111	○
5.2.3	GERD financed by abroad, %ⓓ	14.3	34	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	81	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	92	
5.3	Knowledge absorption	27.6	88	
5.3.1	Intellectual property payments, % total trade	0.1	101	○
5.3.2	High-tech imports less re-imports, % total trade	6.5	88	
5.3.3	ICT services imports, % total trade	0.5	97	
5.3.4	FDI net inflows, % GDP	9.3	12	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**23.9**	**54**	
6.1	Knowledge creation	20.9	44	
6.1.1	Patents by origin/bn PPP$ GDP	2.8	36	
6.1.2	PCT patent applications/bn PPP$ GDP	0.3	44	
6.1.3	Utility models by origin/bn PPP$ GDP	1.7	18	
6.1.4	Scientific & technical articles/bn PPP$ GDP	16.0	47	
6.1.5	Citable documents H index	7.9	75	
6.2	Knowledge impact	30.7	66	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.4	32	
6.2.2	New businesses/th pop. 15–64	5.7	22	
6.2.3	Computer software spending, % GDP	0.1	91	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.4	86	
6.2.5	High- & medium-high-tech manufactures, %ⓓ	0.1	76	
6.3	Knowledge diffusion	20.2	77	
6.3.1	Intellectual property receipts, % total trade	0.0	88	
6.3.2	High-tech exports less re-exports, % total trade	0.5	83	
6.3.3	ICT services exports, % total trade	0.6	96	
6.3.4	FDI net outflows, % GDP	1.8	36	
7	**Creative outputs**	**29.3**	**69**	
7.1	Intangible assets	37.6	85	
7.1.1	Trademarks by origin/bn PPP$ GDP	53.7	41	
7.1.2	Industrial designs by origin/bn PPP$ GDP	4.9	27	
7.1.3	ICTs & business model creation†	50.0	99	
7.1.4	ICTs & organizational model creation†	41.3	107	○
7.2	Creative goods & services	21.0	54	
7.2.1	Cultural & creative services exports, % of total trade	0.1	59	
7.2.2	National feature films/mn pop. 15–69	5.5	35	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %ⓓ	3.1	7	●
7.2.5	Creative goods exports, % total trade	0.1	91	
7.3	Online creativity	20.9	60	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.8	83	
7.3.2	Country-code TLDs/th pop. 15–69	2.1	63	
7.3.3	Wikipedia edits/mn pop. 15–69	6.1	40	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Germany

Key indicators

Population (millions)	80.7
GDP (US$ billions)	3,494.9
GDP per capita, PPP$	46,893.2
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**58.4**	**9**	
Innovation Output Sub-Index	53.5	7	
Innovation Input Sub-Index	63.3	17	
Innovation Efficiency Ratio	0.8	7	
Global Innovation Index 2016 (out of 128)	57.9	10	
1 Institutions	**83.5**	**18**	
1.1 Political environment	84.0	15	
1.1.1 Political stability & safety*	81.2	30	
1.1.2 Government effectiveness*	86.8	12	
1.2 Regulatory environment	80.6	25	
1.2.1 Regulatory quality*	84.7	14	
1.2.2 Rule of law*	91.5	16	
1.2.3 Cost of redundancy dismissal, salary weeks	21.6	88	○
1.3 Business environment	85.9	19	
1.3.1 Ease of starting a business*	83.4	88	○
1.3.2 Ease of resolving insolvency*	92.3	3	●
1.3.3 Ease of paying taxes*	82.1	41	
2 Human capital & research	**60.1**	**10**	
2.1 Education	58.5	29	
2.1.1 Expenditure on education, % GDP	4.9	53	
2.1.2 Gov't expenditure/pupil, secondary, % GDP/cap	23.7	35	
2.1.3 School life expectancy, years	17.3	15	
2.1.4 PISA scales in reading, maths, & science	508.1	11	
2.1.5 Pupil-teacher ratio, secondary	12.1	42	
2.2 Tertiary education	49.8	20	
2.2.1 Tertiary enrolment, % gross	68.3	31	
2.2.2 Graduates in science & engineering, %	n/a	n/a	
2.2.3 Tertiary inbound mobility, %	7.7	23	
2.3 Research & development (R&D)	72.1	8	
2.3.1 Researchers, FTE/mn pop.	4,431.1	19	
2.3.2 Gross expenditure on R&D, % GDP	2.9	9	
2.3.3 Global R&D companies, avg. expend. top 3, mn $US	97.1	2	●
2.3.4 QS university ranking, average score top 3*	70.8	11	
3 Infrastructure	**61.5**	**20**	
3.1 Information & communication technologies (ICTs)	81.5	18	
3.1.1 ICT access*	90.9	5	●
3.1.2 ICT use*	74.9	19	
3.1.3 Government's online service*	84.1	21	
3.1.4 E-participation*	76.3	27	
3.2 General infrastructure	50.1	26	
3.2.1 Electricity output, kWh/cap	7,915.4	21	
3.2.2 Logistics performance*	100.0	1	●
3.2.3 Gross capital formation, % GDP	19.3	91	○
3.3 Ecological sustainability	53.0	36	
3.3.1 GDP/unit of energy use	11.2	32	
3.3.2 Environmental performance*	84.3	30	
3.3.3 ISO 14001 environmental certificates/bn PPP$ GDP	2.1	48	
4 Market sophistication	**60.0**	**16**	
4.1 Credit	50.3	28	
4.1.1 Ease of getting credit*	70.0	29	
4.1.2 Domestic credit to private sector, % GDP	78.0	38	
4.1.3 Microfinance gross loans, % GDP	n/a	n/a	
4.2 Investment	44.9	41	
4.2.1 Ease of protecting minority investors*	60.0	52	
4.2.2 Market capitalization, % GDP	51.0	31	
4.2.3 Venture capital deals/bn PPP$ GDP	0.1	16	
4.3 Trade, competition, & market scale	84.7	4	●
4.3.1 Applied tariff rate, weighted mean, %	1.6	23	
4.3.2 Intensity of local competition†	81.7	9	
4.3.3 Domestic market scale, bn PPP$	3,979.1	5	●
5 Business sophistication	**51.4**	**15**	
5.1 Knowledge workers	66.0	12	
5.1.1 Knowledge-intensive employment, %	44.2	16	
5.1.2 Firms offering formal training, % firms	n/a	n/a	
5.1.3 GERD performed by business, % of GDP	2.0	9	
5.1.4 GERD financed by business, % ◷	65.8	7	
5.1.5 Females employed w/advanced degrees, % total	12.7	51	○
5.2 Innovation linkages	45.2	20	
5.2.1 University/industry research collaboration†	72.5	8	
5.2.2 State of cluster development†	72.7	3	●
5.2.3 GERD financed by abroad, % ◷	5.0	65	○
5.2.4 JV–strategic alliance deals/bn PPP$ GDP	0.0	46	
5.2.5 Patent families 2+ offices/bn PPP$ GDP	6.7	10	
5.3 Knowledge absorption	43.1	27	
5.3.1 Intellectual property payments, % total trade	0.5	60	○
5.3.2 High-tech imports less re-imports, % total trade	11.6	26	
5.3.3 ICT services imports, % total trade	1.7	30	
5.3.4 FDI net inflows, % GDP	1.1	102	○
5.3.5 Research talent, % in business enterprise	56.5	17	
6 Knowledge & technology outputs	**51.1**	**8**	
6.1 Knowledge creation	67.3	4	●
6.1.1 Patents by origin/bn PPP$ GDP	18.7	1	●
6.1.2 PCT patent applications/bn PPP$ GDP	4.6	11	
6.1.3 Utility models by origin/bn PPP$ GDP	2.7	9	
6.1.4 Scientific & technical articles/bn PPP$ GDP	25.7	29	
6.1.5 Citable documents H index	87.1	3	●
6.2 Knowledge impact	43.1	21	
6.2.1 Growth rate of PPP$ GDP/worker, %	0.9	61	○
6.2.2 New businesses/th pop. 15–64 ◷	1.3	60	○
6.2.3 Computer software spending, % GDP	0.5	20	
6.2.4 ISO 9001 quality certificates/bn PPP$ GDP	13.7	27	
6.2.5 High- & medium-high-tech manufactures, %	0.5	6	
6.3 Knowledge diffusion	42.7	15	
6.3.1 Intellectual property receipts, % total trade	0.9	16	
6.3.2 High-tech exports less re-exports, % total trade	13.9	13	
6.3.3 ICT services exports, % total trade	2.0	52	
6.3.4 FDI net outflows, % GDP	2.9	22	
7 Creative outputs	**55.9**	**7**	
7.1 Intangible assets	65.7	4	●
7.1.1 Trademarks by origin/bn PPP$ GDP	66.9	28	
7.1.2 Industrial designs by origin/bn PPP$ GDP	16.5	6	●
7.1.3 ICTs & business model creation†	77.3	15	
7.1.4 ICTs & organizational model creation†	74.0	17	
7.2 Creative goods & services	31.7	28	
7.2.1 Cultural & creative services exports, % of total trade ◷	0.7	22	
7.2.2 National feature films/mn pop. 15–69	3.9	49	
7.2.3 Global ent. & media market/th pop. 15–69	57.8	11	
7.2.4 Printing & publishing manufactures, %	1.1	59	○
7.2.5 Creative goods exports, % total trade	2.2	22	
7.3 Online creativity	60.4	8	
7.3.1 Generic top-level domains (TLDs)/th pop. 15–69	55.3	13	
7.3.2 Country-code TLDs/th pop. 15–69	83.8	5	●
7.3.3 Wikipedia edits/mn pop. 15–69	6.8	15	
7.3.4 Video uploads on YouTube/pop. 15–69	36.8	36	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Greece

Key indicators

Population (millions)	10.9
GDP (US$ billions)	195.9
GDP per capita, PPP$	26,448.7
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**38.8**	**44**	
	Innovation Output Sub-Index	28.0	59	
	Innovation Input Sub-Index	49.7	38	
	Innovation Efficiency Ratio	0.6	87	
	Global Innovation Index 2016 (out of 128)	39.8	40	
1	**Institutions**	**65.2**	**59**	
1.1	Political environment	53.4	60	
1.1.1	Political stability & safety*	58.3	76	
1.1.2	Government effectiveness*	48.6	54	
1.2	Regulatory environment	66.9	53	
1.2.1	Regulatory quality*	52.3	55	
1.2.2	Rule of law*	46.5	51	
1.2.3	Cost of redundancy dismissal, salary weeks	15.9	66	
1.3	Business environment	75.2	49	
1.3.1	Ease of starting a business*	90.7	47	
1.3.2	Ease of resolving insolvency*	56.7	49	
1.3.3	Ease of paying taxes*	78.2	55	
2	**Human capital & research**	**56.4**	**16**	●
2.1	Education	79.2	2	●
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	17.8	12	●
2.1.4	PISA scales in reading, maths, & science	458.5	42	
2.1.5	Pupil-teacher ratio, secondary ⓓ	8.3	11	●
2.2	Tertiary education	58.7	9	●
2.2.1	Tertiary enrolment, % gross ⓓ	113.9	1	●
2.2.2	Graduates in science & engineering, % ⓓ	28.7	11	●
2.2.3	Tertiary inbound mobility, % ⓓ	4.2	45	
2.3	Research & development (R&D)	31.2	36	
2.3.1	Researchers, FTE/mn pop.	3,201.3	27	
2.3.2	Gross expenditure on R&D, % GDP	1.0	39	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	39.5	38	
2.3.4	QS university ranking, average score top 3*	24.8	46	
3	**Infrastructure**	**48.2**	**58**	
3.1	Information & communication technologies (ICTs)	63.0	51	
3.1.1	ICT access*	78.5	31	
3.1.2	ICT use*	54.6	50	
3.1.3	Government's online service*	58.0	71	
3.1.4	E-participation*	61.0	63	
3.2	General infrastructure	25.5	109	○
3.2.1	Electricity output, kWh/cap	4,374.4	48	
3.2.2	Logistics performance*	54.4	46	
3.2.3	Gross capital formation, % GDP	10.3	122	○
3.3	Ecological sustainability	56.0	26	
3.3.1	GDP/unit of energy use	11.2	32	
3.3.2	Environmental performance*	85.8	21	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.9	25	●
4	**Market sophistication**	**50.2**	**48**	
4.1	Credit	47.5	34	
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	113.2	21	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	35.0	84	
4.2.1	Ease of protecting minority investors*	63.3	41	
4.2.2	Market capitalization, % GDP	21.6	60	
4.2.3	Venture capital deals/bn PPP$ GDP ⓓ	0.0	58	
4.3	Trade, competition, & market scale	68.0	43	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	67.6	70	
4.3.3	Domestic market scale, bn PPP$	290.5	53	
5	**Business sophistication**	**28.8**	**80**	
5.1	Knowledge workers	40.6	55	
5.1.1	Knowledge-intensive employment, %	29.9	47	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	0.3	45	
5.1.4	GERD financed by business, %	31.8	47	
5.1.5	Females employed w/advanced degrees, % total	16.9	31	
5.2	Innovation linkages	21.5	91	
5.2.1	University/industry research collaboration†	27.6	112	○
5.2.2	State of cluster development†	33.6	107	○
5.2.3	GERD financed by abroad, %	12.8	38	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	51	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.4	41	
5.3	Knowledge absorption	24.2	104	○
5.3.1	Intellectual property payments, % total trade	0.5	62	
5.3.2	High-tech imports less re-imports, % total trade	6.7	83	
5.3.3	ICT services imports, % total trade	1.1	64	
5.3.4	FDI net inflows, % GDP	1.0	104	○
5.3.5	Research talent, % in business enterprise	14.3	62	○
6	**Knowledge & technology outputs**	**20.4**	**74**	
6.1	Knowledge creation	15.8	51	
6.1.1	Patents by origin/bn PPP$ GDP	2.2	44	
6.1.2	PCT patent applications/bn PPP$ GDP	0.4	43	
6.1.3	Utility models by origin/bn PPP$ GDP	0.0	59	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	33.4	22	●
6.1.5	Citable documents H index	30.4	29	
6.2	Knowledge impact	25.8	87	
6.2.1	Growth rate of PPP$ GDP/worker, %	(2.1)	102	○
6.2.2	New businesses/th pop. 15–64 ⓓ	0.8	78	○
6.2.3	Computer software spending, % GDP	0.6	17	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	21.6	18	●
6.2.5	High- & medium-high-tech manufactures, %	0.1	75	○
6.3	Knowledge diffusion	19.6	82	
6.3.1	Intellectual property receipts, % total trade	0.1	57	
6.3.2	High-tech exports less re-exports, % total trade	2.3	51	
6.3.3	ICT services exports, % total trade	1.5	66	
6.3.4	FDI net outflows, % GDP	0.7	63	
7	**Creative outputs**	**35.5**	**51**	
7.1	Intangible assets	44.1	58	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	4.2	30	
7.1.3	ICTs & business model creation†	54.2	87	
7.1.4	ICTs & organizational model creation†	44.7	94	○
7.2	Creative goods & services	22.0	53	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.6	24	
7.2.2	National feature films/mn pop. 15–69	5.5	36	
7.2.3	Global ent. & media market/th pop. 15–69	18.6	27	
7.2.4	Printing & publishing manufactures, %	0.9	69	
7.2.5	Creative goods exports, % total trade	1.2	36	
7.3	Online creativity	32.0	36	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	12.4	35	
7.3.2	Country-code TLDs/th pop. 15–69	16.3	33	
7.3.3	Wikipedia edits/mn pop. 15–69	6.2	35	
7.3.4	Video uploads on YouTube/pop. 15–69	39.7	29	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Guatemala

Key indicators

Population (millions)	16.7
GDP (US$ billions)	68.4
GDP per capita, PPP$	7,737.6
Income group	Lower-middle income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**27.9**	**98**
Innovation Output Sub-Index	19.9	92
Innovation Input Sub-Index	35.9	97
Innovation Efficiency Ratio	0.6	91
Global Innovation Index 2016 (out of 128)	27.3	97

1	**Institutions**	**46.5**	**107**	
1.1	Political environment	36.0	105	
1.1.1	Political stability & safety*	48.1	95	
1.1.2	Government effectiveness*	23.8	110	
1.2	Regulatory environment	43.1	111	
1.2.1	Regulatory quality*	36.9	81	
1.2.2	Rule of law*	10.6	118	
1.2.3	Cost of redundancy dismissal, salary weeks	27.0	104	
1.3	Business environment	60.5	97	
1.3.1	Ease of starting a business*	82.3	91	
1.3.2	Ease of resolving insolvency*	27.5	119	
1.3.3	Ease of paying taxes*	71.6	71	
2	**Human capital & research**	**18.1**	**107**	
2.1	Education	28.5	112	
2.1.1	Expenditure on education, % GDP	3.0	99	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	5.6	105	○
2.1.3	School life expectancy, years ⓓ	10.7	97	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	12.7	47	
2.2	Tertiary education	25.6	92	
2.2.1	Tertiary enrolment, % gross ⓓ	18.3	94	
2.2.2	Graduates in science & engineering, % ⓓ	16.8	74	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	0.2	112	
2.3.1	Researchers, FTE/mn pop. ⓓ	26.7	99	○
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.0	109	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**34.6**	**103**	
3.1	Information & communication technologies (ICTs)	47.0	86	
3.1.1	ICT access*	44.7	93	
3.1.2	ICT use*	14.0	105	
3.1.3	Government's online service*	66.7	51	
3.1.4	E-participation*	62.7	59	
3.2	General infrastructure	16.7	123	○
3.2.1	Electricity output, kWh/cap	669.5	100	
3.2.2	Logistics performance*	19.1	105	
3.2.3	Gross capital formation, % GDP	13.4	119	○
3.3	Ecological sustainability	40.2	81	
3.3.1	GDP/unit of energy use	8.5	63	
3.3.2	Environmental performance*	69.6	79	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	111	
4	**Market sophistication**	**43.8**	**77**	
4.1	Credit	32.1	73	
4.1.1	Ease of getting credit*	80.0	15	●
4.1.2	Domestic credit to private sector, % GDP	34.4	94	
4.1.3	Microfinance gross loans, % GDP	0.2	52	
4.2	Investment	33.3	[94]	
4.2.1	Ease of protecting minority investors*	33.3	124	○
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	66.1	50	
4.3.1	Applied tariff rate, weighted mean, %	1.4	21	●
4.3.2	Intensity of local competition†	75.3	25	●
4.3.3	Domestic market scale, bn PPP$	132.3	70	
5	**Business sophistication**	**36.2**	**47**	●
5.1	Knowledge workers	28.3	89	
5.1.1	Knowledge-intensive employment, %	9.6	97	
5.1.2	Firms offering formal training, % firms ⓓ	51.9	19	●
5.1.3	GERD performed by business, % of GDP ⓓ	0.0	90	○
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total ⓓ	3.5	80	
5.2	Innovation linkages	50.2	8	●
5.2.1	University/industry research collaboration†	41.8	57	
5.2.2	State of cluster development†	47.4	51	
5.2.3	GERD financed by abroad, % ⓓ	49.0	5	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.0	112	
5.3	Knowledge absorption	30.2	80	
5.3.1	Intellectual property payments, % total trade	1.2	23	●
5.3.2	High-tech imports less re-imports, % total trade	9.4	49	●
5.3.3	ICT services imports, % total trade	0.4	107	
5.3.4	FDI net inflows, % GDP	2.1	81	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**13.9**	**111**	
6.1	Knowledge creation	1.4	123	○
6.1.1	Patents by origin/bn PPP$ GDP	0.1	115	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	101	○
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	54	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.3	121	○
6.1.5	Citable documents H index	3.7	106	
6.2	Knowledge impact	21.1	103	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.0	56	
6.2.2	New businesses/th pop. 15–64 ⓓ	0.5	86	
6.2.3	Computer software spending, % GDP	0.0	121	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.8	96	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	19.2	84	
6.3.1	Intellectual property receipts, % total trade	0.1	55	
6.3.2	High-tech exports less re-exports, % total trade	1.5	61	
6.3.3	ICT services exports, % total trade	2.9	33	●
6.3.4	FDI net outflows, % GDP	0.0	106	
7	**Creative outputs**	**26.0**	**84**	
7.1	Intangible assets	41.3	69	
7.1.1	Trademarks by origin/bn PPP$ GDP ⓓ	39.3	60	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	101	
7.1.3	ICTs & business model creation†	65.2	47	●
7.1.4	ICTs & organizational model creation†	59.2	40	●
7.2	Creative goods & services	7.8	96	
7.2.1	Cultural & creative services exports, % of total trade	0.0	76	
7.2.2	National feature films/mn pop. 15–69 ⓓ	1.2	75	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.4	61	
7.3	Online creativity	13.5	87	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	4.3	60	
7.3.2	Country-code TLDs/th pop. 15–69	0.5	90	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	3.7	90	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Guinea

Key indicators

Population (millions)	12.9
GDP (US$ billions)	6.8
GDP per capita, PPP$	1,213.6
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**17.4**	**126**	○
Innovation Output Sub-Index	10.0	124	
Innovation Input Sub-Index	24.9	126	○
Innovation Efficiency Ratio	0.4	118	
Global Innovation Index 2016 (out of 128)	17.2	127	

1	**Institutions**	**45.0**	**112**	
1.1	Political environment	33.0	111	
1.1.1	Political stability & safety*	53.0	84	●
1.1.2	Government effectiveness*	13.0	122	
1.2	Regulatory environment	54.3	87	●
1.2.1	Regulatory quality*	20.0	115	
1.2.2	Rule of law*	5.2	125	○
1.2.3	Cost of redundancy dismissal, salary weeks	10.1	32	●
1.3	Business environment	47.8	124	
1.3.1	Ease of starting a business*	80.2	100	
1.3.2	Ease of resolving insolvency*	38.8	100	
1.3.3	Ease of paying taxes*	24.3	126	○
2	**Human capital & research**	**8.9**	**126**	○
2.1	Education	20.0	124	
2.1.1	Expenditure on education, % GDP	3.2	96	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	12.0	91	
2.1.3	School life expectancy, years	8.8	108	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondaryⓓ	33.1	105	
2.2	Tertiary education	6.8	118	
2.2.1	Tertiary enrolment, % grossⓓ	10.8	101	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %ⓓ	0.9	83	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**24.8**	**121**	
3.1	Information & communication technologies (ICTs)	12.3	126	○
3.1.1	ICT access*	25.7	120	
3.1.2	ICT use*	6.2	119	
3.1.3	Government's online service*	8.7	123	
3.1.4	E-participation*	8.5	123	○
3.2	General infrastructure	25.0	110	
3.2.1	Electricity output, kWh/cap	n/a	n/a	
3.2.2	Logistics performance*	13.7	117	
3.2.3	Gross capital formation, % GDP	16.9	104	
3.3	Ecological sustainability	37.1	91	●
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	55.4	107	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	118	
4	**Market sophistication**	**26.3**	**126**	○
4.1	Credit	13.0	123	
4.1.1	Ease of getting credit*	30.0	108	
4.1.2	Domestic credit to private sector, % GDP	14.4	119	
4.1.3	Microfinance gross loans, % GDPⓓ	0.2	46	●
4.2	Investment	33.6	91	●
4.2.1	Ease of protecting minority investors*	40.0	111	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDPⓓ	0.1	24	●
4.3	Trade, competition, & market scale	32.2	123	
4.3.1	Applied tariff rate, weighted mean, %ⓓ	11.9	122	
4.3.2	Intensity of local competition†ⓓ	53.3	119	
4.3.3	Domestic market scale, bn PPP$	16.1	124	
5	**Business sophistication**	**19.3**	**124**	
5.1	Knowledge workers	11.7	[120]	
5.1.1	Knowledge-intensive employment, %ⓓ	0.7	108	○
5.1.2	Firms offering formal training, % firmsⓓ	21.1	73	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	22.0	86	●
5.2.1	University/industry research collaboration†	19.7	122	○
5.2.2	State of cluster development†ⓓ	33.7	106	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDPⓓ	0.1	70	●
5.3	Knowledge absorption	24.3	101	
5.3.1	Intellectual property payments, % total tradeⓓ	0.1	107	
5.3.2	High-tech imports less re-imports, % total tradeⓓ	4.5	111	
5.3.3	ICT services imports, % total tradeⓓ	1.5	44	●
5.3.4	FDI net inflows, % GDP	1.5	97	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**6.5**	**127**	○
6.1	Knowledge creation	0.7	127	○
6.1.1	Patents by origin/bn PPP$ GDP	0.1	113	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	0.7	125	○
6.1.5	Citable documents H index	1.6	121	
6.2	Knowledge impact	1.7	126	○
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	0.1	98	
6.2.3	Computer software spending, % GDP	0.0	107	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.6	117	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	17.0	101	
6.3.1	Intellectual property receipts, % total tradeⓓ	0.0	90	
6.3.2	High-tech exports less re-exports, % total tradeⓓ	0.1	106	
6.3.3	ICT services exports, % total tradeⓓ	2.7	40	●
6.3.4	FDI net outflows, % GDP	0.0	105	
7	**Creative outputs**	**13.5**	**122**	
7.1	Intangible assets	23.9	122	
7.1.1	Trademarks by origin/bn PPP$ GDP	13.8	94	
7.1.2	Industrial designs by origin/bn PPP$ GDP	4.6	28	●
7.1.3	ICTs & business model creation†ⓓ	35.9	121	○
7.1.4	ICTs & organizational model creation†ⓓ	28.6	121	○
7.2	Creative goods & services	6.1	103	
7.2.1	Cultural & creative services exports, % of total tradeⓓ	0.4	30	●
7.2.2	National feature films/mn pop. 15–69ⓓ	0.8	84	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total tradeⓓ	0.0	114	
7.3	Online creativity	0.0	127	○
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.0	124	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	115	
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	0.0	126	○
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Honduras

Key indicators

Population (millions)	8.2
GDP (US$ billions)	20.9
GDP per capita, PPP$	4,868.6
Income group	Lower-middle income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**26.4**	**104**
Innovation Output Sub-Index	18.0	103
Innovation Input Sub-Index	34.8	103
Innovation Efficiency Ratio	0.5	101
Global Innovation Index 2016 (out of 128)	26.9	101

		Score/Value	Rank	
1	**Institutions**	**43.2**	**117**	○
1.1	Political environment	36.3	104	
1.1.1	Political stability & safety*	51.5	88	
1.1.2	Government effectiveness*	21.1	115	○
1.2	Regulatory environment	38.8	116	○
1.2.1	Regulatory quality*	32.0	95	
1.2.2	Rule of law*	11.6	115	○
1.2.3	Cost of redundancy dismissal, salary weeks	30.3	117	○
1.3	Business environment	54.6	117	○
1.3.1	Ease of starting a business*	77.0	109	
1.3.2	Ease of resolving insolvency*	31.7	112	
1.3.3	Ease of paying taxes*	55.0	105	
2	**Human capital & research**	**19.7**	**102**	
2.1	Education	43.1	79	
2.1.1	Expenditure on education, % GDP	5.9	23	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	18.1	62	
2.1.3	School life expectancy, years	11.2	92	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	16.1	70	
2.2	Tertiary education	15.9	107	
2.2.1	Tertiary enrolment, % gross ⓓ	21.2	90	
2.2.2	Graduates in science & engineering, %	12.4	94	○
2.2.3	Tertiary inbound mobility, % ⓓ	0.7	85	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**33.8**	**104**	
3.1	Information & communication technologies (ICTs)	31.4	107	
3.1.1	ICT access*	41.7	100	
3.1.2	ICT use*	13.8	106	
3.1.3	Government's online service*	31.2	108	
3.1.4	E-participation*	39.0	98	
3.2	General infrastructure	31.0	88	
3.2.1	Electricity output, kWh/cap	1,009.8	93	
3.2.2	Logistics performance*	18.5	106	
3.2.3	Gross capital formation, % GDP	26.0	38	●
3.3	Ecological sustainability	38.9	86	
3.3.1	GDP/unit of energy use	6.8	86	
3.3.2	Environmental performance*	69.6	79	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.2	59	
4	**Market sophistication**	**45.9**	**66**	
4.1	Credit	38.9	52	●
4.1.1	Ease of getting credit*	85.0	7	●
4.1.2	Domestic credit to private sector, % GDP	55.4	59	
4.1.3	Microfinance gross loans, % GDP	0.6	32	●
4.2	Investment	43.3	[47]	
4.2.1	Ease of protecting minority investors*	43.3	101	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	55.4	93	
4.3.1	Applied tariff rate, weighted mean, %	2.8	64	
4.3.2	Intensity of local competition†	65.9	76	
4.3.3	Domestic market scale, bn PPP$	43.2	95	
5	**Business sophistication**	**31.3**	**70**	
5.1	Knowledge workers	31.4	[82]	
5.1.1	Knowledge-intensive employment, %	12.0	93	
5.1.2	Firms offering formal training, % firms ⓓ	35.8	37	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	31.7	53	●
5.2.1	University/industry research collaboration†	35.4	92	
5.2.2	State of cluster development†	45.5	63	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.0	95	
5.3	Knowledge absorption	30.7	77	
5.3.1	Intellectual property payments, % total trade	0.5	58	
5.3.2	High-tech imports less re-imports, % total trade ⓓ	7.5	71	
5.3.3	ICT services imports, % total trade	0.8	76	
5.3.4	FDI net inflows, % GDP	6.3	21	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**12.4**	**117**	○
6.1	Knowledge creation	1.0	125	○
6.1.1	Patents by origin/bn PPP$ GDP	0.1	107	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	95	○
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	56	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.2	122	○
6.1.5	Citable documents H index	2.1	117	○
6.2	Knowledge impact	15.6	[112]	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.3	55	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.2	67	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	20.5	72	
6.3.1	Intellectual property receipts, % total trade	0.0	85	
6.3.2	High-tech exports less re-exports, % total trade ⓓ	0.5	80	
6.3.3	ICT services exports, % total trade	2.9	34	●
6.3.4	FDI net outflows, % GDP	0.8	60	
7	**Creative outputs**	**23.5**	**93**	
7.1	Intangible assets	40.0	74	
7.1.1	Trademarks by origin/bn PPP$ GDP	49.7	51	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	98	
7.1.3	ICTs & business model creation†	59.4	67	
7.1.4	ICTs & organizational model creation†	54.9	56	●
7.2	Creative goods & services	2.5	118	○
7.2.1	Cultural & creative services exports, % of total trade ⓓ	(0.0)	92	○
7.2.2	National feature films/mn pop. 15–69	1.0	80	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⓓ	0.1	94	
7.3	Online creativity	11.6	94	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.6	100	
7.3.2	Country-code TLDs/th pop. 15–69	0.4	91	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	3.5	95	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Hong Kong (China)

Key indicators

Population (millions)	7.3
GDP (US$ billions)	316.1
GDP per capita, PPP$	56,700.8
Income group	High income
Region	South East Asia, East Asia, and Oceania

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**53.9**	**16**	
	Innovation Output Sub-Index	40.8	25	
	Innovation Input Sub-Index	67.0	8	
	Innovation Efficiency Ratio	0.6	73	○
	Global Innovation Index 2016 (out of 128)	55.7	14	
1	**Institutions**	**92.7**	**3**	●
1.1	Political environment	89.8	7	
1.1.1	Political stability & safety*	87.9	13	
1.1.2	Government effectiveness*	91.7	3	●
1.2	Regulatory environment	97.7	2	●
1.2.1	Regulatory quality*	97.8	2	●
1.2.2	Rule of law*	92.9	12	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	90.7	2	●
1.3.1	Ease of starting a business*	98.2	3	●
1.3.2	Ease of resolving insolvency*	75.1	26	
1.3.3	Ease of paying taxes*	98.7	3	●
2	**Human capital & research**	**47.7**	**28**	
2.1	Education	44.9	73	○
2.1.1	Expenditure on education, % GDP	3.3	95	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	20.4	51	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	532.6	2	●
2.1.5	Pupil-teacher ratio, secondary	13.0	51	
2.2	Tertiary education	63.7	4	
2.2.1	Tertiary enrolment, % gross	68.5	30	
2.2.2	Graduates in science & engineering, %	34.7	5	
2.2.3	Tertiary inbound mobility, %	10.7	16	
2.3	Research & development (R&D)	34.6	33	
2.3.1	Researchers, FTE/mn pop. ⓓ	3,297.6	26	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.7	47	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	81.8	6	
3	**Infrastructure**	**68.4**	**4**	
3.1	Information & communication technologies (ICTs)	85.5	10	
3.1.1	ICT access*	91.6	4	
3.1.2	ICT use*	79.4	12	
3.1.3	Government's online service*	n/a	n/a	
3.1.4	E-participation*	n/a	n/a	
3.2	General infrastructure	49.2	29	
3.2.1	Electricity output, kWh/cap	5,511.3	36	
3.2.2	Logistics performance*	92.7	9	
3.2.3	Gross capital formation, % GDP	22.1	64	
3.3	Ecological sustainability	70.5	1	●
3.3.1	GDP/unit of energy use	26.3	1	●
3.3.2	Environmental performance*	n/a	n/a	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.7	53	
4	**Market sophistication**	**74.8**	**2**	●
4.1	Credit	79.4	3	●
4.1.1	Ease of getting credit*	75.0	19	
4.1.2	Domestic credit to private sector, % GDP	208.0	2	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	68.1	8	
4.2.1	Ease of protecting minority investors*	80.0	3	●
4.2.2	Market capitalization, % GDP	1,029.9	1	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	34	
4.3	Trade, competition, & market scale	76.8	17	
4.3.1	Applied tariff rate, weighted mean, %	0.0	1	●
4.3.2	Intensity of local competition†	86.0	2	●
4.3.3	Domestic market scale, bn PPP$	427.4	42	
5	**Business sophistication**	**51.1**	**16**	
5.1	Knowledge workers	48.6	35	
5.1.1	Knowledge-intensive employment, %	38.6	27	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP ⓓ	0.3	44	
5.1.4	GERD financed by business, % ⓓ	46.4	25	
5.1.5	Females employed w/advanced degrees, % total	13.4	46	
5.2	Innovation linkages	47.3	13	
5.2.1	University/industry research collaboration† ⓓ	59.8	21	
5.2.2	State of cluster development†	67.3	14	
5.2.3	GERD financed by abroad, % ⓓ	7.0	56	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.3	1	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.3	26	
5.3	Knowledge absorption	57.4	3	●
5.3.1	Intellectual property payments, % total trade ⓓ	0.3	74	○
5.3.2	High-tech imports less re-imports, % total trade	46.1	1	●
5.3.3	ICT services imports, % total trade ⓓ	0.3	111	○
5.3.4	FDI net inflows, % GDP	43.6	1	●
5.3.5	Research talent, % in business enterprise ⓓ	40.9	32	
6	**Knowledge & technology outputs**	**36.2**	**25**	
6.1	Knowledge creation	20.9	43	
6.1.1	Patents by origin/bn PPP$ GDP	0.6	73	○
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	1.1	24	
6.1.4	Scientific & technical articles/bn PPP$ GDP	n/a	n/a	
6.1.5	Citable documents H index	33.9	25	
6.2	Knowledge impact	46.0	15	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.0	55	
6.2.2	New businesses/th pop. 15–64	31.3	1	●
6.2.3	Computer software spending, % GDP	0.4	28	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.1	56	
6.2.5	High- & medium-high-tech manufactures, %	0.2	53	
6.3	Knowledge diffusion	41.8	16	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.1	54	
6.3.2	High-tech exports less re-exports, % total trade	0.1	113	○
6.3.3	ICT services exports, % total trade ⓓ	0.5	101	○
6.3.4	FDI net outflows, % GDP	32.8	1	●
7	**Creative outputs**	**45.4**	**25**	
7.1	Intangible assets	53.1	28	
7.1.1	Trademarks by origin/bn PPP$ GDP	69.5	26	
7.1.2	Industrial designs by origin/bn PPP$ GDP	3.2	35	
7.1.3	ICTs & business model creation†	70.7	31	
7.1.4	ICTs & organizational model creation†	71.2	21	
7.2	Creative goods & services	22.7	50	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.2	49	○
7.2.2	National feature films/mn pop. 15–69	10.4	14	
7.2.3	Global ent. & media market/th pop. 15–69	56.2	13	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.2	79	○
7.3	Online creativity	52.7	15	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	70.8	7	
7.3.2	Country-code TLDs/th pop. 15–69	17.5	30	
7.3.3	Wikipedia edits/mn pop. 15–69	7.0	9	
7.3.4	Video uploads on YouTube/pop. 15–69	54.6	14	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Hungary

Key indicators

Population (millions)	9.8
GDP (US$ billions)	117.1
GDP per capita, PPP$	26,222.0
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**41.7**	**39**
Innovation Output Sub-Index	35.1	37
Innovation Input Sub-Index	48.4	41
Innovation Efficiency Ratio	0.7	30
Global Innovation Index 2016 (out of 128)	44.7	33

		Score/Value	Rank	
1	**Institutions**	**70.7**	**40**	
1.1	Political environment	68.2	40	
1.1.1	Political stability & safety*	81.6	29	
1.1.2	Government effectiveness*	54.8	45	
1.2	Regulatory environment	72.9	38	
1.2.1	Regulatory quality*	61.8	41	
1.2.2	Rule of law*	51.2	47	
1.2.3	Cost of redundancy dismissal, salary weeks	13.4	52	
1.3	Business environment	71.0	63	
1.3.1	Ease of starting a business*	87.3	62	
1.3.2	Ease of resolving insolvency*	51.3	58	
1.3.3	Ease of paying taxes*	74.5	62	
2	**Human capital & research**	**39.5**	**42**	
2.1	Education	49.2	57	
2.1.1	Expenditure on education, % GDP	4.2	73	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	16.2	72	
2.1.3	School life expectancy, years	15.4	38	
2.1.4	PISA scales in reading, maths, & science	474.4	36	
2.1.5	Pupil-teacher ratio, secondary	10.3	27	
2.2	Tertiary education	35.7	64	
2.2.1	Tertiary enrolment, % gross	50.9	52	
2.2.2	Graduates in science & engineering, % ⓐ	16.8	72	
2.2.3	Tertiary inbound mobility, %	7.1	28	
2.3	Research & development (R&D)	33.7	34	
2.3.1	Researchers, FTE/mn pop.	2,568.8	33	
2.3.2	Gross expenditure on R&D, % GDP	1.4	25	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	51.0	30	
2.3.4	QS university ranking, average score top 3*	20.8	49	
3	**Infrastructure**	**52.3**	**46**	
3.1	Information & communication technologies (ICTs)	60.3	60	
3.1.1	ICT access*	76.2	35	
3.1.2	ICT use*	52.8	55	
3.1.3	Government's online service*	63.0	57	
3.1.4	E-participation*	49.2	89	○
3.2	General infrastructure	38.4	57	
3.2.1	Electricity output, kWh/cap	3,062.0	62	
3.2.2	Logistics performance*	63.2	30	
3.2.3	Gross capital formation, % GDP	21.0	75	
3.3	Ecological sustainability	58.2	22	
3.3.1	GDP/unit of energy use	9.8	53	
3.3.2	Environmental performance*	84.6	28	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	7.5	14	●
4	**Market sophistication**	**41.5**	**91**	
4.1	Credit	29.5	80	
4.1.1	Ease of getting credit*	75.0	19	
4.1.2	Domestic credit to private sector, % GDP	36.1	89	
4.1.3	Microfinance gross loans, % GDP ⓐ	0.0	79	○
4.2	Investment	31.1	105	○
4.2.1	Ease of protecting minority investors*	55.0	75	
4.2.2	Market capitalization, % GDP	14.5	68	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	45	
4.3	Trade, competition, & market scale	63.8	53	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	52.7	120	○
4.3.3	Domestic market scale, bn PPP$	267.6	55	
5	**Business sophistication**	**37.8**	**40**	
5.1	Knowledge workers	41.5	53	
5.1.1	Knowledge-intensive employment, %	34.9	39	
5.1.2	Firms offering formal training, % firms	15.8	85	○
5.1.3	GERD performed by business, % of GDP	1.0	23	
5.1.4	GERD financed by business, %	49.7	20	
5.1.5	Females employed w/advanced degrees, % total	15.2	41	
5.2	Innovation linkages	24.7	76	
5.2.1	University/industry research collaboration†	32.0	99	○
5.2.2	State of cluster development†	39.3	87	
5.2.3	GERD financed by abroad, %	15.0	31	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	63	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.5	38	
5.3	Knowledge absorption	47.2	18	●
5.3.1	Intellectual property payments, % total trade	1.3	22	
5.3.2	High-tech imports less re-imports, % total trade	13.8	16	●
5.3.3	ICT services imports, % total trade	1.3	51	
5.3.4	FDI net inflows, % GDP	1.4	99	○
5.3.5	Research talent, % in business enterprise	59.4	12	●
6	**Knowledge & technology outputs**	**32.3**	**33**	
6.1	Knowledge creation	20.4	46	
6.1.1	Patents by origin/bn PPP$ GDP	2.6	40	
6.1.2	PCT patent applications/bn PPP$ GDP	0.7	30	
6.1.3	Utility models by origin/bn PPP$ GDP	0.8	28	
6.1.4	Scientific & technical articles/bn PPP$ GDP	25.3	31	
6.1.5	Citable documents H index	28.0	31	
6.2	Knowledge impact	43.0	22	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	84	○
6.2.2	New businesses/th pop. 15–64	3.7	33	
6.2.3	Computer software spending, % GDP	0.3	42	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	22.4	16	●
6.2.5	High- & medium-high-tech manufactures, %	0.6	3	●
6.3	Knowledge diffusion	33.6	33	
6.3.1	Intellectual property receipts, % total trade	1.4	13	●
6.3.2	High-tech exports less re-exports, % total trade	13.9	14	●
6.3.3	ICT services exports, % total trade	1.7	58	
6.3.4	FDI net outflows, % GDP	(0.0)	114	○
7	**Creative outputs**	**37.9**	**42**	
7.1	Intangible assets	41.4	67	
7.1.1	Trademarks by origin/bn PPP$ GDP	35.8	63	
7.1.2	Industrial designs by origin/bn PPP$ GDP	3.3	34	
7.1.3	ICTs & business model creation†	63.8	49	
7.1.4	ICTs & organizational model creation†	54.5	59	
7.2	Creative goods & services	32.9	25	
7.2.1	Cultural & creative services exports, % of total trade ⓐ	0.6	25	
7.2.2	National feature films/mn pop. 15–69	5.7	34	
7.2.3	Global ent. & media market/th pop. 15–69	12.6	30	
7.2.4	Printing & publishing manufactures, %	0.8	73	○
7.2.5	Creative goods exports, % total trade	5.9	8	●
7.3	Online creativity	35.9	31	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	10.3	39	
7.3.2	Country-code TLDs/th pop. 15–69	29.1	20	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.8	16	●
7.3.4	Video uploads on YouTube/pop. 15–69	38.9	33	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Iceland

Key indicators

Population (millions)	0.3
GDP (US$ billions)	19.4
GDP per capita, PPP$	46,097.0
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**55.8**	**13**	
Innovation Output Sub-Index	51.4	10	
Innovation Input Sub-Index	60.1	21	
Innovation Efficiency Ratio	0.9	5	●
Global Innovation Index 2016 (out of 128)	56.0	13	

		Score/Value	Rank	
1	**Institutions**	**86.6**	**16**	
1.1	Political environment	87.6	12	
1.1.1	Political stability & safety*	94.6	4	●
1.1.2	Government effectiveness*	80.7	18	
1.2	Regulatory environment	85.8	19	
1.2.1	Regulatory quality*	74.6	23	
1.2.2	Rule of law*	88.4	17	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	46	
1.3	Business environment	86.4	18	
1.3.1	Ease of starting a business*	92.6	31	
1.3.2	Ease of resolving insolvency*	81.7	13	
1.3.3	Ease of paying taxes*	84.9	27	
2	**Human capital & research**	**49.0**	**26**	
2.1	Education	64.7	11	
2.1.1	Expenditure on education, % GDP	7.8	6	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	18.3	59	
2.1.3	School life expectancy, years◴	19.6	3	●
2.1.4	PISA scales in reading, maths, & science	480.9	33	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	40.4	46	
2.2.1	Tertiary enrolment, % gross◴	81.3	15	
2.2.2	Graduates in science & engineering, %◴	15.6	81	○
2.2.3	Tertiary inbound mobility, %◴	6.5	30	
2.3	Research & development (R&D)	41.8	24	
2.3.1	Researchers, FTE/mn pop.	5,902.5	8	
2.3.2	Gross expenditure on R&D, % GDP	2.2	13	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	44.2	34	
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**59.9**	**25**	
3.1	Information & communication technologies (ICTs)	76.8	26	
3.1.1	ICT access*	94.2	2	●
3.1.2	ICT use*	84.4	5	●
3.1.3	Government's online service*	62.3	60	
3.1.4	E-participation*	66.1	49	
3.2	General infrastructure	59.2	9	
3.2.1	Electricity output, kWh/cap	56,966.7	1	●
3.2.2	Logistics performance*	59.3	38	
3.2.3	Gross capital formation, % GDP	20.5	77	○
3.3	Ecological sustainability	43.8	66	
3.3.1	GDP/unit of energy use	2.4	116	○
3.3.2	Environmental performance*	90.5	2	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.7	27	
4	**Market sophistication**	**55.2**	**24**	
4.1	Credit	48.2	32	
4.1.1	Ease of getting credit*	60.0	55	
4.1.2	Domestic credit to private sector, % GDP	92.1	32	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	66.3	12	
4.2.1	Ease of protecting minority investors*	70.0	22	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	9	
4.3	Trade, competition, & market scale	51.0	102	○
4.3.1	Applied tariff rate, weighted mean, %	0.8	9	
4.3.2	Intensity of local competition†	64.0	82	○
4.3.3	Domestic market scale, bn PPP$	16.1	123	○
5	**Business sophistication**	**49.8**	**20**	
5.1	Knowledge workers	63.3	16	
5.1.1	Knowledge-intensive employment, %	47.8	7	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	1.4	15	
5.1.4	GERD financed by business, %	33.3	45	
5.1.5	Females employed w/advanced degrees, % total	22.7	15	
5.2	Innovation linkages	45.6	18	
5.2.1	University/industry research collaboration†	63.1	16	
5.2.2	State of cluster development†	51.5	41	
5.2.3	GERD financed by abroad, %	26.4	16	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	48	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	5.1	12	
5.3	Knowledge absorption	40.4	32	
5.3.1	Intellectual property payments, % total trade	1.2	26	
5.3.2	High-tech imports less re-imports, % total trade	6.8	80	○
5.3.3	ICT services imports, % total trade	2.1	21	
5.3.4	FDI net inflows, % GDP	4.6	31	
5.3.5	Research talent, % in business enterprise	41.8	31	
6	**Knowledge & technology outputs**	**39.9**	**18**	
6.1	Knowledge creation	48.5	13	
6.1.1	Patents by origin/bn PPP$ GDP	5.6	22	
6.1.2	PCT patent applications/bn PPP$ GDP	3.5	12	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	71.1	1	●
6.1.5	Citable documents H index	17.7	39	
6.2	Knowledge impact	31.1	64	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.2	81	○
6.2.2	New businesses/th pop. 15–64	9.5	12	
6.2.3	Computer software spending, % GDP	0.3	32	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.9	62	
6.2.5	High- & medium-high-tech manufactures, %	0.1	90	○
6.3	Knowledge diffusion	40.1	21	
6.3.1	Intellectual property receipts, % total trade	2.8	7	
6.3.2	High-tech exports less re-exports, % total trade	1.3	65	
6.3.3	ICT services exports, % total trade	2.8	38	
6.3.4	FDI net outflows, % GDP	2.0	31	
7	**Creative outputs**	**62.9**	**2**	●
7.1	Intangible assets	58.3	19	
7.1.1	Trademarks by origin/bn PPP$ GDP	87.7	17	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.1	59	
7.1.3	ICTs & business model creation†	78.6	14	
7.1.4	ICTs & organizational model creation†	77.8	8	
7.2	Creative goods & services	53.7	1	●
7.2.1	Cultural & creative services exports, % of total trade	0.3	36	
7.2.2	National feature films/mn pop. 15–69	55.9	1	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	6.4	1	●
7.2.5	Creative goods exports, % total trade	0.1	95	○
7.3	Online creativity	81.4	1	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	100.0	1	●
7.3.2	Country-code TLDs/th pop. 15–69	77.0	6	
7.3.3	Wikipedia edits/mn pop. 15–69◴	7.0	11	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◴ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

India

Key indicators

Population (millions)	1,326.8
GDP (US$ billions)	2,251.0
GDP per capita, PPP$	6,161.6
Income group	Lower-middle income
Region	Central and Southern Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**35.5**	**60**
Innovation Output Sub-Index	28.1	58
Innovation Input Sub-Index	42.8	66
Innovation Efficiency Ratio	0.7	53
Global Innovation Index 2016 (out of 128)	33.6	66

		Score/Value	Rank	
1	**Institutions**	**51.4**	**92**	
1.1	Political environment	43.1	87	
1.1.1	Political stability & safety*	41.5	106	
1.1.2	Government effectiveness*	44.7	66	
1.2	Regulatory environment	59.8	73	
1.2.1	Regulatory quality*	32.1	93	
1.2.2	Rule of law*	37.8	61	
1.2.3	Cost of redundancy dismissal, salary weeks	15.8	64	
1.3	Business environment	51.2	121	○
1.3.1	Ease of starting a business*	74.3	114	○
1.3.2	Ease of resolving insolvency*	32.8	111	○
1.3.3	Ease of paying taxes*	46.6	118	○
2	**Human capital & research**	**32.3**	**64**	
2.1	Education	26.7	114	○
2.1.1	Expenditure on education, % GDP	3.8	84	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	16.8	67	
2.1.3	School life expectancy, years	11.9	89	
2.1.4	PISA scales in reading, maths, & science ◴	336.0	71	○
2.1.5	Pupil-teacher ratio, secondary ◴	31.8	104	○
2.2	Tertiary education	34.3	68	
2.2.1	Tertiary enrolment, % gross ◴	25.5	88	
2.2.2	Graduates in science & engineering, %	29.1	10	●
2.2.3	Tertiary inbound mobility, % ◴	0.1	102	○
2.3	Research & development (R&D)	35.9	32	
2.3.1	Researchers, FTE/mn pop. ◴	156.6	81	
2.3.2	Gross expenditure on R&D, % GDP ◴	0.8	43	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	74.0	14	●
2.3.4	QS university ranking, average score top 3*	49.0	21	●
3	**Infrastructure**	**44.1**	**73**	
3.1	Information & communication technologies (ICTs)	49.2	80	
3.1.1	ICT access*	33.2	106	
3.1.2	ICT use*	12.5	109	
3.1.3	Government's online service*	74.6	33	
3.1.4	E-participation*	76.3	27	
3.2	General infrastructure	48.5	32	
3.2.1	Electricity output, kWh/cap	993.9	94	
3.2.2	Logistics performance*	62.7	34	
3.2.3	Gross capital formation, % GDP	31.7	12	●
3.3	Ecological sustainability	34.6	103	
3.3.1	GDP/unit of energy use	8.4	65	
3.3.2	Environmental performance*	53.6	108	○
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.8	69	
4	**Market sophistication**	**51.9**	**39**	
4.1	Credit	31.7	74	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	52.6	67	
4.1.3	Microfinance gross loans, % GDP	0.6	34	
4.2	Investment	46.9	36	
4.2.1	Ease of protecting minority investors*	73.3	13	●
4.2.2	Market capitalization, % GDP	72.4	22	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	40	
4.3	Trade, competition, & market scale	77.0	16	●
4.3.1	Applied tariff rate, weighted mean, % ◴	6.3	100	
4.3.2	Intensity of local competition†	62.5	91	
4.3.3	Domestic market scale, bn PPP$	8,720.5	3	●
5	**Business sophistication**	**34.6**	**55**	
5.1	Knowledge workers	31.3	[83]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	35.9	36	
5.1.3	GERD performed by business, % of GDP ◴	0.3	46	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	37.8	37	
5.2.1	University/industry research collaboration†	58.9	23	
5.2.2	State of cluster development†	58.7	26	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	49	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	43	
5.3	Knowledge absorption	34.7	55	
5.3.1	Intellectual property payments, % total trade	1.1	29	
5.3.2	High-tech imports less re-imports, % total trade	9.2	52	
5.3.3	ICT services imports, % total trade	0.8	78	
5.3.4	FDI net inflows, % GDP	1.8	87	
5.3.5	Research talent, % in business enterprise ◴	38.7	33	
6	**Knowledge & technology outputs**	**30.3**	**38**	
6.1	Knowledge creation	14.2	55	
6.1.1	Patents by origin/bn PPP$ GDP	1.6	53	
6.1.2	PCT patent applications/bn PPP$ GDP	0.2	54	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.9	79	
6.1.5	Citable documents H index	37.1	21	●
6.2	Knowledge impact	40.5	30	
6.2.1	Growth rate of PPP$ GDP/worker, %	5.2	5	●
6.2.2	New businesses/th pop. 15–64	0.1	100	○
6.2.3	Computer software spending, % GDP	0.2	66	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.5	65	
6.2.5	High- & medium-high-tech manufactures, %	0.3	40	
6.3	Knowledge diffusion	36.2	26	
6.3.1	Intellectual property receipts, % total trade	0.1	53	
6.3.2	High-tech exports less re-exports, % total trade	3.2	45	
6.3.3	ICT services exports, % total trade	12.6	1	●
6.3.4	FDI net outflows, % GDP	0.3	76	
7	**Creative outputs**	**25.9**	**85**	
7.1	Intangible assets	39.0	78	
7.1.1	Trademarks by origin/bn PPP$ GDP	31.3	71	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.9	66	
7.1.3	ICTs & business model creation†	56.6	80	
7.1.4	ICTs & organizational model creation†	61.9	35	
7.2	Creative goods & services	17.5	67	
7.2.1	Cultural & creative services exports, % of total trade	0.1	52	
7.2.2	National feature films/mn pop. 15–69	2.1	59	
7.2.3	Global ent. & media market/th pop. 15–69	0.3	61	○
7.2.4	Printing & publishing manufactures, %	0.6	85	
7.2.5	Creative goods exports, % total trade	2.6	18	●
7.3	Online creativity	8.1	103	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.0	98	
7.3.2	Country-code TLDs/th pop. 15–69	0.7	85	
7.3.3	Wikipedia edits/mn pop. 15–69	2.9	100	
7.3.4	Video uploads on YouTube/pop. 15–69	2.5	68	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◴ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Indonesia

Key indicators

Population (millions)	260.6
GDP (US$ billions)	941.0
GDP per capita, PPP$	11,125.9
Income group	Lower-middle income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**30.1**	**87**
Innovation Output Sub-Index	24.5	73
Innovation Input Sub-Index	35.7	99
Innovation Efficiency Ratio	0.7	42
Global Innovation Index 2016 (out of 128)	29.1	88

1	**Institutions**	**41.2**	**120**	○
1.1	Political environment	42.9	89	
1.1.1	Political stability & safety*	49.4	94	
1.1.2	Government effectiveness*	36.4	83	
1.2	Regulatory environment	16.7	126	○
1.2.1	Regulatory quality*	36.7	82	
1.2.2	Rule of law*	27.4	86	
1.2.3	Cost of redundancy dismissal, salary weeks	57.8	125	○
1.3	Business environment	64.0	79	
1.3.1	Ease of starting a business*	76.4	112	
1.3.2	Ease of resolving insolvency*	46.5	70	
1.3.3	Ease of paying taxes*	69.3	77	
2	**Human capital & research**	**23.0**	**92**	
2.1	Education	33.5	103	
2.1.1	Expenditure on education, % GDP	3.3	94	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	9.9	97	○
2.1.3	School life expectancy, years	12.9	75	
2.1.4	PISA scales in reading, maths, & science	395.5	63	
2.1.5	Pupil-teacher ratio, secondary ⓓ	15.5	66	
2.2	Tertiary education	27.5	87	
2.2.1	Tertiary enrolment, % gross ⓓ	31.1	77	
2.2.2	Graduates in science & engineering, % ⓓ	21.7	47	
2.2.3	Tertiary inbound mobility, % ⓓ	0.1	104	○
2.3	Research & development (R&D)	8.1	63	
2.3.1	Researchers, FTE/mn pop. ⓓ	89.5	87	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.1	105	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	29.8	38	●
3	**Infrastructure**	**42.0**	**81**	
3.1	Information & communication technologies (ICTs)	35.6	99	
3.1.1	ICT access*	47.1	88	
3.1.2	ICT use*	21.9	96	
3.1.3	Government's online service*	36.2	102	
3.1.4	E-participation*	37.3	101	
3.2	General infrastructure	46.7	35	●
3.2.1	Electricity output, kWh/cap	898.2	96	
3.2.2	Logistics performance*	42.6	62	
3.2.3	Gross capital formation, % GDP	34.7	8	●
3.3	Ecological sustainability	43.6	69	
3.3.1	GDP/unit of energy use	11.1	36	●
3.3.2	Environmental performance*	65.9	91	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.8	72	
4	**Market sophistication**	**46.0**	**64**	
4.1	Credit	25.0	99	
4.1.1	Ease of getting credit*	60.0	55	
4.1.2	Domestic credit to private sector, % GDP	39.1	83	
4.1.3	Microfinance gross loans, % GDP	0.0	68	
4.2	Investment	33.2	96	
4.2.1	Ease of protecting minority investors*	56.7	67	
4.2.2	Market capitalization, % GDP	41.0	38	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	80	
4.3	Trade, competition, & market scale	79.7	8	●
4.3.1	Applied tariff rate, weighted mean, % ⓓ	2.3	58	
4.3.2	Intensity of local competition†	71.2	50	
4.3.3	Domestic market scale, bn PPP$	3,027.8	8	●
5	**Business sophistication**	**26.2**	**96**	
5.1	Knowledge workers	9.7	123	○
5.1.1	Knowledge-intensive employment, %	9.8	96	○
5.1.2	Firms offering formal training, % firms	7.7	90	○
5.1.3	GERD performed by business, % of GDP ⓓ	0.0	76	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	4.8	77	
5.2	Innovation linkages	34.7	44	
5.2.1	University/industry research collaboration†	57.0	27	●
5.2.2	State of cluster development†	57.6	28	●
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	97	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	117	○
5.3	Knowledge absorption	34.1	58	
5.3.1	Intellectual property payments, % total trade	0.9	36	
5.3.2	High-tech imports less re-imports, % total trade	8.5	58	
5.3.3	ICT services imports, % total trade	1.0	66	
5.3.4	FDI net inflows, % GDP	2.6	70	
5.3.5	Research talent, % in business enterprise ⓓ	35.5	39	
6	**Knowledge & technology outputs**	**20.9**	**70**	
6.1	Knowledge creation	2.9	113	○
6.1.1	Patents by origin/bn PPP$ GDP	0.4	81	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	103	○
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	53	
6.1.4	Scientific & technical articles/bn PPP$ GDP	0.7	124	○
6.1.5	Citable documents H index	11.8	55	
6.2	Knowledge impact	39.8	33	●
6.2.1	Growth rate of PPP$ GDP/worker, %	4.6	9	●
6.2.2	New businesses/th pop. 15–64 ⓓ	0.3	91	
6.2.3	Computer software spending, % GDP	0.3	36	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.0	80	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.3	43	
6.3	Knowledge diffusion	19.9	81	
6.3.1	Intellectual property receipts, % total trade	0.0	76	
6.3.2	High-tech exports less re-exports, % total trade	3.5	43	
6.3.3	ICT services exports, % total trade	0.6	95	
6.3.4	FDI net outflows, % GDP	1.2	48	
7	**Creative outputs**	**28.1**	**77**	
7.1	Intangible assets	37.5	88	
7.1.1	Trademarks by origin/bn PPP$ GDP	13.2	95	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.9	64	
7.1.3	ICTs & business model creation†	62.9	52	
7.1.4	ICTs & organizational model creation†	59.8	38	●
7.2	Creative goods & services	22.3	52	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69 ⓓ	0.5	93	
7.2.3	Global ent. & media market/th pop. 15–69	1.8	52	
7.2.4	Printing & publishing manufactures, % ⓓ	0.5	88	○
7.2.5	Creative goods exports, % total trade	3.9	13	●
7.3	Online creativity	15.2	79	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.6	87	
7.3.2	Country-code TLDs/th pop. 15–69	2.0	66	
7.3.3	Wikipedia edits/mn pop. 15–69	3.6	94	
7.3.4	Video uploads on YouTube/pop. 15–69	22.8	56	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Iran, Islamic Republic of

Key indicators

Population (millions)	80.0
GDP (US$ billions)	412.3
GDP per capita, PPP$	17,251.3
Income group	Upper-middle income
Region	Central and Southern Asia

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**32.1**	**75**	
Innovation Output Sub-Index	28.5	57	
Innovation Input Sub-Index	35.7	98	
Innovation Efficiency Ratio	0.8	16	●
Global Innovation Index 2016 (out of 128)	30.5	78	

		Score/Value	Rank	
1	**Institutions**	**46.6**	**106**	
1.1	Political environment	39.4	99	
1.1.1	Political stability & safety*	41.9	105	
1.1.2	Government effectiveness*	37.0	82	
1.2	Regulatory environment	40.3	115	
1.2.1	Regulatory quality*	9.4	126	○
1.2.2	Rule of law*	11.5	116	
1.2.3	Cost of redundancy dismissal, salary weeks	23.1	97	
1.3	Business environment	60.0	98	
1.3.1	Ease of starting a business*	85.1	77	
1.3.2	Ease of resolving insolvency*	25.3	123	○
1.3.3	Ease of paying taxes*	69.8	75	
2	**Human capital & research**	**37.5**	**45**	
2.1	Education	38.6	93	
2.1.1	Expenditure on education, % GDP	2.9	101	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	15.1	81	
2.1.3	School life expectancy, years	14.9	53	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	17.0	74	
2.2	Tertiary education	63.7	3	●
2.2.1	Tertiary enrolment, % gross	71.9	23	●
2.2.2	Graduates in science & engineering, %	46.6	2	●
2.2.3	Tertiary inbound mobility, %	0.3	97	
2.3	Research & development (R&D)	10.4	58	
2.3.1	Researchers, FTE/mn pop.ⓓ	691.4	56	
2.3.2	Gross expenditure on R&D, % GDPⓓ	0.3	78	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	25.9	45	
3	**Infrastructure**	**36.2**	**99**	
3.1	Information & communication technologies (ICTs)	35.9	98	
3.1.1	ICT access*	62.6	68	
3.1.2	ICT use*	27.4	91	
3.1.3	Government's online service*	33.3	104	
3.1.4	E-participation*	20.3	113	○
3.2	General infrastructure	38.1	59	
3.2.1	Electricity output, kWh/cap	3,514.3	57	
3.2.2	Logistics performance*	24.9	94	
3.2.3	Gross capital formation, % GDP	28.9	23	●
3.3	Ecological sustainability	34.4	105	
3.3.1	GDP/unit of energy use	5.3	100	
3.3.2	Environmental performance*	66.3	90	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	80	
4	**Market sophistication**	**35.5**	**112**	
4.1	Credit	33.0	69	
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDPⓓ	54.4	61	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	20.4	126	○
4.2.1	Ease of protecting minority investors*	35.0	121	○
4.2.2	Market capitalization, % GDPⓓ	27.4	52	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	92	○
4.3	Trade, competition, & market scale	52.9	99	
4.3.1	Applied tariff rate, weighted mean, %ⓓ	15.2	124	○
4.3.2	Intensity of local competition†	54.0	116	○
4.3.3	Domestic market scale, bn PPP$	1,459.2	18	●
5	**Business sophistication**	**22.8**	**115**	
5.1	Knowledge workers	25.5	96	
5.1.1	Knowledge-intensive employment, %	17.7	81	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDPⓓ	0.1	67	
5.1.4	GERD financed by business, %ⓓ	30.9	49	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	24.5	77	
5.2.1	University/industry research collaboration†	33.6	97	
5.2.2	State of cluster development†	43.3	76	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	94	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	111	○
5.3	Knowledge absorption	18.4	124	○
5.3.1	Intellectual property payments, % total tradeⓓ	0.2	85	
5.3.2	High-tech imports less re-imports, % total tradeⓓ	4.0	115	○
5.3.3	ICT services imports, % total tradeⓓ	0.6	93	
5.3.4	FDI net inflows, % GDP	0.5	115	
5.3.5	Research talent, % in business enterpriseⓓ	15.0	60	
6	**Knowledge & technology outputs**	**26.7**	**47**	
6.1	Knowledge creation	25.0	36	●
6.1.1	Patents by origin/bn PPP$ GDPⓓ	10.1	12	●
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	85	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	21.5	35	●
6.1.5	Citable documents H index	15.9	41	●
6.2	Knowledge impact	42.5	24	●
6.2.1	Growth rate of PPP$ GDP/worker, %	3.6	18	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.2	67	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.9	93	
6.2.5	High- & medium-high-tech manufactures, %	0.3	36	●
6.3	Knowledge diffusion	12.7	121	○
6.3.1	Intellectual property receipts, % total tradeⓓ	0.0	82	
6.3.2	High-tech exports less re-exports, % total tradeⓓ	0.5	81	
6.3.3	ICT services exports, % total tradeⓓ	0.2	116	○
6.3.4	FDI net outflows, % GDP	0.0	101	
7	**Creative outputs**	**30.2**	**65**	
7.1	Intangible assets	47.8	47	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDPⓓ	6.5	19	●
7.1.3	ICTs & business model creation†	58.8	70	
7.1.4	ICTs & organizational model creation†	43.4	100	
7.2	Creative goods & services	6.4	101	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	1.5	68	
7.2.3	Global ent. & media market/th pop. 15–69	1.3	54	
7.2.4	Printing & publishing manufactures, %	0.2	98	○
7.2.5	Creative goods exports, % total tradeⓓ	0.5	58	
7.3	Online creativity	18.7	68	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.8	79	
7.3.2	Country-code TLDs/th pop. 15–69	4.3	55	
7.3.3	Wikipedia edits/mn pop. 15–69	5.2	55	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
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Ireland

Key indicators

Population (millions)	4.7
GDP (US$ billions)	307.9
GDP per capita, PPP$	55,532.9
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**58.1**	**10**	
Innovation Output Sub-Index	53.4	8	
Innovation Input Sub-Index	62.9	19	
Innovation Efficiency Ratio	0.8	6	●
Global Innovation Index 2016 (out of 128)	59.0	7	

		Score/Value	Rank	
1	**Institutions**	**87.6**	**12**	
1.1	Political environment	84.0	16	
1.1.1	Political stability & safety*	86.3	22	
1.1.2	Government effectiveness*	81.6	17	
1.2	Regulatory environment	88.8	15	
1.2.1	Regulatory quality*	88.5	6	●
1.2.2	Rule of law*	91.6	15	
1.2.3	Cost of redundancy dismissal, salary weeks	14.3	56	○
1.3	Business environment	90.1	5	●
1.3.1	Ease of starting a business*	95.9	10	
1.3.2	Ease of resolving insolvency*	80.0	16	
1.3.3	Ease of paying taxes*	94.4	5	●
2	**Human capital & research**	**55.1**	**18**	
2.1	Education	60.3	20	
2.1.1	Expenditure on education, % GDP	5.3	36	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓐ	26.0	24	
2.1.3	School life expectancy, years	19.0	7	
2.1.4	PISA scales in reading, maths, & science	509.0	10	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	49.0	22	
2.2.1	Tertiary enrolment, % gross ⓐ	77.6	19	
2.2.2	Graduates in science & engineering, % ⓐ	23.8	34	
2.2.3	Tertiary inbound mobility, % ⓐ	7.0	29	
2.3	Research & development (R&D)	55.8	19	
2.3.1	Researchers, FTE/mn pop.	4,575.2	13	
2.3.2	Gross expenditure on R&D, % GDP ⓐ	1.5	23	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	81.1	12	
2.3.4	QS university ranking, average score top 3*	51.2	19	
3	**Infrastructure**	**62.1**	**17**	
3.1	Information & communication technologies (ICTs)	74.8	28	
3.1.1	ICT access*	81.9	22	
3.1.2	ICT use*	73.8	21	
3.1.3	Government's online service*	72.5	39	
3.1.4	E-participation*	71.2	39	
3.2	General infrastructure	47.1	34	
3.2.1	Electricity output, kWh/cap	6,102.2	32	
3.2.2	Logistics performance*	80.1	18	
3.2.3	Gross capital formation, % GDP	22.5	60	○
3.3	Ecological sustainability	64.3	8	
3.3.1	GDP/unit of energy use	17.5	4	●
3.3.2	Environmental performance*	86.6	19	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.5	45	
4	**Market sophistication**	**55.0**	**25**	
4.1	Credit	45.5	40	
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	54.3	62	○
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	50.5	29	
4.2.1	Ease of protecting minority investors*	73.3	13	
4.2.2	Market capitalization, % GDP	45.1	35	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	17	
4.3	Trade, competition, & market scale	69.1	38	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	69.9	63	○
4.3.3	Domestic market scale, bn PPP$	324.3	49	
5	**Business sophistication**	**54.5**	**10**	
5.1	Knowledge workers	62.7	20	
5.1.1	Knowledge-intensive employment, %	40.6	24	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP ⓐ	1.1	20	
5.1.4	GERD financed by business, % ⓐ	52.8	17	
5.1.5	Females employed w/advanced degrees, % total	24.9	8	
5.2	Innovation linkages	44.2	22	
5.2.1	University/industry research collaboration†	68.5	13	
5.2.2	State of cluster development†	65.8	16	
5.2.3	GERD financed by abroad, % ⓐ	18.6	22	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	26	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.5	20	
5.3	Knowledge absorption	56.6	4	●
5.3.1	Intellectual property payments, % total trade	26.3	1	●
5.3.2	High-tech imports less re-imports, % total trade	9.0	54	○
5.3.3	ICT services imports, % total trade	0.7	85	○
5.3.4	FDI net inflows, % GDP	42.2	2	●
5.3.5	Research talent, % in business enterprise	53.8	19	
6	**Knowledge & technology outputs**	**55.9**	**5**	●
6.1	Knowledge creation	24.1	38	
6.1.1	Patents by origin/bn PPP$ GDP	2.7	37	
6.1.2	PCT patent applications/bn PPP$ GDP	1.4	25	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	23.3	34	
6.1.5	Citable documents H index	31.3	28	
6.2	Knowledge impact	62.5	2	●
6.2.1	Growth rate of PPP$ GDP/worker, %	5.1	6	●
6.2.2	New businesses/th pop. 15–64	5.8	21	
6.2.3	Computer software spending, % GDP	0.8	2	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.6	46	
6.2.5	High- & medium-high-tech manufactures, % ⓐ	0.6	5	●
6.3	Knowledge diffusion	81.1	1	●
6.3.1	Intellectual property receipts, % total trade	2.4	8	
6.3.2	High-tech exports less re-exports, % total trade	11.7	18	
6.3.3	ICT services exports, % total trade	24.0	1	●
6.3.4	FDI net outflows, % GDP	39.6	1	●
7	**Creative outputs**	**50.9**	**13**	
7.1	Intangible assets	62.5	11	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.3	53	○
7.1.3	ICTs & business model creation†	80.4	9	
7.1.4	ICTs & organizational model creation†	72.2	19	
7.2	Creative goods & services	28.3	33	
7.2.1	Cultural & creative services exports, % of total trade ⓐ	0.2	46	○
7.2.2	National feature films/mn pop. 15–69	10.1	15	
7.2.3	Global ent. & media market/th pop. 15–69	49.3	18	
7.2.4	Printing & publishing manufactures, % ⓐ	0.8	71	○
7.2.5	Creative goods exports, % total trade	1.9	25	
7.3	Online creativity	50.5	16	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	61.4	11	
7.3.2	Country-code TLDs/th pop. 15–69	20.2	28	
7.3.3	Wikipedia edits/mn pop. 15–69	6.5	27	
7.3.4	Video uploads on YouTube/pop. 15–69	57.3	10	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Israel

Key indicators

Population (millions)	8.2
GDP (US$ billions)	311.7
GDP per capita, PPP$	33,656.1
Income group	High income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**53.9**	**17**	
	Innovation Output Sub-Index	46.8	14	
	Innovation Input Sub-Index	61.0	20	
	Innovation Efficiency Ratio	0.8	23	
	Global Innovation Index 2016 (out of 128)	52.3	21	
1	**Institutions**	**67.9**	**49**	
1.1	Political environment	57.1	53	
1.1.1	Political stability & safety*	36.7	115	○
1.1.2	Government effectiveness*	77.5	23	
1.2	Regulatory environment	67.8	49	
1.2.1	Regulatory quality*	74.6	22	
1.2.2	Rule of law*	73.6	24	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	111	○
1.3	Business environment	78.7	35	
1.3.1	Ease of starting a business*	92.3	35	
1.3.2	Ease of resolving insolvency*	72.8	29	
1.3.3	Ease of paying taxes*	71.0	72	○
2	**Human capital & research**	**56.5**	**15**	
2.1	Education	54.0	44	
2.1.1	Expenditure on education, % GDP	5.9	24	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	16.1	74	○
2.1.3	School life expectancy, years	16.0	33	
2.1.4	PISA scales in reading, maths, & science	471.7	38	○
2.1.5	Pupil-teacher ratio, secondary ⓓ	12.4	46	
2.2	Tertiary education	36.1	62	
2.2.1	Tertiary enrolment, % gross ⓓ	66.2	33	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % ⓓ	2.8	61	○
2.3	Research & development (R&D)	79.4	2	●
2.3.1	Researchers, FTE/mn pop. ⓓ	8,255.4	1	●
2.3.2	Gross expenditure on R&D, % GDP	4.3	1	●
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	69.2	18	
2.3.4	QS university ranking, average score top 3*	48.4	22	
3	**Infrastructure**	**57.8**	**28**	
3.1	Information & communication technologies (ICTs)	78.1	24	
3.1.1	ICT access*	82.8	18	
3.1.2	ICT use*	60.2	38	
3.1.3	Government's online service*	86.2	18	
3.1.4	E-participation*	83.1	17	
3.2	General infrastructure	43.7	42	
3.2.1	Electricity output, kWh/cap	7,849.7	23	
3.2.2	Logistics performance*	73.9	27	
3.2.3	Gross capital formation, % GDP	19.5	89	○
3.3	Ecological sustainability	51.5	42	
3.3.1	GDP/unit of energy use	11.1	37	
3.3.2	Environmental performance*	78.1	48	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.0	34	
4	**Market sophistication**	**61.5**	**15**	
4.1	Credit	45.5	39	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	66.6	45	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	71.2	6	
4.2.1	Ease of protecting minority investors*	75.0	9	
4.2.2	Market capitalization, % GDP	81.5	19	
4.2.3	Venture capital deals/bn PPP$ GDP	0.4	1	●
4.3	Trade, competition, & market scale	67.7	44	
4.3.1	Applied tariff rate, weighted mean, %	2.2	57	
4.3.2	Intensity of local competition†	69.8	64	
4.3.3	Domestic market scale, bn PPP$	297.0	52	
5	**Business sophistication**	**61.5**	**5**	●
5.1	Knowledge workers	63.0	18	
5.1.1	Knowledge-intensive employment, %	48.3	6	
5.1.2	Firms offering formal training, % firms	18.6	78	○
5.1.3	GERD performed by business, % of GDP	3.7	1	●
5.1.4	GERD financed by business, % ⓓ	37.0	40	
5.1.5	Females employed w/advanced degrees, % total ⓓ	28.4	4	●
5.2	Innovation linkages	67.8	2	●
5.2.1	University/industry research collaboration†	76.7	3	●
5.2.2	State of cluster development†	53.8	33	
5.2.3	GERD financed by abroad, % ⓓ	49.2	4	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	12	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	8.0	8	
5.3	Knowledge absorption	53.5	9	
5.3.1	Intellectual property payments, % total trade	0.6	56	
5.3.2	High-tech imports less re-imports, % total trade	11.4	29	
5.3.3	ICT services imports, % total trade	2.1	22	
5.3.4	FDI net inflows, % GDP	3.4	48	
5.3.5	Research talent, % in business enterprise ⓓ	83.7	1	●
6	**Knowledge & technology outputs**	**49.6**	**9**	
6.1	Knowledge creation	54.6	11	
6.1.1	Patents by origin/bn PPP$ GDP	4.5	26	
6.1.2	PCT patent applications/bn PPP$ GDP	6.2	7	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	45.8	11	
6.1.5	Citable documents H index	47.4	16	
6.2	Knowledge impact	37.2	42	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.2	82	○
6.2.2	New businesses/th pop. 15–64	3.1	36	
6.2.3	Computer software spending, % GDP	0.3	53	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	31.8	6	
6.2.5	High- & medium-high-tech manufactures, %	0.3	37	
6.3	Knowledge diffusion	57.1	8	
6.3.1	Intellectual property receipts, % total trade	0.9	17	
6.3.2	High-tech exports less re-exports, % total trade	15.8	8	
6.3.3	ICT services exports, % total trade	10.6	1	●
6.3.4	FDI net outflows, % GDP	2.1	28	
7	**Creative outputs**	**43.9**	**30**	
7.1	Intangible assets	49.3	40	
7.1.1	Trademarks by origin/bn PPP$ GDP	13.0	97	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	3.7	32	
7.1.3	ICTs & business model creation†	80.9	8	
7.1.4	ICTs & organizational model creation†	75.5	11	
7.2	Creative goods & services	33.2	24	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	1.3	8	
7.2.2	National feature films/mn pop. 15–69	6.1	33	
7.2.3	Global ent. & media market/th pop. 15–69	35.9	21	
7.2.4	Printing & publishing manufactures, %	1.2	46	
7.2.5	Creative goods exports, % total trade	1.8	27	
7.3	Online creativity	43.7	25	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	23.2	24	
7.3.2	Country-code TLDs/th pop. 15–69	13.5	35	
7.3.3	Wikipedia edits/mn pop. 15–69	7.6	3	●
7.3.4	Video uploads on YouTube/pop. 15–69	64.9	4	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Italy

Key indicators

Population (millions)	59.8
GDP (US$ billions)	1,852.5
GDP per capita, PPP$	35,708.3
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)		**47.0**	**29**	
Innovation Output Sub-Index		39.5	29	
Innovation Input Sub-Index		54.4	29	
Innovation Efficiency Ratio		0.7	31	
Global Innovation Index 2016 (out of 128)		47.2	29	
1	**Institutions**	**71.9**	**38**	
1.1	Political environment	63.0	46	
1.1.1	Political stability & safety*	72.2	46	
1.1.2	Government effectiveness*	53.8	46	
1.2	Regulatory environment	76.9	33	
1.2.1	Regulatory quality*	60.8	42	
1.2.2	Rule of law*	46.8	50	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	75.9	44	
1.3.1	Ease of starting a business*	89.4	54	
1.3.2	Ease of resolving insolvency*	76.6	23	
1.3.3	Ease of paying taxes*	61.7	91	○
2	**Human capital & research**	**46.3**	**32**	
2.1	Education	53.6	48	
2.1.1	Expenditure on education, % GDP	4.2	75	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	23.3	38	
2.1.3	School life expectancy, years	16.4	23	
2.1.4	PISA scales in reading, maths, & science	485.0	31	
2.1.5	Pupil-teacher ratio, secondary◷	11.4	36	
2.2	Tertiary education	38.9	51	
2.2.1	Tertiary enrolment, % gross◷	63.1	39	
2.2.2	Graduates in science & engineering, %◷	20.2	55	
2.2.3	Tertiary inbound mobility, %◷	4.7	39	
2.3	Research & development (R&D)	46.5	21	
2.3.1	Researchers, FTE/mn pop.	2,018.1	36	
2.3.2	Gross expenditure on R&D, % GDP	1.3	26	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	84.5	9	●
2.3.4	QS university ranking, average score top 3*	46.3	27	
3	**Infrastructure**	**61.8**	**19**	
3.1	Information & communication technologies (ICTs)	79.5	20	
3.1.1	ICT access*	76.9	33	
3.1.2	ICT use*	62.5	34	
3.1.3	Government's online service*	87.0	17	●
3.1.4	E-participation*	91.5	8	●
3.2	General infrastructure	38.7	56	
3.2.1	Electricity output, kWh/cap	4,597.4	47	
3.2.2	Logistics performance*	78.2	21	
3.2.3	Gross capital formation, % GDP	16.6	105	○
3.3	Ecological sustainability	67.2	4	●
3.3.1	GDP/unit of energy use	13.2	18	
3.3.2	Environmental performance*	84.5	29	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	10.3	7	●
4	**Market sophistication**	**52.6**	**36**	
4.1	Credit	39.9	50	
4.1.1	Ease of getting credit*	45.0	84	○
4.1.2	Domestic credit to private sector, % GDP	88.0	34	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	38.5	71	○
4.2.1	Ease of protecting minority investors*	63.3	41	
4.2.2	Market capitalization, % GDP◷	27.3	53	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	30	
4.3	Trade, competition, & market scale	79.3	10	●
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	71.8	45	
4.3.3	Domestic market scale, bn PPP$	2,220.6	12	●
5	**Business sophistication**	**39.6**	**35**	
5.1	Knowledge workers	47.6	40	
5.1.1	Knowledge-intensive employment, %	35.7	35	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	0.7	25	
5.1.4	GERD financed by business, %◷	46.2	26	
5.1.5	Females employed w/advanced degrees, % total	11.5	60	○
5.2	Innovation linkages	35.3	43	
5.2.1	University/industry research collaboration†	44.7	43	
5.2.2	State of cluster development†	72.6	4	●
5.2.3	GERD financed by abroad, %◷	9.3	49	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	61	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	1.8	25	
5.3	Knowledge absorption	35.8	51	
5.3.1	Intellectual property payments, % total trade	0.9	39	
5.3.2	High-tech imports less re-imports, % total trade	8.1	64	
5.3.3	ICT services imports, % total trade	1.7	29	
5.3.4	FDI net inflows, % GDP	0.8	109	○
5.3.5	Research talent, % in business enterprise	38.6	34	
6	**Knowledge & technology outputs**	**36.1**	**26**	
6.1	Knowledge creation	30.9	31	
6.1.1	Patents by origin/bn PPP$ GDP	1.8	49	
6.1.2	PCT patent applications/bn PPP$ GDP	1.5	23	
6.1.3	Utility models by origin/bn PPP$ GDP◷	1.1	21	
6.1.4	Scientific & technical articles/bn PPP$ GDP	27.6	27	
6.1.5	Citable documents H index	68.9	7	●
6.2	Knowledge impact	51.0	9	●
6.2.1	Growth rate of PPP$ GDP/worker, %	0.2	80	○
6.2.2	New businesses/th pop. 15–64	2.3	44	
6.2.3	Computer software spending, % GDP	0.6	15	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	61.1	1	●
6.2.5	High- & medium-high-tech manufactures, %	0.4	26	
6.3	Knowledge diffusion	26.4	47	
6.3.1	Intellectual property receipts, % total trade	0.6	22	
6.3.2	High-tech exports less re-exports, % total trade	5.7	31	
6.3.3	ICT services exports, % total trade	1.5	67	
6.3.4	FDI net outflows, % GDP	0.9	54	
7	**Creative outputs**	**42.9**	**33**	
7.1	Intangible assets	53.5	27	
7.1.1	Trademarks by origin/bn PPP$ GDP◷	49.9	50	
7.1.2	Industrial designs by origin/bn PPP$ GDP◷	18.5	1	●
7.1.3	ICTs & business model creation†	61.7	57	
7.1.4	ICTs & organizational model creation†	50.5	75	○
7.2	Creative goods & services	25.8	44	
7.2.1	Cultural & creative services exports, % of total trade◷	0.3	41	
7.2.2	National feature films/mn pop. 15–69	4.4	45	
7.2.3	Global ent. & media market/th pop. 15–69	28.1	23	
7.2.4	Printing & publishing manufactures, %	1.2	48	
7.2.5	Creative goods exports, % total trade	2.3	19	
7.3	Online creativity	38.6	29	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	23.1	25	
7.3.2	Country-code TLDs/th pop. 15–69	21.4	26	
7.3.3	Wikipedia edits/mn pop. 15–69	6.5	29	
7.3.4	Video uploads on YouTube/pop. 15–69	47.3	19	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
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Jamaica

Key indicators

Population (millions)	2.8
GDP (US$ billions)	13.8
GDP per capita, PPP$	8,758.5
Income group	Upper-middle income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**30.4**	**84**
Innovation Output Sub-Index	22.0	84
Innovation Input Sub-Index	38.7	84
Innovation Efficiency Ratio	0.6	86
Global Innovation Index 2016 (out of 128)	29.0	89

		Score/Value	Rank	
1	**Institutions**	**65.8**	**57**	
1.1	Political environment	57.3	51	
1.1.1	Political stability & safety*	66.1	56	
1.1.2	Government effectiveness*	48.5	55	
1.2	Regulatory environment	63.4	67	
1.2.1	Regulatory quality*	44.9	68	
1.2.2	Rule of law*	32.6	72	
1.2.3	Cost of redundancy dismissal, salary weeks	14.0	54	
1.3	Business environment	76.6	40	
1.3.1	Ease of starting a business*	95.6	12	●
1.3.2	Ease of resolving insolvency*	69.2	35	●
1.3.3	Ease of paying taxes*	65.2	85	
2	**Human capital & research**	**23.8**	**88**	
2.1	Education	47.9	62	
2.1.1	Expenditure on education, % GDP	5.4	34	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	27.1	19	●
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	16.4	72	
2.2	Tertiary education	23.4	[98]	
2.2.1	Tertiary enrolment, % gross	27.2	85	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**32.8**	**108**	
3.1	Information & communication technologies (ICTs)	36.6	96	
3.1.1	ICT access*	48.3	85	
3.1.2	ICT use*	35.5	76	
3.1.3	Government's online service*	35.5	103	
3.1.4	E-participation*	27.1	110	○
3.2	General infrastructure	18.9	120	○
3.2.1	Electricity output, kWh/cap	1,516.2	86	
3.2.2	Logistics performance*	15.6	111	○
3.2.3	Gross capital formation, % GDP	15.4	109	○
3.3	Ecological sustainability	42.9	73	
3.3.1	GDP/unit of energy use	8.1	69	
3.3.2	Environmental performance*	77.0	53	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	82	
4	**Market sophistication**	**39.8**	**95**	
4.1	Credit	31.2	75	
4.1.1	Ease of getting credit*	80.0	15	●
4.1.2	Domestic credit to private sector, % GDP	29.9	99	
4.1.3	Microfinance gross loans, % GDP	0.1	53	
4.2	Investment	43.8	44	
4.2.1	Ease of protecting minority investors*	58.3	62	
4.2.2	Market capitalization, % GDP ◷	34.7	43	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	44.4	117	○
4.3.1	Applied tariff rate, weighted mean, % ◷	9.6	112	○
4.3.2	Intensity of local competition†	74.8	27	●
4.3.3	Domestic market scale, bn PPP$	25.4	115	○
5	**Business sophistication**	**31.3**	**69**	
5.1	Knowledge workers	32.1	[81]	
5.1.1	Knowledge-intensive employment, % ◷	20.1	73	
5.1.2	Firms offering formal training, % firms ◷	25.9	60	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	28.9	58	
5.2.1	University/industry research collaboration†	40.8	64	
5.2.2	State of cluster development†	44.3	70	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	34	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	55	
5.3	Knowledge absorption	32.9	64	
5.3.1	Intellectual property payments, % total trade	1.0	35	●
5.3.2	High-tech imports less re-imports, % total trade	6.0	93	
5.3.3	ICT services imports, % total trade	1.5	41	
5.3.4	FDI net inflows, % GDP	4.9	28	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**14.4**	**108**	
6.1	Knowledge creation	4.8	88	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	89	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.6	82	
6.1.5	Citable documents H index	4.3	99	
6.2	Knowledge impact	22.0	100	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.5)	93	
6.2.2	New businesses/th pop. 15–64	1.0	70	
6.2.3	Computer software spending, % GDP	0.3	38	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	108	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	16.3	106	
6.3.1	Intellectual property receipts, % total trade	0.1	51	
6.3.2	High-tech exports less re-exports, % total trade	0.0	124	○
6.3.3	ICT services exports, % total trade	2.3	47	
6.3.4	FDI net outflows, % GDP	(0.2)	118	○
7	**Creative outputs**	**29.7**	**67**	
7.1	Intangible assets	52.7	29	●
7.1.1	Trademarks by origin/bn PPP$ GDP	126.4	6	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	2.6	39	
7.1.3	ICTs & business model creation†	62.0	55	
7.1.4	ICTs & organizational model creation†	50.7	74	
7.2	Creative goods & services	2.0	[120]	
7.2.1	Cultural & creative services exports, % of total trade	0.1	60	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	108	○
7.3	Online creativity	11.3	95	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.9	78	
7.3.2	Country-code TLDs/th pop. 15–69	1.0	81	
7.3.3	Wikipedia edits/mn pop. 15–69 ◷	3.2	98	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Japan

Key indicators

Population (millions)	126.3
GDP (US$ billions)	4,730.3
GDP per capita, PPP$	38,054.2
Income group	High income
Region	South East Asia, East Asia, and Oceania

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**54.7**	**14**	
	Innovation Output Sub-Index	44.0	20	
	Innovation Input Sub-Index	65.5	11	
	Innovation Efficiency Ratio	0.7	49	
	Global Innovation Index 2016 (out of 128)	54.5	16	
1	**Institutions**	**87.4**	**13**	
1.1	Political environment	87.9	11	
1.1.1	Political stability & safety*	87.6	15	
1.1.2	Government effectiveness*	88.2	10	
1.2	Regulatory environment	89.0	14	
1.2.1	Regulatory quality*	72.2	24	
1.2.2	Rule of law*	83.6	19	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	85.5	21	
1.3.1	Ease of starting a business*	86.1	72	
1.3.2	Ease of resolving insolvency*	93.3	2	●
1.3.3	Ease of paying taxes*	77.0	59	
2	**Human capital & research**	**56.7**	**14**	
2.1	Education	53.8	46	
2.1.1	Expenditure on education, % GDP	3.8	85	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	25.1	29	
2.1.3	School life expectancy, years	15.4	39	
2.1.4	PISA scales in reading, maths, & science	528.9	3	●
2.1.5	Pupil-teacher ratio, secondaryⓓ	11.7	38	
2.2	Tertiary education	37.1	60	
2.2.1	Tertiary enrolment, % grossⓓ	63.4	37	
2.2.2	Graduates in science & engineering, %	19.9	59	○
2.2.3	Tertiary inbound mobility, %ⓓ	3.4	53	
2.3	Research & development (R&D)	79.4	3	●
2.3.1	Researchers, FTE/mn pop.	5,230.7	9	
2.3.2	Gross expenditure on R&D, % GDP	3.5	3	●
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	93.2	4	●
2.3.4	QS university ranking, average score top 3*	79.7	8	
3	**Infrastructure**	**64.3**	**9**	
3.1	Information & communication technologies (ICTs)	88.8	5	
3.1.1	ICT access*	88.0	10	
3.1.2	ICT use*	81.4	8	
3.1.3	Government's online service*	87.7	15	
3.1.4	E-participation*	98.3	2	●
3.2	General infrastructure	49.7	28	
3.2.1	Electricity output, kWh/cap	7,948.1	20	
3.2.2	Logistics performance*	88.2	12	
3.2.3	Gross capital formation, % GDP	21.5	71	
3.3	Ecological sustainability	54.3	32	
3.3.1	GDP/unit of energy use	10.2	46	
3.3.2	Environmental performance*	80.6	39	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	5.4	20	
4	**Market sophistication**	**64.3**	**12**	
4.1	Credit	61.8	12	
4.1.1	Ease of getting credit*	50.0	72	○
4.1.2	Domestic credit to private sector, % GDP	182.9	4	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	43.7	45	
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDP	111.7	7	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	49	
4.3	Trade, competition, & market scale	87.5	3	●
4.3.1	Applied tariff rate, weighted mean, %	1.4	20	
4.3.2	Intensity of local competition†	87.1	1	●
4.3.3	Domestic market scale, bn PPP$	4,931.9	4	●
5	**Business sophistication**	**54.5**	**11**	
5.1	Knowledge workers	64.1	15	
5.1.1	Knowledge-intensive employment, %	24.8	55	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	2.7	3	●
5.1.4	GERD financed by business, %	78.0	1	●
5.1.5	Females employed w/advanced degrees, % total	20.3	22	
5.2	Innovation linkages	45.3	19	
5.2.1	University/industry research collaboration†	62.5	17	
5.2.2	State of cluster development†	70.3	7	
5.2.3	GERD financed by abroad, %	0.5	92	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	38	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	15.5	1	●
5.3	Knowledge absorption	54.1	8	
5.3.1	Intellectual property payments, % total trade	2.2	9	
5.3.2	High-tech imports less re-imports, % total trade	14.9	15	
5.3.3	ICT services imports, % total trade	1.5	43	
5.3.4	FDI net inflows, % GDP	0.2	122	○
5.3.5	Research talent, % in business enterprise	73.4	3	●
6	**Knowledge & technology outputs**	**47.1**	**12**	
6.1	Knowledge creation	56.7	9	
6.1.1	Patents by origin/bn PPP$ GDP	53.4	1	●
6.1.2	PCT patent applications/bn PPP$ GDP	9.2	1	●
6.1.3	Utility models by origin/bn PPP$ GDP	1.1	22	
6.1.4	Scientific & technical articles/bn PPP$ GDP	15.1	51	
6.1.5	Citable documents H index	71.8	6	
6.2	Knowledge impact	33.2	55	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	85	○
6.2.2	New businesses/th pop. 15–64	0.2	96	○
6.2.3	Computer software spending, % GDP	0.3	60	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	9.7	37	
6.2.5	High- & medium-high-tech manufactures, %ⓓ	0.5	9	
6.3	Knowledge diffusion	51.6	10	
6.3.1	Intellectual property receipts, % total trade	4.7	2	●
6.3.2	High-tech exports less re-exports, % total trade	12.8	16	
6.3.3	ICT services exports, % total trade	0.4	105	○
6.3.4	FDI net outflows, % GDP	2.9	21	
7	**Creative outputs**	**40.8**	**36**	
7.1	Intangible assets	52.0	30	
7.1.1	Trademarks by origin/bn PPP$ GDP	59.9	35	
7.1.2	Industrial designs by origin/bn PPP$ GDP	5.1	24	
7.1.3	ICTs & business model creation†	71.3	29	
7.1.4	ICTs & organizational model creation†	66.3	27	
7.2	Creative goods & services	34.3	21	
7.2.1	Cultural & creative services exports, % of total trade	0.1	55	○
7.2.2	National feature films/mn pop. 15–69	6.7	26	
7.2.3	Global ent. & media market/th pop. 15–69	61.8	10	
7.2.4	Printing & publishing manufactures, %ⓓ	2.1	20	
7.2.5	Creative goods exports, % total trade	2.2	20	
7.3	Online creativity	25.1	50	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	15.1	31	
7.3.2	Country-code TLDs/th pop. 15–69	5.1	49	
7.3.3	Wikipedia edits/mn pop. 15–69	5.7	47	
7.3.4	Video uploads on YouTube/pop. 15–69	25.3	49	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Jordan

Key indicators

Population (millions)	7.7
GDP (US$ billions)	39.5
GDP per capita, PPP$	12,122.9
Income group	Upper-middle income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**30.5**	**83**
Innovation Output Sub-Index	24.0	74
Innovation Input Sub-Index	37.1	92
Innovation Efficiency Ratio	0.6	57
Global Innovation Index 2016 (out of 128)	30.0	82

		Score/Value	Rank	
1	**Institutions**	**61.6**	**64**	
1.1	Political environment	47.8	73	
1.1.1	Political stability & safety*	49.9	91	
1.1.2	Government effectiveness*	45.6	62	
1.2	Regulatory environment	74.1	36	●
1.2.1	Regulatory quality*	43.3	69	
1.2.2	Rule of law*	52.9	44	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	63.0	82	
1.3.1	Ease of starting a business*	84.6	81	
1.3.2	Ease of resolving insolvency*	30.4	115	○
1.3.3	Ease of paying taxes*	73.9	64	
2	**Human capital & research**	**26.7**	**83**	
2.1	Education	32.3	105	○
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓐ	16.5	71	
2.1.3	School life expectancy, years ⓐ	12.8	80	
2.1.4	PISA scales in reading, maths, & science	399.0	62	○
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	41.2	43	
2.2.1	Tertiary enrolment, % gross	44.9	59	
2.2.2	Graduates in science & engineering, % ⓐ	16.1	78	○
2.2.3	Tertiary inbound mobility, %	12.9	13	●
2.3	Research & development (R&D)	6.7	68	
2.3.1	Researchers, FTE/mn pop.	308.0	70	
2.3.2	Gross expenditure on R&D, % GDP ⓐ	0.4	70	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	13.3	58	
3	**Infrastructure**	**40.1**	**87**	
3.1	Information & communication technologies (ICTs)	46.1	87	
3.1.1	ICT access*	61.0	70	
3.1.2	ICT use*	32.0	83	
3.1.3	Government's online service*	45.7	91	
3.1.4	E-participation*	45.8	95	
3.2	General infrastructure	31.0	89	
3.2.1	Electricity output, kWh/cap	2,756.4	64	
3.2.2	Logistics performance*	41.3	66	
3.2.3	Gross capital formation, % GDP	19.5	88	
3.3	Ecological sustainability	43.0	72	
3.3.1	GDP/unit of energy use	9.1	60	
3.3.2	Environmental performance*	72.2	68	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.8	71	
4	**Market sophistication**	**32.3**	**116**	○
4.1	Credit	11.8	124	○
4.1.1	Ease of getting credit*	0.0	126	○
4.1.2	Domestic credit to private sector, % GDP	70.3	42	●
4.1.3	Microfinance gross loans, % GDP	0.4	36	
4.2	Investment	25.6	122	○
4.2.1	Ease of protecting minority investors*	35.0	121	○
4.2.2	Market capitalization, % GDP	67.8	23	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	65	
4.3	Trade, competition, & market scale	59.5	74	
4.3.1	Applied tariff rate, weighted mean, %	4.0	79	
4.3.2	Intensity of local competition†	73.3	37	●
4.3.3	Domestic market scale, bn PPP$	86.2	76	
5	**Business sophistication**	**24.7**	**[104]**	
5.1	Knowledge workers	0.0	[127]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	3.4	92	○
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	34.7	45	
5.2.1	University/industry research collaboration†	47.3	37	●
5.2.2	State of cluster development†	54.7	30	●
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	32	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	65	
5.3	Knowledge absorption	39.3	[34]	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	6.8	79	
5.3.3	ICT services imports, % total trade	n/a	n/a	
5.3.4	FDI net inflows, % GDP	4.8	29	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**19.3**	**79**	
6.1	Knowledge creation	10.8	62	
6.1.1	Patents by origin/bn PPP$ GDP	0.5	76	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	16.0	46	
6.1.5	Citable documents H index	7.8	77	
6.2	Knowledge impact	26.2	85	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.4	72	
6.2.2	New businesses/th pop. 15–64	1.0	71	
6.2.3	Computer software spending, % GDP	0.3	54	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.1	69	
6.2.5	High- & medium-high-tech manufactures, % ⓐ	0.2	55	
6.3	Knowledge diffusion	21.0	68	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.7	73	
6.3.3	ICT services exports, % total trade	n/a	n/a	
6.3.4	FDI net outflows, % GDP	0.1	92	
7	**Creative outputs**	**28.6**	**72**	
7.1	Intangible assets	38.9	79	
7.1.1	Trademarks by origin/bn PPP$ GDP	32.9	68	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.7	73	
7.1.3	ICTs & business model creation†	64.6	48	
7.1.4	ICTs & organizational model creation†	53.3	64	
7.2	Creative goods & services	17.2	68	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	1.7	53	○
7.2.4	Printing & publishing manufactures, % ⓐ	1.2	51	
7.2.5	Creative goods exports, % total trade	1.0	42	●
7.3	Online creativity	19.4	63	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	6.6	49	
7.3.2	Country-code TLDs/th pop. 15–69	0.3	98	○
7.3.3	Wikipedia edits/mn pop. 15–69	5.4	52	
7.3.4	Video uploads on YouTube/pop. 15–69	18.8	59	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Kazakhstan

Key indicators

Population (millions)	17.9
GDP (US$ billions)	128.1
GDP per capita, PPP$	24,267.9
Income group	Upper-middle income
Region	Central and Southern Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**31.5**	**78**	
	Innovation Output Sub-Index	19.8	93	
	Innovation Input Sub-Index	43.2	64	
	Innovation Efficiency Ratio	0.5	116	○
	Global Innovation Index 2016 (out of 128)	31.5	75	
1	**Institutions**	**66.1**	**55**	
1.1	Political environment	51.1	67	
1.1.1	Political stability & safety*	61.5	69	
1.1.2	Government effectiveness*	40.8	75	
1.2	Regulatory environment	66.9	54	
1.2.1	Regulatory quality*	41.5	71	
1.2.2	Rule of law*	28.7	83	
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	22	●
1.3	Business environment	80.2	31	●
1.3.1	Ease of starting a business*	91.9	38	
1.3.2	Ease of resolving insolvency*	69.2	34	●
1.3.3	Ease of paying taxes*	79.5	51	
2	**Human capital & research**	**31.0**	**71**	
2.1	Education	43.4	78	
2.1.1	Expenditure on education, % GDP	2.8	104	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	19.2	56	
2.1.3	School life expectancy, years	15.0	48	
2.1.4	PISA scales in reading, maths, & science ◷	416.4	53	
2.1.5	Pupil-teacher ratio, secondary	6.8	1	●
2.2	Tertiary education	37.7	57	
2.2.1	Tertiary enrolment, % gross	46.3	57	
2.2.2	Graduates in science & engineering, %	25.7	26	●
2.2.3	Tertiary inbound mobility, %	2.0	68	
2.3	Research & development (R&D)	11.9	55	
2.3.1	Researchers, FTE/mn pop. ◷	734.1	54	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.2	92	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	35.1	35	●
3	**Infrastructure**	**47.9**	**60**	
3.1	Information & communication technologies (ICTs)	65.8	46	
3.1.1	ICT access*	75.6	37	
3.1.2	ICT use*	51.5	57	
3.1.3	Government's online service*	76.8	31	●
3.1.4	E-participation*	59.3	65	
3.2	General infrastructure	41.3	49	
3.2.1	Electricity output, kWh/cap	6,076.8	33	●
3.2.2	Logistics performance*	31.9	77	
3.2.3	Gross capital formation, % GDP	28.1	28	●
3.3	Ecological sustainability	36.5	94	
3.3.1	GDP/unit of energy use	5.1	102	
3.3.2	Environmental performance*	73.3	64	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	99	
4	**Market sophistication**	**43.2**	**80**	
4.1	Credit	23.5	105	
4.1.1	Ease of getting credit*	55.0	67	
4.1.2	Domestic credit to private sector, % GDP	37.7	85	
4.1.3	Microfinance gross loans, % GDP	0.1	59	
4.2	Investment	42.2	53	
4.2.1	Ease of protecting minority investors*	80.0	3	●
4.2.2	Market capitalization, % GDP	18.9	62	
4.2.3	Venture capital deals/bn PPP$ GDP ◷	0.0	88	○
4.3	Trade, competition, & market scale	64.0	52	
4.3.1	Applied tariff rate, weighted mean, %	4.7	86	
4.3.2	Intensity of local competition†	60.5	97	
4.3.3	Domestic market scale, bn PPP$	460.7	39	
5	**Business sophistication**	**27.6**	**87**	
5.1	Knowledge workers	38.9	58	
5.1.1	Knowledge-intensive employment, %	33.3	41	
5.1.2	Firms offering formal training, % firms	28.3	55	
5.1.3	GERD performed by business, % of GDP ◷	0.0	70	
5.1.4	GERD financed by business, % ◷	28.9	52	
5.1.5	Females employed w/advanced degrees, % total ◷	17.5	29	
5.2	Innovation linkages	16.5	121	○
5.2.1	University/industry research collaboration†	40.9	63	
5.2.2	State of cluster development†	33.3	109	○
5.2.3	GERD financed by abroad, % ◷	0.8	88	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	78	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	57	
5.3	Knowledge absorption	27.5	89	
5.3.1	Intellectual property payments, % total trade	0.3	75	
5.3.2	High-tech imports less re-imports, % total trade	7.6	69	
5.3.3	ICT services imports, % total trade	0.7	82	
5.3.4	FDI net inflows, % GDP	3.7	43	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**17.8**	**88**	
6.1	Knowledge creation	10.7	64	
6.1.1	Patents by origin/bn PPP$ GDP	2.9	35	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	76	
6.1.3	Utility models by origin/bn PPP$ GDP	1.0	26	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.8	118	○
6.1.5	Citable documents H index	3.6	107	
6.2	Knowledge impact	21.9	101	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.0	57	
6.2.2	New businesses/th pop. 15–64 ◷	1.7	50	
6.2.3	Computer software spending, % GDP	0.0	119	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	106	
6.2.5	High- & medium-high-tech manufactures, % ◷	0.1	67	
6.3	Knowledge diffusion	20.9	69	
6.3.1	Intellectual property receipts, % total trade	0.0	101	○
6.3.2	High-tech exports less re-exports, % total trade	5.9	30	●
6.3.3	ICT services exports, % total trade	0.3	109	○
6.3.4	FDI net outflows, % GDP	1.2	46	
7	**Creative outputs**	**21.9**	**95**	
7.1	Intangible assets	32.1	99	
7.1.1	Trademarks by origin/bn PPP$ GDP ◷	16.7	90	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	96	
7.1.3	ICTs & business model creation†	54.4	85	
7.1.4	ICTs & organizational model creation†	49.2	77	
7.2	Creative goods & services	5.6	107	
7.2.1	Cultural & creative services exports, % of total trade	0.0	77	
7.2.2	National feature films/mn pop. 15–69	1.3	73	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ◷	0.7	79	
7.2.5	Creative goods exports, % total trade	0.2	80	
7.3	Online creativity	17.7	72	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.3	112	○
7.3.2	Country-code TLDs/th pop. 15–69	3.1	57	
7.3.3	Wikipedia edits/mn pop. 15–69	5.2	56	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Kenya

Key indicators

Population (millions)	47.3
GDP (US$ billions)	69.2
GDP per capita, PPP$	3,207.7
Income group	Lower-middle income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**31.0**	**80**
Innovation Output Sub-Index	24.7	70
Innovation Input Sub-Index	37.2	91
Innovation Efficiency Ratio	0.7	50
Global Innovation Index 2016 (out of 128)	30.4	80

		Score	Rank	
1	**Institutions**	**53.8**	**84**	
1.1	Political environment	33.7	109	
1.1.1	Political stability & safety*	32.5	118	○
1.1.2	Government effectiveness*	34.8	87	
1.2	Regulatory environment	64.9	63	
1.2.1	Regulatory quality*	34.6	89	
1.2.2	Rule of law*	25.1	91	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	62.7	83	
1.3.1	Ease of starting a business*	83.1	90	
1.3.2	Ease of resolving insolvency*	43.4	83	
1.3.3	Ease of paying taxes*	61.7	90	
2	**Human capital & research**	**14.1**	**119**	○
2.1	Education	33.3	104	
2.1.1	Expenditure on education, % GDP	5.3	39	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	24.9	31	
2.1.3	School life expectancy, years ⓓ	11.1	94	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	41.1	111	○
2.2	Tertiary education	2.9	[122]	
2.2.1	Tertiary enrolment, % gross ⓓ	4.0	118	○
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	6.2	73	
2.3.1	Researchers, FTE/mn pop. ⓓ	230.7	73	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.8	45	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	4.3	73	
3	**Infrastructure**	**36.7**	**97**	
3.1	Information & communication technologies (ICTs)	41.1	93	
3.1.1	ICT access*	35.4	103	
3.1.2	ICT use*	20.5	99	
3.1.3	Government's online service*	55.8	75	
3.1.4	E-participation*	52.5	82	
3.2	General infrastructure	36.5	69	
3.2.1	Electricity output, kWh/cap	206.4	111	○
3.2.2	Logistics performance*	58.6	41	
3.2.3	Gross capital formation, % GDP	22.5	59	
3.3	Ecological sustainability	32.5	112	
3.3.1	GDP/unit of energy use	5.2	101	
3.3.2	Environmental performance*	62.5	99	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	90	
4	**Market sophistication**	**48.2**	**56**	
4.1	Credit	53.0	22	●
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	34.9	92	
4.1.3	Microfinance gross loans, % GDP	4.3	9	●
4.2	Investment	33.4	93	
4.2.1	Ease of protecting minority investors*	53.3	80	
4.2.2	Market capitalization, % GDP ⓓ	24.3	58	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	29	
4.3	Trade, competition, & market scale	58.3	76	
4.3.1	Applied tariff rate, weighted mean, %	7.6	107	
4.3.2	Intensity of local competition†	77.2	18	●
4.3.3	Domestic market scale, bn PPP$	152.7	67	
5	**Business sophistication**	**33.2**	**62**	
5.1	Knowledge workers	26.4	95	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	40.6	33	
5.1.3	GERD performed by business, % of GDP ⓓ	0.1	68	
5.1.4	GERD financed by business, % ⓓ	4.3	79	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	47.5	11	●
5.2.1	University/industry research collaboration†	57.6	25	●
5.2.2	State of cluster development†	52.6	38	
5.2.3	GERD financed by abroad, % ⓓ	47.1	6	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	44	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	91	
5.3	Knowledge absorption	25.7	94	
5.3.1	Intellectual property payments, % total trade ⓓ	1.0	34	
5.3.2	High-tech imports less re-imports, % total trade ⓓ	10.8	36	●
5.3.3	ICT services imports, % total trade ⓓ	0.1	120	○
5.3.4	FDI net inflows, % GDP	1.5	96	
5.3.5	Research talent, % in business enterprise ⓓ	11.4	64	
6	**Knowledge & technology outputs**	**21.6**	**63**	
6.1	Knowledge creation	11.7	59	
6.1.1	Patents by origin/bn PPP$ GDP	1.0	65	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	93	○
6.1.3	Utility models by origin/bn PPP$ GDP	0.8	30	
6.1.4	Scientific & technical articles/bn PPP$ GDP	11.6	61	
6.1.5	Citable documents H index	14.0	52	
6.2	Knowledge impact	29.6	71	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.8	22	●
6.2.2	New businesses/th pop. 15–64	1.8	49	
6.2.3	Computer software spending, % GDP	0.2	74	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.6	64	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	78	
6.3	Knowledge diffusion	23.5	61	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.4	28	●
6.3.2	High-tech exports less re-exports, % total trade ⓓ	0.6	79	
6.3.3	ICT services exports, % total trade ⓓ	4.3	17	●
6.3.4	FDI net outflows, % GDP	(0.0)	111	○
7	**Creative outputs**	**27.8**	**79**	
7.1	Intangible assets	40.9	71	
7.1.1	Trademarks by origin/bn PPP$ GDP	32.9	67	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.5	78	
7.1.3	ICTs & business model creation†	67.8	37	
7.1.4	ICTs & organizational model creation†	57.5	46	
7.2	Creative goods & services	22.9	49	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.0	88	○
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	2.3	50	
7.2.4	Printing & publishing manufactures, % ⓓ	3.8	4	●
7.2.5	Creative goods exports, % total trade ⓓ	0.3	68	
7.3	Online creativity	6.6	106	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.1	93	
7.3.2	Country-code TLDs/th pop. 15–69	0.7	86	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	2.4	105	
7.3.4	Video uploads on YouTube/pop. 15–69	1.0	70	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Korea, Republic of

Key indicators

Population (millions)	50.5
GDP (US$ billions)	1,404.4
GDP per capita, PPP$	36,511.0
Income group	High income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**57.7**	**11**
Innovation Output Sub-Index	52.1	9
Innovation Input Sub-Index	63.3	16
Innovation Efficiency Ratio	0.8	14
Global Innovation Index 2016 (out of 128)	57.1	11

1	**Institutions**	**74.5**	**35**	
1.1	Political environment	67.4	42	
1.1.1	Political stability & safety*	66.2	55	
1.1.2	Government effectiveness*	68.5	34	
1.2	Regulatory environment	65.5	61	
1.2.1	Regulatory quality*	71.7	26	
1.2.2	Rule of law*	67.3	30	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	107	○
1.3	Business environment	90.5	3	●
1.3.1	Ease of starting a business*	95.8	11	
1.3.2	Ease of resolving insolvency*	89.2	4	●
1.3.3	Ease of paying taxes*	86.6	21	
2	**Human capital & research**	**66.2**	**2**	●
2.1	Education	55.6	40	
2.1.1	Expenditure on education, % GDP Ⓐ	4.6	62	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	23.4	37	
2.1.3	School life expectancy, years Ⓐ	16.6	18	
2.1.4	PISA scales in reading, maths, & science	519.1	7	
2.1.5	Pupil-teacher ratio, secondary Ⓐ	15.6	68	
2.2	Tertiary education	54.8	15	
2.2.1	Tertiary enrolment, % gross Ⓐ	95.3	2	●
2.2.2	Graduates in science & engineering, % Ⓐ	31.9	8	
2.2.3	Tertiary inbound mobility, % Ⓐ	1.7	75	○
2.3	Research & development (R&D)	88.2	1	●
2.3.1	Researchers, FTE/mn pop.	7,087.4	3	●
2.3.2	Gross expenditure on R&D, % GDP	4.2	2	●
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	92.8	5	
2.3.4	QS university ranking, average score top 3*	75.7	9	
3	**Infrastructure**	**63.4**	**13**	
3.1	Information & communication technologies (ICTs)	91.6	2	●
3.1.1	ICT access*	89.9	8	
3.1.2	ICT use*	85.7	3	●
3.1.3	Government's online service*	94.2	5	
3.1.4	E-participation*	96.6	4	●
3.2	General infrastructure	57.6	11	
3.2.1	Electricity output, kWh/cap	10,756.7	11	
3.2.2	Logistics performance*	76.5	24	
3.2.3	Gross capital formation, % GDP	28.9	22	
3.3	Ecological sustainability	40.9	79	
3.3.1	GDP/unit of energy use	6.3	91	○
3.3.2	Environmental performance*	70.6	73	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.9	37	
4	**Market sophistication**	**61.6**	**14**	
4.1	Credit	60.6	13	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	140.6	11	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	47.6	32	
4.2.1	Ease of protecting minority investors*	73.3	13	
4.2.2	Market capitalization, % GDP	89.4	12	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	53	
4.3	Trade, competition, & market scale	76.5	18	
4.3.1	Applied tariff rate, weighted mean, %	4.8	88	○
4.3.2	Intensity of local competition†	81.9	7	
4.3.3	Domestic market scale, bn PPP$	1,928.6	13	
5	**Business sophistication**	**51.1**	**17**	
5.1	Knowledge workers	61.3	22	
5.1.1	Knowledge-intensive employment, %	21.4	68	○
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	3.3	2	●
5.1.4	GERD financed by business, %	74.5	3	●
5.1.5	Females employed w/advanced degrees, % total	16.2	35	
5.2	Innovation linkages	41.0	28	
5.2.1	University/industry research collaboration†	56.0	28	
5.2.2	State of cluster development†	58.6	27	
5.2.3	GERD financed by abroad, %	0.8	89	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	43	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	16.3	1	●
5.3	Knowledge absorption	50.9	12	
5.3.1	Intellectual property payments, % total trade	1.7	17	
5.3.2	High-tech imports less re-imports, % total trade	15.2	14	
5.3.3	ICT services imports, % total trade	0.5	100	○
5.3.4	FDI net inflows, % GDP	0.7	111	○
5.3.5	Research talent, % in business enterprise	79.7	2	●
6	**Knowledge & technology outputs**	**54.7**	**6**	
6.1	Knowledge creation	80.4	2	●
6.1.1	Patents by origin/bn PPP$ GDP	90.3	1	●
6.1.2	PCT patent applications/bn PPP$ GDP	8.1	1	●
6.1.3	Utility models by origin/bn PPP$ GDP	4.5	1	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	29.2	25	
6.1.5	Citable documents H index	41.8	19	
6.2	Knowledge impact	38.8	38	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.3	48	
6.2.2	New businesses/th pop. 15–64	2.3	45	
6.2.3	Computer software spending, % GDP	0.3	50	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.5	55	
6.2.5	High- & medium-high-tech manufactures, %	0.5	8	
6.3	Knowledge diffusion	45.0	13	
6.3.1	Intellectual property receipts, % total trade	1.0	14	
6.3.2	High-tech exports less re-exports, % total trade	24.8	5	
6.3.3	ICT services exports, % total trade	0.6	94	○
6.3.4	FDI net outflows, % GDP	2.1	30	
7	**Creative outputs**	**49.4**	**15**	
7.1	Intangible assets	70.4	3	●
7.1.1	Trademarks by origin/bn PPP$ GDP	103.3	14	
7.1.2	Industrial designs by origin/bn PPP$ GDP	35.6	1	●
7.1.3	ICTs & business model creation†	76.7	18	
7.1.4	ICTs & organizational model creation†	66.8	26	
7.2	Creative goods & services	28.0	35	
7.2.1	Cultural & creative services exports, % of total trade Ⓐ	0.3	42	
7.2.2	National feature films/mn pop. 15–69	6.9	24	
7.2.3	Global ent. & media market/th pop. 15–69	47.1	19	
7.2.4	Printing & publishing manufactures, %	0.3	97	○
7.2.5	Creative goods exports, % total trade	3.1	16	
7.3	Online creativity	28.8	40	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	8.2	43	
7.3.2	Country-code TLDs/th pop. 15–69	8.0	42	
7.3.3	Wikipedia edits/mn pop. 15–69	5.6	50	
7.3.4	Video uploads on YouTube/pop. 15–69	45.4	21	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
Ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Kuwait

Key indicators

Population (millions)	4.0
GDP (US$ billions)	110.5
GDP per capita, PPP$	70,166.0
Income group	High income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)		**36.1**	**56**	
Innovation Output Sub-Index		31.9	45	
Innovation Input Sub-Index		40.3	80	
Innovation Efficiency Ratio		0.8	18	●
Global Innovation Index 2016 (out of 128)		33.6	67	

1	**Institutions**	**55.8**	**76**	
1.1	Political environment	51.4	66	
1.1.1	Political stability & safety*	61.2	71	
1.1.2	Government effectiveness*	41.5	71	
1.2	Regulatory environment	49.7	100	
1.2.1	Regulatory quality*	38.1	77	
1.2.2	Rule of law*	40.4	58	
1.2.3	Cost of redundancy dismissal, salary weeks	28.1	113	○
1.3	Business environment	66.3	74	
1.3.1	Ease of starting a business*	66.8	121	○
1.3.2	Ease of resolving insolvency*	39.6	96	
1.3.3	Ease of paying taxes*	92.5	6	●
2	**Human capital & research**	**31.3**	**68**	
2.1	Education	48.0	61	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	17.6	65	
2.1.3	School life expectancy, years ⓓ	13.2	68	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	7.2	3	●
2.2	Tertiary education	42.6	41	
2.2.1	Tertiary enrolment, % gross ⓓ	27.0	86	
2.2.2	Graduates in science & engineering, %	26.7	21	●
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	3.4	86	
2.3.1	Researchers, FTE/mn pop. ⓓ	128.4	83	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.3	80	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	5.3	70	
3	**Infrastructure**	**51.4**	**49**	
3.1	Information & communication technologies (ICTs)	66.3	45	
3.1.1	ICT access*	74.0	39	
3.1.2	ICT use*	61.5	36	●
3.1.3	Government's online service*	65.2	53	
3.1.4	E-participation*	64.4	54	
3.2	General infrastructure	50.9	23	●
3.2.1	Electricity output, kWh/cap	17,370.7	6	●
3.2.2	Logistics performance*	50.3	52	
3.2.3	Gross capital formation, % GDP	23.5	52	
3.3	Ecological sustainability	36.9	92	
3.3.1	GDP/unit of energy use	7.6	76	
3.3.2	Environmental performance*	64.4	95	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	93	
4	**Market sophistication**	**47.8**	**58**	
4.1	Credit	39.6	51	
4.1.1	Ease of getting credit*	40.0	98	
4.1.2	Domestic credit to private sector, % GDP	98.6	27	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	37.0	79	
4.2.1	Ease of protecting minority investors*	55.0	75	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP ⓓ	0.0	87	○
4.3	Trade, competition, & market scale	66.8	47	
4.3.1	Applied tariff rate, weighted mean, %	3.0	68	
4.3.2	Intensity of local competition†	70.2	58	
4.3.3	Domestic market scale, bn PPP$	301.1	50	
5	**Business sophistication**	**15.2**	**127**	○
5.1	Knowledge workers	1.7	[126]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⓓ	1.4	86	○
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	19.6	110	
5.2.1	University/industry research collaboration†	27.3	113	○
5.2.2	State of cluster development†	49.1	46	
5.2.3	GERD financed by abroad, % ⓓ	1.2	84	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	55	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	102	
5.3	Knowledge absorption	24.4	100	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	6.4	92	
5.3.3	ICT services imports, % total trade	0.6	90	
5.3.4	FDI net inflows, % GDP	0.5	117	○
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**29.7**	**41**	
6.1	Knowledge creation	3.5	106	
6.1.1	Patents by origin/bn PPP$ GDP	0.0	123	○
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.6	115	○
6.1.5	Citable documents H index	7.4	80	
6.2	Knowledge impact	24.2	92	
6.2.1	Growth rate of PPP$ GDP/worker, %	(1.3)	100	○
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.4	21	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.2	104	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	69	
6.3	Knowledge diffusion	61.6	6	●
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.3	96	
6.3.3	ICT services exports, % total trade	4.9	12	●
6.3.4	FDI net outflows, % GDP	7.5	1	●
7	**Creative outputs**	**34.1**	**55**	
7.1	Intangible assets	50.2	37	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	53.4	89	
7.1.4	ICTs & organizational model creation†	47.0	85	
7.2	Creative goods & services	10.0	90	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	10.7	35	
7.2.4	Printing & publishing manufactures, % ⓓ	0.6	84	
7.2.5	Creative goods exports, % total trade	0.4	62	
7.3	Online creativity	25.9	46	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	8.1	44	
7.3.2	Country-code TLDs/th pop. 15–69	0.4	93	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	5.1	58	
7.3.4	Video uploads on YouTube/pop. 15–69	45.8	20	●

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Kyrgyzstan

Key indicators

Population (millions)	6.0
GDP (US$ billions)	5.8
GDP per capita, PPP$	3,362.6
Income group	Lower-middle income
Region	Central and Southern Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**28.0**	**95**	
	Innovation Output Sub-Index	17.9	104	
	Innovation Input Sub-Index	38.2	86	
	Innovation Efficiency Ratio	0.5	114	
	Global Innovation Index 2016 (out of 128)	26.6	103	
1	**Institutions**	**47.6**	**102**	
1.1	Political environment	30.8	116	
1.1.1	Political stability & safety*	42.7	103	
1.1.2	Government effectiveness*	19.0	117	
1.2	Regulatory environment	50.9	95	
1.2.1	Regulatory quality*	30.2	97	
1.2.2	Rule of law*	10.3	119	○
1.2.3	Cost of redundancy dismissal, salary weeks	17.3	71	
1.3	Business environment	61.2	92	
1.3.1	Ease of starting a business*	93.0	27	●
1.3.2	Ease of resolving insolvency*	34.1	108	
1.3.3	Ease of paying taxes*	56.4	102	
2	**Human capital & research**	**30.6**	**74**	
2.1	Education	58.0	32	●
2.1.1	Expenditure on education, % GDP	5.5	31	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	13.1	72	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary◷	12.4	45	
2.2	Tertiary education	32.8	73	
2.2.1	Tertiary enrolment, % gross◷	45.9	58	
2.2.2	Graduates in science & engineering, %	18.3	67	
2.2.3	Tertiary inbound mobility, %◷	4.5	41	
2.3	Research & development (R&D)	0.8	106	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.1	100	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**38.2**	**94**	
3.1	Information & communication technologies (ICTs)	41.8	92	
3.1.1	ICT access*	42.5	97	
3.1.2	ICT use*	22.5	95	
3.1.3	Government's online service*	42.8	96	
3.1.4	E-participation*	59.3	65	
3.2	General infrastructure	37.2	64	
3.2.1	Electricity output, kWh/cap	2,499.5	71	
3.2.2	Logistics performance*	4.3	123	○
3.2.3	Gross capital formation, % GDP	33.4	11	●
3.3	Ecological sustainability	35.7	100	
3.3.1	GDP/unit of energy use	4.8	106	
3.3.2	Environmental performance*	73.1	65	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP◷	0.1	122	○
4	**Market sophistication**	**46.9**	**61**	
4.1	Credit	50.7	27	●
4.1.1	Ease of getting credit*	70.0	29	●
4.1.2	Domestic credit to private sector, % GDP	23.0	107	
4.1.3	Microfinance gross loans, % GDP	4.2	11	●
4.2	Investment	42.6	52	
4.2.1	Ease of protecting minority investors*	63.3	41	
4.2.2	Market capitalization, % GDP◷	2.5	84	○
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	47.4	109	
4.3.1	Applied tariff rate, weighted mean, %	2.7	62	
4.3.2	Intensity of local competition†	52.5	121	○
4.3.3	Domestic market scale, bn PPP$	21.0	119	○
5	**Business sophistication**	**27.5**	**89**	
5.1	Knowledge workers	36.3	70	
5.1.1	Knowledge-intensive employment, %	18.3	78	
5.1.2	Firms offering formal training, % firms	62.7	6	●
5.1.3	GERD performed by business, % of GDP	0.0	79	
5.1.4	GERD financed by business, %	2.2	83	
5.1.5	Females employed w/advanced degrees, % total◷	10.8	61	
5.2	Innovation linkages	17.5	118	
5.2.1	University/industry research collaboration†	28.5	109	
5.2.2	State of cluster development†	32.7	112	
5.2.3	GERD financed by abroad, %	1.0	87	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	19	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	80	
5.3	Knowledge absorption	28.7	84	
5.3.1	Intellectual property payments, % total trade◷	0.1	95	
5.3.2	High-tech imports less re-imports, % total trade	6.5	85	
5.3.3	ICT services imports, % total trade	0.6	91	
5.3.4	FDI net inflows, % GDP	10.3	8	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**18.3**	**87**	
6.1	Knowledge creation	12.2	58	
6.1.1	Patents by origin/bn PPP$ GDP	6.4	19	●
6.1.2	PCT patent applications/bn PPP$ GDP◷	0.0	79	
6.1.3	Utility models by origin/bn PPP$ GDP	0.7	32	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.6	95	
6.1.5	Citable documents H index	1.5	122	○
6.2	Knowledge impact	23.9	94	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.6	29	●
6.2.2	New businesses/th pop. 15–64	1.1	67	
6.2.3	Computer software spending, % GDP	0.1	90	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.0	126	○
6.2.5	High- & medium-high-tech manufactures, %◷	0.0	95	
6.3	Knowledge diffusion	18.7	92	
6.3.1	Intellectual property receipts, % total trade◷	0.0	77	
6.3.2	High-tech exports less re-exports, % total trade	1.2	67	
6.3.3	ICT services exports, % total trade	0.7	93	
6.3.4	FDI net outflows, % GDP	1.2	44	
7	**Creative outputs**	**17.4**	**111**	
7.1	Intangible assets	25.7	121	○
7.1.1	Trademarks by origin/bn PPP$ GDP	16.8	89	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.0	60	
7.1.3	ICTs & business model creation†	41.1	118	○
7.1.4	ICTs & organizational model creation†	38.0	111	
7.2	Creative goods & services	4.3	112	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69◷	0.5	91	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %◷	0.7	83	
7.2.5	Creative goods exports, % total trade	0.1	98	
7.3	Online creativity	14.0	82	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	114	
7.3.2	Country-code TLDs/th pop. 15–69	0.4	92	
7.3.3	Wikipedia edits/mn pop. 15–69◷	4.3	73	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Latvia

Key indicators

Population (millions)	2.0
GDP (US$ billions)	27.9
GDP per capita, PPP$	24,712.2
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**44.6**	**33**
Innovation Output Sub-Index	38.0	33
Innovation Input Sub-Index	51.3	35
Innovation Efficiency Ratio	0.7	26
Global Innovation Index 2016 (out of 128)	44.3	34

		Score	Rank	
1	**Institutions**	**77.8**	**28**	
1.1	Political environment	72.6	35	
1.1.1	Political stability & safety*	74.8	42	
1.1.2	Government effectiveness*	70.4	27	
1.2	Regulatory environment	78.1	29	
1.2.1	Regulatory quality*	69.9	30	
1.2.2	Rule of law*	62.4	36	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	47	
1.3	Business environment	82.6	26	
1.3.1	Ease of starting a business*	94.2	20	
1.3.2	Ease of resolving insolvency*	64.0	41	
1.3.3	Ease of paying taxes*	89.8	14	●
2	**Human capital & research**	**35.2**	**52**	
2.1	Education	57.2	35	
2.1.1	Expenditure on education, % GDP	4.9	57	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	25.5	28	
2.1.3	School life expectancy, years	16.1	29	
2.1.4	PISA scales in reading, maths, & science	486.8	30	
2.1.5	Pupil-teacher ratio, secondary ⓓ	8.2	10	●
2.2	Tertiary education	37.7	56	
2.2.1	Tertiary enrolment, % gross ⓓ	67.0	32	
2.2.2	Graduates in science & engineering, %	17.9	68	○
2.2.3	Tertiary inbound mobility, % ⓓ	5.0	36	
2.3	Research & development (R&D)	10.6	57	
2.3.1	Researchers, FTE/mn pop.	1,833.5	41	
2.3.2	Gross expenditure on R&D, % GDP	0.6	53	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	6.1	67	
3	**Infrastructure**	**53.1**	**42**	
3.1	Information & communication technologies (ICTs)	62.5	55	
3.1.1	ICT access*	73.8	40	
3.1.2	ICT use*	62.7	33	
3.1.3	Government's online service*	60.9	62	
3.1.4	E-participation*	52.5	82	○
3.2	General infrastructure	37.5	63	
3.2.1	Electricity output, kWh/cap	2,583.4	67	
3.2.2	Logistics performance*	58.4	42	
3.2.3	Gross capital formation, % GDP	21.6	70	
3.3	Ecological sustainability	59.2	19	
3.3.1	GDP/unit of energy use	9.8	53	
3.3.2	Environmental performance*	85.7	22	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	7.9	12	●
4	**Market sophistication**	**52.1**	**38**	
4.1	Credit	51.9	25	
4.1.1	Ease of getting credit*	85.0	7	●
4.1.2	Domestic credit to private sector, % GDP	48.8	73	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	44.2	42	
4.2.1	Ease of protecting minority investors*	63.3	41	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	52	
4.3	Trade, competition, & market scale	60.1	69	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	73.7	34	
4.3.3	Domestic market scale, bn PPP$	50.9	93	○
5	**Business sophistication**	**38.2**	**39**	
5.1	Knowledge workers	43.0	46	
5.1.1	Knowledge-intensive employment, %	41.2	22	
5.1.2	Firms offering formal training, % firms	25.2	64	○
5.1.3	GERD performed by business, % of GDP	0.2	56	
5.1.4	GERD financed by business, %	20.1	63	○
5.1.5	Females employed w/advanced degrees, % total	23.6	12	
5.2	Innovation linkages	40.6	29	
5.2.1	University/industry research collaboration†	39.2	74	
5.2.2	State of cluster development†	41.2	82	○
5.2.3	GERD financed by abroad, %	45.0	7	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	68	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.5	36	
5.3	Knowledge absorption	30.9	76	
5.3.1	Intellectual property payments, % total trade	0.2	83	○
5.3.2	High-tech imports less re-imports, % total trade	10.9	34	
5.3.3	ICT services imports, % total trade	1.3	53	
5.3.4	FDI net inflows, % GDP	3.2	51	
5.3.5	Research talent, % in business enterprise	16.7	59	○
6	**Knowledge & technology outputs**	**26.5**	**48**	
6.1	Knowledge creation	13.0	56	
6.1.1	Patents by origin/bn PPP$ GDP	3.4	31	
6.1.2	PCT patent applications/bn PPP$ GDP	0.5	38	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	14.9	52	
6.1.5	Citable documents H index	7.8	77	
6.2	Knowledge impact	39.2	37	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.4	44	
6.2.2	New businesses/th pop. 15–64	10.6	10	●
6.2.3	Computer software spending, % GDP	0.1	87	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	22.8	15	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.2	65	
6.3	Knowledge diffusion	27.3	46	
6.3.1	Intellectual property receipts, % total trade	0.0	70	
6.3.2	High-tech exports less re-exports, % total trade	8.0	24	
6.3.3	ICT services exports, % total trade	2.5	44	
6.3.4	FDI net outflows, % GDP	1.3	41	
7	**Creative outputs**	**49.4**	**14**	●
7.1	Intangible assets	47.0	49	
7.1.1	Trademarks by origin/bn PPP$ GDP	72.8	24	
7.1.2	Industrial designs by origin/bn PPP$ GDP	3.9	31	
7.1.3	ICTs & business model creation†	60.5	63	
7.1.4	ICTs & organizational model creation†	56.6	50	
7.2	Creative goods & services	53.4	2	●
7.2.1	Cultural & creative services exports, % of total trade ⓓ	1.2	9	●
7.2.2	National feature films/mn pop. 15–69	12.2	11	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	3.0	8	●
7.2.5	Creative goods exports, % total trade	4.2	12	●
7.3	Online creativity	50.2	17	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	9.4	40	
7.3.2	Country-code TLDs/th pop. 15–69	43.0	16	
7.3.3	Wikipedia edits/mn pop. 15–69	6.9	14	●
7.3.4	Video uploads on YouTube/pop. 15–69	81.8	2	●

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Lebanon

Key indicators

Population (millions)	6.0
GDP (US$ billions)	51.8
GDP per capita, PPP$	18,239.8
Income group	Upper-middle income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**30.6**	**81**	
	Innovation Output Sub-Index	23.3	78	
	Innovation Input Sub-Index	38.0	87	
	Innovation Efficiency Ratio	0.6	69	
	Global Innovation Index 2016 (out of 128)	32.7	70	
1	**Institutions**	**47.9**	**100**	
1.1	Political environment	26.1	121	○
1.1.1	Political stability & safety*	22.1	122	○
1.1.2	Government effectiveness*	30.1	92	
1.2	Regulatory environment	55.8	83	
1.2.1	Regulatory quality*	35.0	88	
1.2.2	Rule of law*	16.4	106	
1.2.3	Cost of redundancy dismissal, salary weeks	15.1	60	
1.3	Business environment	61.9	88	
1.3.1	Ease of starting a business*	78.5	104	
1.3.2	Ease of resolving insolvency*	30.0	116	○
1.3.3	Ease of paying taxes*	77.2	57	
2	**Human capital & research**	**29.0**	**78**	
2.1	Education	28.8	111	○
2.1.1	Expenditure on education, % GDP	2.6	109	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	6.0	103	○
2.1.3	School life expectancy, years	11.1	93	
2.1.4	PISA scales in reading, maths, & science	376.4	66	○
2.1.5	Pupil-teacher ratio, secondary	7.7	5	●
2.2	Tertiary education	43.7	37	
2.2.1	Tertiary enrolment, % gross	38.5	68	
2.2.2	Graduates in science & engineering, %	23.3	35	
2.2.3	Tertiary inbound mobility, %	9.9	19	●
2.3	Research & development (R&D)	14.6	49	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	29.3	39	
3	**Infrastructure**	**40.0**	**88**	
3.1	Information & communication technologies (ICTs)	55.4	70	
3.1.1	ICT access*	65.7	62	
3.1.2	ICT use*	55.1	48	
3.1.3	Government's online service*	51.4	81	
3.1.4	E-participation*	49.2	89	
3.2	General infrastructure	22.2	115	○
3.2.1	Electricity output, kWh/cap	3,945.5	54	
3.2.2	Logistics performance*	30.3	81	
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	Ecological sustainability	42.6	76	
3.3.1	GDP/unit of energy use	9.9	52	
3.3.2	Environmental performance*	69.1	83	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	86	
4	**Market sophistication**	**39.4**	**96**	
4.1	Credit	28.0	86	
4.1.1	Ease of getting credit*	40.0	98	
4.1.2	Domestic credit to private sector, % GDP	106.6	25	●
4.1.3	Microfinance gross loans, % GDP	0.1	57	
4.2	Investment	28.9	118	○
4.2.1	Ease of protecting minority investors*	40.0	111	○
4.2.2	Market capitalization, % GDP	22.6	59	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	23	●
4.3	Trade, competition, & market scale	61.3	63	
4.3.1	Applied tariff rate, weighted mean, %	2.8	63	
4.3.2	Intensity of local competition†	73.9	32	●
4.3.3	Domestic market scale, bn PPP$	85.2	78	
5	**Business sophistication**	**33.5**	**61**	
5.1	Knowledge workers	43.0	[47]	
5.1.1	Knowledge-intensive employment, %	31.8	45	
5.1.2	Firms offering formal training, % firms	26.6	58	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	28.7	60	
5.2.1	University/industry research collaboration†	43.9	48	
5.2.2	State of cluster development†	47.2	53	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	75	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	81	
5.3	Knowledge absorption	28.8	83	
5.3.1	Intellectual property payments, % total trade	0.1	89	
5.3.2	High-tech imports less re-imports, % total trade	3.8	116	○
5.3.3	ICT services imports, % total trade	1.8	28	●
5.3.4	FDI net inflows, % GDP	5.8	23	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**19.1**	**82**	
6.1	Knowledge creation	12.9	57	
6.1.1	Patents by origin/bn PPP$ GDP	1.3	58	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	15.7	48	
6.1.5	Citable documents H index	10.2	60	
6.2	Knowledge impact	15.9	110	○
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	104	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.6	47	
6.2.5	High- & medium-high-tech manufactures, %	0.2	54	
6.3	Knowledge diffusion	28.4	44	
6.3.1	Intellectual property receipts, % total trade	0.1	59	
6.3.2	High-tech exports less re-exports, % total trade	0.2	100	
6.3.3	ICT services exports, % total trade	2.8	36	●
6.3.4	FDI net outflows, % GDP	2.8	23	●
7	**Creative outputs**	**27.5**	**81**	
7.1	Intangible assets	32.4	98	
7.1.1	Trademarks by origin/bn PPP$ GDP	15.1	93	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	48.5	109	○
7.1.4	ICTs & organizational model creation†	41.4	105	○
7.2	Creative goods & services	28.8	32	●
7.2.1	Cultural & creative services exports, % of total trade	0.2	44	
7.2.2	National feature films/mn pop. 15–69	3.6	52	
7.2.3	Global ent. & media market/th pop. 15–69	3.0	49	
7.2.4	Printing & publishing manufactures, %	4.2	3	●
7.2.5	Creative goods exports, % total trade	0.8	47	
7.3	Online creativity	16.4	76	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	6.9	48	
7.3.2	Country-code TLDs/th pop. 15–69	0.3	99	
7.3.3	Wikipedia edits/mn pop. 15–69	4.3	72	
7.3.4	Video uploads on YouTube/pop. 15–69	16.9	60	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Lithuania

Key indicators

Population (millions)	2.9
GDP (US$ billions)	42.8
GDP per capita, PPP$	28,359.1
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**41.2**	**40**
Innovation Output Sub-Index	30.4	49
Innovation Input Sub-Index	51.9	34
Innovation Efficiency Ratio	0.6	84
Global Innovation Index 2016 (out of 128)	41.8	36

		Score	Rank	
1	**Institutions**	**74.1**	**36**	
1.1	Political environment	76.9	27	
1.1.1	Political stability & safety*	80.8	32	
1.1.2	Government effectiveness*	73.0	25	
1.2	Regulatory environment	69.4	46	
1.2.1	Regulatory quality*	74.9	20	●
1.2.2	Rule of law*	68.2	29	
1.2.3	Cost of redundancy dismissal, salary weeks	24.6	100	○
1.3	Business environment	75.9	42	
1.3.1	Ease of starting a business*	93.0	26	
1.3.2	Ease of resolving insolvency*	49.2	61	
1.3.3	Ease of paying taxes*	85.4	25	
2	**Human capital & research**	**37.5**	**46**	
2.1	Education	53.7	47	
2.1.1	Expenditure on education, % GDP	4.6	63	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	17.8	64	
2.1.3	School life expectancy, years	16.5	21	●
2.1.4	PISA scales in reading, maths, & science	475.4	35	
2.1.5	Pupil-teacher ratio, secondary ⓓ	8.1	8	●
2.2	Tertiary education	39.4	50	
2.2.1	Tertiary enrolment, % gross ⓓ	68.5	29	
2.2.2	Graduates in science & engineering, %	22.2	43	
2.2.3	Tertiary inbound mobility, % ⓓ	2.5	64	
2.3	Research & development (R&D)	19.5	45	
2.3.1	Researchers, FTE/mn pop.	2,822.4	30	
2.3.2	Gross expenditure on R&D, % GDP	1.0	35	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	20.1	50	
3	**Infrastructure**	**57.2**	**31**	
3.1	Information & communication technologies (ICTs)	75.1	27	
3.1.1	ICT access*	70.8	49	
3.1.2	ICT use*	64.0	29	
3.1.3	Government's online service*	82.6	22	●
3.1.4	E-participation*	83.1	17	●
3.2	General infrastructure	35.4	73	
3.2.1	Electricity output, kWh/cap	1,265.5	90	○
3.2.2	Logistics performance*	72.5	28	
3.2.3	Gross capital formation, % GDP	17.7	100	○
3.3	Ecological sustainability	61.2	16	●
3.3.1	GDP/unit of energy use	10.4	43	
3.3.2	Environmental performance*	85.5	23	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	8.7	10	●
4	**Market sophistication**	**53.0**	**32**	
4.1	Credit	43.0	44	
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	41.8	80	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	52.7	27	
4.2.1	Ease of protecting minority investors*	61.7	50	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP ⓓ	0.1	18	
4.3	Trade, competition, & market scale	63.5	55	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	75.2	26	
4.3.3	Domestic market scale, bn PPP$	85.8	77	
5	**Business sophistication**	**37.8**	**41**	
5.1	Knowledge workers	53.1	31	
5.1.1	Knowledge-intensive employment, %	41.8	20	
5.1.2	Firms offering formal training, % firms	42.0	30	
5.1.3	GERD performed by business, % of GDP	0.3	47	
5.1.4	GERD financed by business, %	28.0	54	
5.1.5	Females employed w/advanced degrees, % total	27.2	5	●
5.2	Innovation linkages	35.9	42	
5.2.1	University/industry research collaboration†	51.9	33	
5.2.2	State of cluster development†	39.0	88	○
5.2.3	GERD financed by abroad, %	34.6	13	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	99	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.4	42	
5.3	Knowledge absorption	24.2	103	○
5.3.1	Intellectual property payments, % total trade	0.2	88	○
5.3.2	High-tech imports less re-imports, % total trade	6.7	82	
5.3.3	ICT services imports, % total trade	0.6	88	○
5.3.4	FDI net inflows, % GDP	1.6	92	○
5.3.5	Research talent, % in business enterprise	22.7	52	
6	**Knowledge & technology outputs**	**21.3**	**66**	
6.1	Knowledge creation	14.6	54	
6.1.1	Patents by origin/bn PPP$ GDP	1.7	51	
6.1.2	PCT patent applications/bn PPP$ GDP	0.3	46	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	24.8	33	
6.1.5	Citable documents H index	10.7	57	
6.2	Knowledge impact	28.1	78	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.3	76	
6.2.2	New businesses/th pop. 15–64	4.2	30	
6.2.3	Computer software spending, % GDP	0.1	96	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	15.0	23	●
6.2.5	High- & medium-high-tech manufactures, %	0.2	61	
6.3	Knowledge diffusion	21.1	66	
6.3.1	Intellectual property receipts, % total trade	0.1	62	
6.3.2	High-tech exports less re-exports, % total trade	6.1	28	
6.3.3	ICT services exports, % total trade	0.8	88	○
6.3.4	FDI net outflows, % GDP	0.8	58	
7	**Creative outputs**	**39.6**	**38**	
7.1	Intangible assets	48.8	43	
7.1.1	Trademarks by origin/bn PPP$ GDP	50.6	48	
7.1.2	Industrial designs by origin/bn PPP$ GDP	2.0	45	
7.1.3	ICTs & business model creation†	70.9	30	
7.1.4	ICTs & organizational model creation†	68.9	24	
7.2	Creative goods & services	25.4	45	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.4	29	
7.2.2	National feature films/mn pop. 15–69	4.4	46	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	1.1	60	
7.2.5	Creative goods exports, % total trade	2.1	23	
7.3	Online creativity	35.4	32	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	13.8	33	
7.3.2	Country-code TLDs/th pop. 15–69	26.6	23	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.4	30	
7.3.4	Video uploads on YouTube/pop. 15–69	39.5	31	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Luxembourg

Key indicators

Population (millions)	0.6
GDP (US$ billions)	61.0
GDP per capita, PPP$	98,987.2
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**56.4**	**12**	
	Innovation Output Sub-Index	55.4	4	●
	Innovation Input Sub-Index	57.4	24	
	Innovation Efficiency Ratio	1.0	1	●
	Global Innovation Index 2016 (out of 128)	57.1	12	
1	**Institutions**	**82.6**	**19**	
1.1	Political environment	92.2	4	●
1.1.1	Political stability & safety*	98.0	2	●
1.1.2	Government effectiveness*	86.5	14	
1.2	Regulatory environment	81.2	23	
1.2.1	Regulatory quality*	84.9	13	
1.2.2	Rule of law*	93.9	9	
1.2.3	Cost of redundancy dismissal, salary weeks	21.7	92	○
1.3	Business environment	74.3	54	
1.3.1	Ease of starting a business*	88.7	55	
1.3.2	Ease of resolving insolvency*	45.4	74	
1.3.3	Ease of paying taxes*	88.9	15	
2	**Human capital & research**	**42.9**	**33**	
2.1	Education	48.5	59	
2.1.1	Expenditure on education, % GDP ⓐ	4.1	76	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	19.4	55	
2.1.3	School life expectancy, years ⓐ	13.9	64	
2.1.4	PISA scales in reading, maths, & science	483.3	32	
2.1.5	Pupil-teacher ratio, secondary ⓐ	9.1	16	
2.2	Tertiary education	43.9	36	
2.2.1	Tertiary enrolment, % gross ⓐ	19.4	92	○
2.2.2	Graduates in science & engineering, %	16.3	77	○
2.2.3	Tertiary inbound mobility, % ⓐ	40.6	1	●
2.3	Research & development (R&D)	36.2	31	
2.3.1	Researchers, FTE/mn pop.	5,058.3	10	
2.3.2	Gross expenditure on R&D, % GDP	1.3	27	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	53.9	26	
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**60.1**	**24**	
3.1	Information & communication technologies (ICTs)	79.3	21	
3.1.1	ICT access*	95.4	1	●
3.1.2	ICT use*	80.5	10	
3.1.3	Government's online service*	71.7	40	
3.1.4	E-participation*	69.5	43	
3.2	General infrastructure	44.2	41	
3.2.1	Electricity output, kWh/cap	2,289.5	75	
3.2.2	Logistics performance*	99.7	2	●
3.2.3	Gross capital formation, % GDP	18.6	96	○
3.3	Ecological sustainability	56.9	25	
3.3.1	GDP/unit of energy use	13.3	17	
3.3.2	Environmental performance*	86.6	20	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.9	49	
4	**Market sophistication**	**43.4**	**78**	
4.1	Credit	26.4	94	○
4.1.1	Ease of getting credit*	15.0	121	○
4.1.2	Domestic credit to private sector, % GDP	95.4	31	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	43.4	46	
4.2.1	Ease of protecting minority investors*	45.0	98	○
4.2.2	Market capitalization, % GDP	81.6	18	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	13	
4.3	Trade, competition, & market scale	60.5	66	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	71.9	41	
4.3.3	Domestic market scale, bn PPP$	58.7	91	○
5	**Business sophistication**	**57.8**	**7**	
5.1	Knowledge workers	59.9	23	
5.1.1	Knowledge-intensive employment, %	56.8	1	●
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	0.7	29	
5.1.4	GERD financed by business, % ⓐ	16.5	66	
5.1.5	Females employed w/advanced degrees, % total	20.6	21	
5.2	Innovation linkages	64.4	3	●
5.2.1	University/industry research collaboration†	60.8	20	
5.2.2	State of cluster development†	69.7	10	
5.2.3	GERD financed by abroad, % ⓐ	32.3	15	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	8	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	8.4	7	
5.3	Knowledge absorption	49.0	16	
5.3.1	Intellectual property payments, % total trade	2.6	6	
5.3.2	High-tech imports less re-imports, % total trade	2.5	125	○
5.3.3	ICT services imports, % total trade	2.8	9	
5.3.4	FDI net inflows, % GDP	28.7	4	●
5.3.5	Research talent, % in business enterprise	36.0	38	
6	**Knowledge & technology outputs**	**45.0**	**15**	
6.1	Knowledge creation	45.9	15	
6.1.1	Patents by origin/bn PPP$ GDP	9.7	13	
6.1.2	PCT patent applications/bn PPP$ GDP	7.3	5	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	18.7	40	
6.1.5	Citable documents H index	7.9	75	
6.2	Knowledge impact	34.2	50	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.3	34	
6.2.2	New businesses/th pop. 15–64 ⓐ	6.1	20	
6.2.3	Computer software spending, % GDP	0.2	73	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.5	66	
6.2.5	High- & medium-high-tech manufactures, %	0.2	62	
6.3	Knowledge diffusion	54.9	9	
6.3.1	Intellectual property receipts, % total trade	1.0	15	
6.3.2	High-tech exports less re-exports, % total trade	0.7	72	
6.3.3	ICT services exports, % total trade	3.9	20	
6.3.4	FDI net outflows, % GDP	48.4	1	●
7	**Creative outputs**	**65.8**	**1**	●
7.1	Intangible assets	74.8	1	●
7.1.1	Trademarks by origin/bn PPP$ GDP	131.6	5	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	13.8	7	
7.1.3	ICTs & business model creation†	82.7	6	
7.1.4	ICTs & organizational model creation†	74.2	14	
7.2	Creative goods & services	39.9	10	
7.2.1	Cultural & creative services exports, % of total trade ⓐ	5.0	1	●
7.2.2	National feature films/mn pop. 15–69 ⓐ	42.4	1	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	1.2	54	
7.2.5	Creative goods exports, % total trade	0.1	89	○
7.3	Online creativity	74.0	3	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	92.5	4	●
7.3.2	Country-code TLDs/th pop. 15–69	63.9	8	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓐ	6.8	17	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Madagascar

Key indicators

Population (millions)	24.9
GDP (US$ billions)	9.7
GDP per capita, PPP$	1,462.2
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**24.2**	**111**	
Innovation Output Sub-Index	19.5	95	
Innovation Input Sub-Index	28.8	120	
Innovation Efficiency Ratio	0.7	45	●
Global Innovation Index 2016 (out of 128)	24.8	111	

		Score	Rank	
1	**Institutions**	**48.7**	**99**	
1.1	Political environment	31.5	113	
1.1.1	Political stability & safety*	54.1	83	
1.1.2	Government effectiveness*	9.0	126	○
1.2	Regulatory environment	53.9	91	
1.2.1	Regulatory quality*	22.8	109	
1.2.2	Rule of law*	19.1	100	
1.2.3	Cost of redundancy dismissal, salary weeks	14.7	58	●
1.3	Business environment	60.8	96	
1.3.1	Ease of starting a business*	83.5	87	
1.3.2	Ease of resolving insolvency*	34.2	107	
1.3.3	Ease of paying taxes*	64.8	86	
2	**Human capital & research**	**14.8**	**116**	
2.1	Education	22.0	122	
2.1.1	Expenditure on education, % GDP	2.1	112	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	8.4	101	
2.1.3	School life expectancy, years	10.5	100	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	23.1	90	
2.2	Tertiary education	22.3	100	
2.2.1	Tertiary enrolment, % gross ⓓ	4.8	115	
2.2.2	Graduates in science & engineering, %	20.3	54	
2.2.3	Tertiary inbound mobility, % ⓓ	1.8	73	
2.3	Research & development (R&D)	0.1	114	
2.3.1	Researchers, FTE/mn pop. ⓓ	51.0	88	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.0	110	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**20.8**	**125**	○
3.1	Information & communication technologies (ICTs)	17.8	120	
3.1.1	ICT access*	23.9	121	
3.1.2	ICT use*	4.4	122	
3.1.3	Government's online service*	22.5	112	
3.1.4	E-participation*	20.3	113	
3.2	General infrastructure	19.5	119	
3.2.1	Electricity output, kWh/cap	n/a	n/a	
3.2.2	Logistics performance*	4.2	124	○
3.2.3	Gross capital formation, % GDP	15.3	110	
3.3	Ecological sustainability	25.2	120	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	37.1	123	○
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	107	
4	**Market sophistication**	**36.9**	**106**	
4.1	Credit	13.8	122	
4.1.1	Ease of getting credit*	15.0	121	○
4.1.2	Domestic credit to private sector, % GDP	13.3	123	○
4.1.3	Microfinance gross loans, % GDP	1.2	24	●
4.2	Investment	48.3	[31]	
4.2.1	Ease of protecting minority investors*	48.3	92	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	48.5	106	
4.3.1	Applied tariff rate, weighted mean, % ⓓ	6.0	98	
4.3.2	Intensity of local competition†	60.0	101	
4.3.3	Domestic market scale, bn PPP$	37.5	100	
5	**Business sophistication**	**22.7**	**116**	
5.1	Knowledge workers	8.3	125	○
5.1.1	Knowledge-intensive employment, %	3.7	106	○
5.1.2	Firms offering formal training, % firms	12.7	87	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total ⓓ	2.3	83	
5.2	Innovation linkages	21.6	90	
5.2.1	University/industry research collaboration†	40.0	70	
5.2.2	State of cluster development†	35.6	101	
5.2.3	GERD financed by abroad, % ⓓ	10.6	45	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	82	
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.0	88	
5.3	Knowledge absorption	38.2	41	●
5.3.1	Intellectual property payments, % total trade ⓓ	0.5	59	
5.3.2	High-tech imports less re-imports, % total trade	5.9	98	
5.3.3	ICT services imports, % total trade ⓓ	2.9	8	●
5.3.4	FDI net inflows, % GDP	4.6	30	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**13.6**	**113**	
6.1	Knowledge creation	3.2	110	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	108	
6.1.2	PCT patent applications/bn PPP$ GDP ⓓ	0.1	73	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.8	92	
6.1.5	Citable documents H index	4.2	101	
6.2	Knowledge impact	18.7	107	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.1	51	●
6.2.2	New businesses/th pop. 15–64	0.7	81	
6.2.3	Computer software spending, % GDP	0.0	115	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.7	82	
6.2.5	High- & medium-high-tech manufactures, %	0.0	101	○
6.3	Knowledge diffusion	19.0	88	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.5	24	●
6.3.2	High-tech exports less re-exports, % total trade	0.0	119	
6.3.3	ICT services exports, % total trade ⓓ	1.7	62	
6.3.4	FDI net outflows, % GDP	0.1	96	
7	**Creative outputs**	**25.4**	**88**	
7.1	Intangible assets	41.6	66	
7.1.1	Trademarks by origin/bn PPP$ GDP	57.0	38	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	5.8	20	●
7.1.3	ICTs & business model creation†	53.4	88	
7.1.4	ICTs & organizational model creation†	47.6	82	
7.2	Creative goods & services	13.4	77	
7.2.1	Cultural & creative services exports, % of total trade	0.0	73	
7.2.2	National feature films/mn pop. 15–69	2.6	57	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	2.1	21	●
7.2.5	Creative goods exports, % total trade	0.1	87	
7.3	Online creativity	5.2	111	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.1	120	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	118	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	1.6	109	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Malawi

Key indicators

Population (millions)	17.7
GDP (US$ billions)	5.5
GDP per capita, PPP$	1,124.2
Income group	Low income
Region	Sub-Saharan Africa

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**23.5**	**115**	
	Innovation Output Sub-Index	16.2	112	
	Innovation Input Sub-Index	30.8	112	
	Innovation Efficiency Ratio	0.5	98	
	Global Innovation Index 2016 (out of 128)	27.3	98	
1	**Institutions**	**51.3**	**93**	
1.1	Political environment	43.5	85	
1.1.1	Political stability & safety*	62.3	65	●
1.1.2	Government effectiveness*	24.8	108	
1.2	Regulatory environment	54.1	89	
1.2.1	Regulatory quality*	21.2	112	
1.2.2	Rule of law*	29.7	77	
1.2.3	Cost of redundancy dismissal, salary weeks	16.7	69	
1.3	Business environment	56.2	111	
1.3.1	Ease of starting a business*	76.7	111	
1.3.2	Ease of resolving insolvency*	22.3	126	○
1.3.3	Ease of paying taxes*	69.6	76	
2	**Human capital & research**	**12.3**	**122**	
2.1	Education	33.9	101	
2.1.1	Expenditure on education, % GDP	5.6	27	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	25.1	30	●
2.1.3	School life expectancy, years◷	10.7	96	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	40.9	110	○
2.2	Tertiary education	2.9	121	○
2.2.1	Tertiary enrolment, % gross◷	0.8	121	○
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %◷	1.1	79	
2.3	Research & development (R&D)	0.2	113	
2.3.1	Researchers, FTE/mn pop.◷	49.6	89	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**26.2**	**117**	
3.1	Information & communication technologies (ICTs)	19.9	116	
3.1.1	ICT access*	20.3	126	○
3.1.2	ICT use*	8.6	116	
3.1.3	Government's online service*	21.7	113	
3.1.4	E-participation*	28.8	107	
3.2	General infrastructure	25.5	107	
3.2.1	Electricity output, kWh/cap	n/a	n/a	
3.2.2	Logistics performance*◷	34.7	71	
3.2.3	Gross capital formation, % GDP	12.6	120	
3.3	Ecological sustainability	33.3	110	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	49.7	113	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	116	
4	**Market sophistication**	**32.0**	**118**	
4.1	Credit	18.0	117	
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	12.2	124	○
4.1.3	Microfinance gross loans, % GDP	0.3	42	

		Score 0–100 or value (hard data)	Rank	
4.2	Investment	30.7	106	
4.2.1	Ease of protecting minority investors*	43.3	101	
4.2.2	Market capitalization, % GDP◷	12.6	73	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	47.1	112	
4.3.1	Applied tariff rate, weighted mean, %	4.2	83	
4.3.2	Intensity of local competition†	59.7	104	
4.3.3	Domestic market scale, bn PPP$	21.2	118	
5	**Business sophistication**	**32.0**	**[66]**	
5.1	Knowledge workers	38.9	[57]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	32.9	42	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	30.3	[56]	
5.2.1	University/industry research collaboration†	28.5	110	
5.2.2	State of cluster development†	31.2	118	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	Knowledge absorption	26.7	92	
5.3.1	Intellectual property payments, % total trade◷	0.1	92	
5.3.2	High-tech imports less re-imports, % total trade	8.6	57	●
5.3.3	ICT services imports, % total trade◷	1.2	59	●
5.3.4	FDI net inflows, % GDP	8.7	15	●
5.3.5	Research talent, % in business enterprise◷	1.7	76	
6	**Knowledge & technology outputs**	**15.8**	**98**	
6.1	Knowledge creation	9.4	68	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	87	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	82	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	20.7	37	●
6.1.5	Citable documents H index	7.0	82	
6.2	Knowledge impact	21.3	102	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.8	40	●
6.2.2	New businesses/th pop. 15–64◷	0.1	102	○
6.2.3	Computer software spending, % GDP	0.1	102	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.8	111	
6.2.5	High- & medium-high-tech manufactures, %◷	0.1	86	
6.3	Knowledge diffusion	16.6	104	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.2	99	
6.3.3	ICT services exports, % total trade◷	0.9	87	
6.3.4	FDI net outflows, % GDP	(0.1)	116	
7	**Creative outputs**	**16.5**	**118**	
7.1	Intangible assets	26.7	116	
7.1.1	Trademarks by origin/bn PPP$ GDP	21.0	82	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	39.4	120	○
7.1.4	ICTs & organizational model creation†	30.5	119	
7.2	Creative goods & services	11.7	83	
7.2.1	Cultural & creative services exports, % of total trade	0.0	68	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %◷	1.7	30	●
7.2.5	Creative goods exports, % total trade	0.1	92	
7.3	Online creativity	0.9	124	○
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	115	
7.3.2	Country-code TLDs/th pop. 15–69	0.3	96	
7.3.3	Wikipedia edits/mn pop. 15–69◷	0.2	124	○
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Malaysia

Key indicators

Population (millions)	30.8
GDP (US$ billions)	302.7
GDP per capita, PPP$	26,314.8
Income group	Upper-middle income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**42.7**	**37**
Innovation Output Sub-Index	34.5	39
Innovation Input Sub-Index	50.9	36
Innovation Efficiency Ratio	0.7	46
Global Innovation Index 2016 (out of 128)	43.4	35

		Score/Value	Rank	
1	**Institutions**	**67.0**	**53**	
1.1	Political environment	67.7	41	
1.1.1	Political stability & safety*	68.5	52	
1.1.2	Government effectiveness*	66.9	37	
1.2	Regulatory environment	58.3	75	
1.2.1	Regulatory quality*	61.9	40	
1.2.2	Rule of law*	56.2	40	
1.2.3	Cost of redundancy dismissal, salary weeks	29.4	115	○
1.3	Business environment	75.1	50	
1.3.1	Ease of starting a business*	83.7	86	
1.3.2	Ease of resolving insolvency*	62.5	43	
1.3.3	Ease of paying taxes*	79.2	52	
2	**Human capital & research**	**41.9**	**35**	
2.1	Education	43.9	77	
2.1.1	Expenditure on education, % GDP	5.0	49	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	18.4	58	
2.1.3	School life expectancy, years	12.9	74	
2.1.4	PISA scales in reading, maths, & science ◷	412.7	58	○
2.1.5	Pupil-teacher ratio, secondary	12.0	40	
2.2	Tertiary education	48.4	24	
2.2.1	Tertiary enrolment, % gross	26.1	87	○
2.2.2	Graduates in science & engineering, %	33.3	7	●
2.2.3	Tertiary inbound mobility, %	7.4	26	
2.3	Research & development (R&D)	33.3	35	
2.3.1	Researchers, FTE/mn pop. ◷	2,017.4	37	
2.3.2	Gross expenditure on R&D, % GDP ◷	1.3	29	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	35.5	42	
2.3.4	QS university ranking, average score top 3*	44.4	29	
3	**Infrastructure**	**52.4**	**45**	
3.1	Information & communication technologies (ICTs)	66.4	44	
3.1.1	ICT access*	67.5	59	
3.1.2	ICT use*	58.6	41	
3.1.3	Government's online service*	71.7	40	
3.1.4	E-participation*	67.8	47	
3.2	General infrastructure	45.9	37	
3.2.1	Electricity output, kWh/cap	4,932.1	42	
3.2.2	Logistics performance*	63.0	31	
3.2.3	Gross capital formation, % GDP	26.1	35	
3.3	Ecological sustainability	45.0	62	
3.3.1	GDP/unit of energy use	8.0	71	
3.3.2	Environmental performance*	74.2	59	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.9	35	
4	**Market sophistication**	**57.6**	**20**	
4.1	Credit	42.4	46	
4.1.1	Ease of getting credit*	75.0	19	
4.1.2	Domestic credit to private sector, % GDP	125.2	17	●
4.1.3	Microfinance gross loans, % GDP ◷	0.1	54	
4.2	Investment	55.1	22	
4.2.1	Ease of protecting minority investors*	80.0	3	●
4.2.2	Market capitalization, % GDP	129.3	6	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	55	
4.3	Trade, competition, & market scale	75.3	21	
4.3.1	Applied tariff rate, weighted mean, % ◷	1.3	17	●
4.3.2	Intensity of local competition†	73.1	39	
4.3.3	Domestic market scale, bn PPP$	863.8	27	
5	**Business sophistication**	**35.7**	**48**	
5.1	Knowledge workers	26.9	93	○
5.1.1	Knowledge-intensive employment, %	25.5	53	
5.1.2	Firms offering formal training, % firms	18.5	79	○
5.1.3	GERD performed by business, % of GDP ◷	0.6	32	
5.1.4	GERD financed by business, % ◷	6.9	75	○
5.1.5	Females employed w/advanced degrees, % total	12.2	57	
5.2	Innovation linkages	34.5	47	
5.2.1	University/industry research collaboration†	70.0	11	●
5.2.2	State of cluster development†	69.5	12	●
5.2.3	GERD financed by abroad, % ◷	0.2	96	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	18	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	45	
5.3	Knowledge absorption	45.6	20	
5.3.1	Intellectual property payments, % total trade	0.6	52	
5.3.2	High-tech imports less re-imports, % total trade	24.7	1	●
5.3.3	ICT services imports, % total trade	1.6	38	
5.3.4	FDI net inflows, % GDP	3.4	47	
5.3.5	Research talent, % in business enterprise ◷	10.3	66	○
6	**Knowledge & technology outputs**	**31.7**	**36**	
6.1	Knowledge creation	8.0	74	
6.1.1	Patents by origin/bn PPP$ GDP	1.6	54	
6.1.2	PCT patent applications/bn PPP$ GDP	0.2	50	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	51	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	12.3	58	
6.1.5	Citable documents H index	15.0	45	
6.2	Knowledge impact	37.1	43	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.9	58	
6.2.2	New businesses/th pop. 15–64	2.4	43	
6.2.3	Computer software spending, % GDP	0.4	29	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	14.6	26	
6.2.5	High- & medium-high-tech manufactures, % ◷	0.4	28	
6.3	Knowledge diffusion	50.1	11	●
6.3.1	Intellectual property receipts, % total trade	0.0	73	
6.3.2	High-tech exports less re-exports, % total trade	32.3	1	●
6.3.3	ICT services exports, % total trade	1.3	71	
6.3.4	FDI net outflows, % GDP	4.1	12	●
7	**Creative outputs**	**37.3**	**45**	
7.1	Intangible assets	46.1	53	
7.1.1	Trademarks by origin/bn PPP$ GDP	19.5	84	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.8	70	
7.1.3	ICTs & business model creation†	76.2	20	
7.1.4	ICTs & organizational model creation†	73.7	18	
7.2	Creative goods & services	38.4	13	●
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	3.7	51	
7.2.3	Global ent. & media market/th pop. 15–69	11.2	32	
7.2.4	Printing & publishing manufactures, % ◷	0.9	70	
7.2.5	Creative goods exports, % total trade	10.3	2	●
7.3	Online creativity	18.5	69	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	6.3	52	
7.3.2	Country-code TLDs/th pop. 15–69	4.3	54	
7.3.3	Wikipedia edits/mn pop. 15–69	4.6	69	
7.3.4	Video uploads on YouTube/pop. 15–69	19.0	58	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Mali

Key indicators

Population (millions)	18.1
GDP (US$ billions)	14.1
GDP per capita, PPP$	2,199.0
Income group	Low income
Region	Sub-Saharan Africa

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**22.5**	**118**	
	Innovation Output Sub-Index	16.8	107	
	Innovation Input Sub-Index	28.1	123	○
	Innovation Efficiency Ratio	0.6	78	
	Global Innovation Index 2016 (out of 128)	24.8	112	
1	**Institutions**	**45.9**	**110**	
1.1	Political environment	21.2	123	○
1.1.1	Political stability & safety*	23.6	121	
1.1.2	Government effectiveness*	18.7	118	
1.2	Regulatory environment	55.6	85	
1.2.1	Regulatory quality*	27.6	104	
1.2.2	Rule of law*	17.3	105	
1.2.3	Cost of redundancy dismissal, salary weeks	13.7	53	●
1.3	Business environment	61.0	93	
1.3.1	Ease of starting a business*	84.1	83	
1.3.2	Ease of resolving insolvency*	41.5	88	
1.3.3	Ease of paying taxes*	57.5	100	
2	**Human capital & research**	**12.2**	**123**	○
2.1	Education	29.4	109	
2.1.1	Expenditure on education, % GDP	3.6	89	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	22.1	46	●
2.1.3	School life expectancy, years◷	7.7	113	○
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	19.2	78	
2.2	Tertiary education	4.0	120	○
2.2.1	Tertiary enrolment, % gross◷	6.9	112	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %◷	0.5	90	
2.3	Research & development (R&D)	3.4	85	
2.3.1	Researchers, FTE/mn pop.◷	29.2	98	○
2.3.2	Gross expenditure on R&D, % GDP◷	0.6	58	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**24.5**	**122**	
3.1	Information & communication technologies (ICTs)	14.7	124	○
3.1.1	ICT access*	33.0	107	
3.1.2	ICT use*	9.7	114	
3.1.3	Government's online service*	9.4	122	○
3.1.4	E-participation*	6.8	125	○
3.2	General infrastructure	31.0	90	
3.2.1	Electricity output, kWh/cap	n/a	n/a	
3.2.2	Logistics performance*	20.4	103	
3.2.3	Gross capital formation, % GDP	19.4	90	
3.3	Ecological sustainability	27.8	118	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	41.5	121	○
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	120	
4	**Market sophistication**	**28.6**	**124**	○
4.1	Credit	14.5	120	
4.1.1	Ease of getting credit*	30.0	108	
4.1.2	Domestic credit to private sector, % GDP	24.4	105	
4.1.3	Microfinance gross loans, % GDP	0.3	44	
4.2	Investment	30.2	110	
4.2.1	Ease of protecting minority investors*	40.0	111	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP◷	0.0	37	●
4.3	Trade, competition, & market scale	41.1	120	
4.3.1	Applied tariff rate, weighted mean, %	10.6	116	
4.3.2	Intensity of local competition†	57.2	111	
4.3.3	Domestic market scale, bn PPP$	38.1	99	
5	**Business sophistication**	**29.4**	**74**	
5.1	Knowledge workers	22.2	105	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms◷	32.1	44	●
5.1.3	GERD performed by business, % of GDP◷	0.0	83	
5.1.4	GERD financed by business, %◷	10.1	73	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	26.7	69	
5.2.1	University/industry research collaboration†	35.8	90	
5.2.2	State of cluster development†	40.8	83	
5.2.3	GERD financed by abroad, %◷	8.8	50	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	35	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	Knowledge absorption	39.3	35	●
5.3.1	Intellectual property payments, % total trade◷	0.1	105	
5.3.2	High-tech imports less re-imports, % total trade◷	5.1	107	
5.3.3	ICT services imports, % total trade◷	3.1	7	●
5.3.4	FDI net inflows, % GDP	1.5	95	
5.3.5	Research talent, % in business enterprise◷	49.0	26	●
6	**Knowledge & technology outputs**	**19.1**	**80**	
6.1	Knowledge creation	3.8	100	
6.1.1	Patents by origin/bn PPP$ GDP◷	0.3	90	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.6	101	
6.1.5	Citable documents H index	4.3	99	
6.2	Knowledge impact	32.9	58	●
6.2.1	Growth rate of PPP$ GDP/worker, %	2.7	24	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	111	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.2	123	○
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	20.7	70	
6.3.1	Intellectual property receipts, % total trade◷	0.0	94	
6.3.2	High-tech exports less re-exports, % total trade◷	0.1	111	
6.3.3	ICT services exports, % total trade◷	4.7	14	●
6.3.4	FDI net outflows, % GDP	0.0	104	
7	**Creative outputs**	**14.5**	**121**	
7.1	Intangible assets	26.1	119	
7.1.1	Trademarks by origin/bn PPP$ GDP	5.4	111	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.5	77	
7.1.3	ICTs & business model creation†	48.8	107	
7.1.4	ICTs & organizational model creation†	38.9	109	
7.2	Creative goods & services	0.5	127	
7.2.1	Cultural & creative services exports, % of total trade	0.0	74	
7.2.2	National feature films/mn pop. 15–69◷	0.1	101	○
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade◷	0.0	122	○
7.3	Online creativity	5.2	110	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	119	
7.3.2	Country-code TLDs/th pop. 15–69	11.1	38	●
7.3.3	Wikipedia edits/mn pop. 15–69◷	0.5	121	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Malta

Key indicators

Population (millions)	0.4
GDP (US$ billions)	10.5
GDP per capita, PPP$	35,825.6
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**50.6**	**26**
Innovation Output Sub-Index	46.3	15
Innovation Input Sub-Index	54.9	28
Innovation Efficiency Ratio	0.8	8
Global Innovation Index 2016 (out of 128)	50.4	26

		Score/Value	Rank	
1	**Institutions**	**77.6**	**29**	
1.1	Political environment	76.5	29	
1.1.1	Political stability & safety*	89.1	10	
1.1.2	Government effectiveness*	64.0	38	
1.2	Regulatory environment	86.3	17	
1.2.1	Regulatory quality*	72.2	25	
1.2.2	Rule of law*	73.1	25	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	70.1	66	
1.3.1	Ease of starting a business*	80.2	99	○
1.3.2	Ease of resolving insolvency*	45.4	76	
1.3.3	Ease of paying taxes*	84.6	29	
2	**Human capital & research**	**41.9**	**37**	
2.1	Education	69.8	7	
2.1.1	Expenditure on education, % GDP	8.3	5	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	40.6	4	●
2.1.3	School life expectancy, years	15.0	46	
2.1.4	PISA scales in reading, maths, & science	463.4	40	
2.1.5	Pupil-teacher ratio, secondary◷	7.8	6	
2.2	Tertiary education	36.2	61	
2.2.1	Tertiary enrolment, % gross	47.0	56	
2.2.2	Graduates in science & engineering, %◷	19.1	63	○
2.2.3	Tertiary inbound mobility, %	6.2	31	
2.3	Research & development (R&D)	19.6	44	
2.3.1	Researchers, FTE/mn pop.	1,951.4	40	
2.3.2	Gross expenditure on R&D, % GDP◷	0.8	46	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	37.4	41	
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**60.6**	**23**	
3.1	Information & communication technologies (ICTs)	78.9	22	
3.1.1	ICT access*	90.4	6	●
3.1.2	ICT use*	67.5	26	
3.1.3	Government's online service*	79.7	26	
3.1.4	E-participation*	78.0	25	
3.2	General infrastructure	41.4	48	
3.2.1	Electricity output, kWh/cap	5,220.9	37	
3.2.2	Logistics performance*	46.5	55	
3.2.3	Gross capital formation, % GDP	25.6	42	
3.3	Ecological sustainability	61.5	15	
3.3.1	GDP/unit of energy use	15.2	9	
3.3.2	Environmental performance*	88.5	9	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.6	42	
4	**Market sophistication**	**45.4**	**69**	
4.1	Credit	34.4	67	
4.1.1	Ease of getting credit*	30.0	108	○
4.1.2	Domestic credit to private sector, % GDP	98.0	28	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	47.0	35	
4.2.1	Ease of protecting minority investors*	65.0	31	
4.2.2	Market capitalization, % GDP	45.2	34	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	15	
4.3	Trade, competition, & market scale	54.8	94	○
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	83.2	4	●
4.3.3	Domestic market scale, bn PPP$	16.3	122	○
5	**Business sophistication**	**49.0**	**21**	
5.1	Knowledge workers	48.7	34	
5.1.1	Knowledge-intensive employment, %	39.8	26	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP◷	0.4	38	
5.1.4	GERD financed by business, %	44.1	28	
5.1.5	Females employed w/advanced degrees, % total	12.3	55	○
5.2	Innovation linkages	49.0	9	
5.2.1	University/industry research collaboration†	50.0	36	
5.2.2	State of cluster development†	53.6	35	
5.2.3	GERD financed by abroad, %	21.3	19	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	24	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	8.8	6	
5.3	Knowledge absorption	49.4	15	
5.3.1	Intellectual property payments, % total trade	3.2	5	●
5.3.2	High-tech imports less re-imports, % total trade	7.4	73	
5.3.3	ICT services imports, % total trade	1.0	67	
5.3.4	FDI net inflows, % GDP	9.5	10	
5.3.5	Research talent, % in business enterprise	58.0	14	
6	**Knowledge & technology outputs**	**36.6**	**23**	
6.1	Knowledge creation	33.3	28	
6.1.1	Patents by origin/bn PPP$ GDP	6.0	21	
6.1.2	PCT patent applications/bn PPP$ GDP	5.3	9	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	17.9	42	
6.1.5	Citable documents H index	5.0	93	○
6.2	Knowledge impact	59.0	3	●
6.2.1	Growth rate of PPP$ GDP/worker, %	2.7	25	
6.2.2	New businesses/th pop. 15–64	17.3	1	●
6.2.3	Computer software spending, % GDP	0.4	25	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	32.8	5	●
6.2.5	High- & medium-high-tech manufactures, %◷	0.2	50	
6.3	Knowledge diffusion	17.4	99	○
6.3.1	Intellectual property receipts, % total trade	2.1	9	
6.3.2	High-tech exports less re-exports, % total trade	4.7	36	
6.3.3	ICT services exports, % total trade	1.0	82	○
6.3.4	FDI net outflows, % GDP	(81.5)	124	○
7	**Creative outputs**	**56.0**	**6**	●
7.1	Intangible assets	62.8	10	
7.1.1	Trademarks by origin/bn PPP$ GDP	104.6	13	
7.1.2	Industrial designs by origin/bn PPP$ GDP◷	13.0	9	
7.1.3	ICTs & business model creation†	69.9	32	
7.1.4	ICTs & organizational model creation†	61.2	36	
7.2	Creative goods & services	45.1	7	
7.2.1	Cultural & creative services exports, % of total trade◷	0.0	90	○
7.2.2	National feature films/mn pop. 15–69	22.8	4	●
7.2.3	Global ent. & media market/th pop. 15–69	8.8	36	
7.2.4	Printing & publishing manufactures, %◷	36.2	1	●
7.2.5	Creative goods exports, % total trade	0.4	64	
7.3	Online creativity	53.5	14	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	94.5	3	●
7.3.2	Country-code TLDs/th pop. 15–69	7.3	44	
7.3.3	Wikipedia edits/mn pop. 15–69◷	6.1	42	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Mauritius

Key indicators

Population (millions)	1.3
GDP (US$ billions)	11.7
GDP per capita, PPP$	19,509.2
Income group	Upper-middle income
Region	Sub-Saharan Africa

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**34.8**	**64**	
	Innovation Output Sub-Index	22.5	82	
	Innovation Input Sub-Index	47.1	47	
	Innovation Efficiency Ratio	0.5	109	○
	Global Innovation Index 2016 (out of 128)	35.9	53	
1	**Institutions**	**80.0**	**27**	●
1.1	Political environment	77.8	25	●
1.1.1	Political stability & safety*	86.9	20	●
1.1.2	Government effectiveness*	68.8	33	●
1.2	Regulatory environment	81.0	24	●
1.2.1	Regulatory quality*	70.0	29	●
1.2.2	Rule of law*	64.4	34	
1.2.3	Cost of redundancy dismissal, salary weeks	10.6	36	
1.3	Business environment	81.2	29	●
1.3.1	Ease of starting a business*	91.7	41	
1.3.2	Ease of resolving insolvency*	69.1	36	
1.3.3	Ease of paying taxes*	83.0	38	
2	**Human capital & research**	**30.2**	**76**	
2.1	Education	53.8	45	
2.1.1	Expenditure on education, % GDP	5.0	50	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	31.2	12	●
2.1.3	School life expectancy, years	14.9	54	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	12.9	49	
2.2	Tertiary education	35.2	65	
2.2.1	Tertiary enrolment, % gross	36.7	71	
2.2.2	Graduates in science & engineering, %	22.9	37	
2.2.3	Tertiary inbound mobility, %	4.0	50	
2.3	Research & development (R&D)	1.5	98	
2.3.1	Researchers, FTE/mn pop.◷	181.1	77	
2.3.2	Gross expenditure on R&D, % GDP◷	0.2	91	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**47.2**	**64**	
3.1	Information & communication technologies (ICTs)	60.7	58	
3.1.1	ICT access*	68.6	53	
3.1.2	ICT use*	37.8	74	
3.1.3	Government's online service*	70.3	45	
3.1.4	E-participation*	66.1	49	
3.2	General infrastructure	28.0	97	
3.2.1	Electricity output, kWh/cap	2,328.6	73	
3.2.2	Logistics performance*◷	20.9	99	
3.2.3	Gross capital formation, % GDP	21.7	68	
3.3	Ecological sustainability	52.8	37	
3.3.1	GDP/unit of energy use	15.6	8	●
3.3.2	Environmental performance*	70.9	70	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.9	67	
4	**Market sophistication**	**50.6**	**44**	
4.1	Credit	52.9	23	●
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	102.8	26	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	42.2	54	
4.2.1	Ease of protecting minority investors*	65.0	31	
4.2.2	Market capitalization, % GDP	62.0	27	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	35	
4.3	Trade, competition, & market scale	56.8	84	
4.3.1	Applied tariff rate, weighted mean, %	0.6	7	●
4.3.2	Intensity of local competition†	71.7	47	
4.3.3	Domestic market scale, bn PPP$	25.8	113	○
5	**Business sophistication**	**27.7**	**86**	
5.1	Knowledge workers	27.7	92	
5.1.1	Knowledge-intensive employment, %	24.7	56	
5.1.2	Firms offering formal training, % firms◷	25.6	61	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %◷	0.3	91	○
5.1.5	Females employed w/advanced degrees, % total◷	7.4	73	○
5.2	Innovation linkages	24.4	78	
5.2.1	University/industry research collaboration†	36.5	87	
5.2.2	State of cluster development†	52.3	39	
5.2.3	GERD financed by abroad, %◷	6.4	60	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP◷	0.0	64	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	53	
5.3	Knowledge absorption	31.0	75	
5.3.1	Intellectual property payments, % total trade◷	0.3	77	
5.3.2	High-tech imports less re-imports, % total trade	8.9	55	
5.3.3	ICT services imports, % total trade◷	1.3	54	
5.3.4	FDI net inflows, % GDP	2.5	72	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**13.6**	**115**	○
6.1	Knowledge creation	2.8	116	○
6.1.1	Patents by origin/bn PPP$ GDP	0.0	117	○
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.6	100	
6.1.5	Citable documents H index	2.3	114	○
6.2	Knowledge impact	17.7	108	○
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	5.1	24	●
6.2.3	Computer software spending, % GDP	0.2	75	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	9.7	38	
6.2.5	High- & medium-high-tech manufactures, %◷	0.1	87	○
6.3	Knowledge diffusion	20.3	74	
6.3.1	Intellectual property receipts, % total trade◷	0.0	72	
6.3.2	High-tech exports less re-exports, % total trade	0.0	122	○
6.3.3	ICT services exports, % total trade◷	2.6	41	
6.3.4	FDI net outflows, % GDP	0.9	55	
7	**Creative outputs**	**31.4**	**61**	
7.1	Intangible assets	37.8	83	
7.1.1	Trademarks by origin/bn PPP$ GDP	40.2	59	
7.1.2	Industrial designs by origin/bn PPP$ GDP◷	0.4	81	
7.1.3	ICTs & business model creation†	60.0	64	
7.1.4	ICTs & organizational model creation†	50.9	71	
7.2	Creative goods & services	32.0	27	●
7.2.1	Cultural & creative services exports, % of total trade	0.0	69	
7.2.2	National feature films/mn pop. 15–69	9.4	16	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %◷	3.2	5	●
7.2.5	Creative goods exports, % total trade	1.1	41	
7.3	Online creativity	18.1	70	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	12.7	34	
7.3.2	Country-code TLDs/th pop. 15–69	2.3	62	
7.3.3	Wikipedia edits/mn pop. 15–69◷	4.1	79	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Mexico

Key indicators

Population (millions)	128.6
GDP (US$ billions)	1,063.6
GDP per capita, PPP$	17,534.4
Income group	Upper-middle income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**35.8**	**58**
Innovation Output Sub-Index	27.1	60
Innovation Input Sub-Index	44.5	54
Innovation Efficiency Ratio	0.6	74
Global Innovation Index 2016 (out of 128)	34.6	61

		Score/Value	Rank	
1	**Institutions**	**58.5**	**68**	
1.1	Political environment	45.1	82	
1.1.1	Political stability & safety*	42.7	104	○
1.1.2	Government effectiveness*	47.6	59	
1.2	Regulatory environment	55.6	84	
1.2.1	Regulatory quality*	52.4	54	
1.2.2	Rule of law*	25.7	90	
1.2.3	Cost of redundancy dismissal, salary weeks	22.0	94	
1.3	Business environment	74.9	51	
1.3.1	Ease of starting a business*	85.7	75	
1.3.2	Ease of resolving insolvency*	73.1	28	
1.3.3	Ease of paying taxes*	65.8	83	
2	**Human capital & research**	**33.7**	**55**	
2.1	Education	43.1	80	
2.1.1	Expenditure on education, % GDP◷	5.2	44	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	16.6	69	
2.1.3	School life expectancy, years	13.3	66	
2.1.4	PISA scales in reading, maths, & science	415.7	55	○
2.1.5	Pupil-teacher ratio, secondary◷	16.1	71	
2.2	Tertiary education	33.0	72	
2.2.1	Tertiary enrolment, % gross◷	29.9	79	
2.2.2	Graduates in science & engineering, %◷	26.9	19	●
2.2.3	Tertiary inbound mobility, %◷	0.2	99	○
2.3	Research & development (R&D)	24.8	41	
2.3.1	Researchers, FTE/mn pop.◷	241.8	72	
2.3.2	Gross expenditure on R&D, % GDP	0.6	59	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	42.5	37	
2.3.4	QS university ranking, average score top 3*	41.6	32	
3	**Infrastructure**	**49.7**	**53**	
3.1	Information & communication technologies (ICTs)	66.5	42	
3.1.1	ICT access*	50.8	81	
3.1.2	ICT use*	42.4	65	
3.1.3	Government's online service*	84.8	19	●
3.1.4	E-participation*	88.1	14	●
3.2	General infrastructure	36.7	67	
3.2.1	Electricity output, kWh/cap	2,538.6	70	
3.2.2	Logistics performance*	48.6	53	
3.2.3	Gross capital formation, % GDP	23.1	54	
3.3	Ecological sustainability	45.8	58	
3.3.1	GDP/unit of energy use	10.6	41	
3.3.2	Environmental performance*	73.6	63	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	78	
4	**Market sophistication**	**50.0**	**49**	
4.1	Credit	35.5	63	
4.1.1	Ease of getting credit*	90.0	5	●
4.1.2	Domestic credit to private sector, % GDP	32.7	97	
4.1.3	Microfinance gross loans, % GDP	0.2	47	
4.2	Investment	34.5	86	
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDP	35.2	42	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	70	
4.3	Trade, competition, & market scale	79.9	7	●
4.3.1	Applied tariff rate, weighted mean, %◷	1.0	12	●
4.3.2	Intensity of local competition†	70.3	56	
4.3.3	Domestic market scale, bn PPP$	2,306.7	11	●
5	**Business sophistication**	**30.8**	**71**	
5.1	Knowledge workers	34.9	75	
5.1.1	Knowledge-intensive employment, %	18.8	77	
5.1.2	Firms offering formal training, % firms◷	50.8	22	
5.1.3	GERD performed by business, % of GDP	0.2	54	
5.1.4	GERD financed by business, %	20.6	62	
5.1.5	Females employed w/advanced degrees, % total◷	8.2	69	○
5.2	Innovation linkages	22.3	84	
5.2.1	University/industry research collaboration†	43.8	50	
5.2.2	State of cluster development†	53.8	34	
5.2.3	GERD financed by abroad, %	0.4	93	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	87	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	73	
5.3	Knowledge absorption	35.0	54	
5.3.1	Intellectual property payments, % total trade	0.2	82	
5.3.2	High-tech imports less re-imports, % total trade	18.4	9	●
5.3.3	ICT services imports, % total trade	0.0	125	○
5.3.4	FDI net inflows, % GDP	2.9	61	
5.3.5	Research talent, % in business enterprise◷	24.5	50	
6	**Knowledge & technology outputs**	**21.5**	**64**	
6.1	Knowledge creation	8.3	70	
6.1.1	Patents by origin/bn PPP$ GDP	0.6	72	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	61	
6.1.3	Utility models by origin/bn PPP$ GDP	0.3	40	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.8	93	
6.1.5	Citable documents H index	26.8	34	
6.2	Knowledge impact	30.3	70	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	83	
6.2.2	New businesses/th pop. 15–64	0.9	73	
6.2.3	Computer software spending, % GDP	0.3	57	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.3	74	
6.2.5	High- & medium-high-tech manufactures, %◷	0.4	16	●
6.3	Knowledge diffusion	25.9	49	
6.3.1	Intellectual property receipts, % total trade	0.1	58	
6.3.2	High-tech exports less re-exports, % total trade	14.8	10	●
6.3.3	ICT services exports, % total trade	0.0	126	○
6.3.4	FDI net outflows, % GDP	0.9	53	
7	**Creative outputs**	**32.6**	**58**	
7.1	Intangible assets	41.7	64	
7.1.1	Trademarks by origin/bn PPP$ GDP	40.7	58	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.8	69	
7.1.3	ICTs & business model creation†	66.6	43	
7.1.4	ICTs & organizational model creation†	57.0	49	
7.2	Creative goods & services	29.9	31	
7.2.1	Cultural & creative services exports, % of total trade	0.0	75	○
7.2.2	National feature films/mn pop. 15–69	1.6	67	
7.2.3	Global ent. & media market/th pop. 15–69	8.3	38	
7.2.4	Printing & publishing manufactures, %◷	0.6	87	○
7.2.5	Creative goods exports, % total trade	10.0	3	●
7.3	Online creativity	17.1	73	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.6	71	
7.3.2	Country-code TLDs/th pop. 15–69	2.8	59	
7.3.3	Wikipedia edits/mn pop. 15–69	4.0	85	
7.3.4	Video uploads on YouTube/pop. 15–69	24.9	51	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Moldova, Republic of

Key indicators

Population (millions)	4.1
GDP (US$ billions)	6.7
GDP per capita, PPP$	5,006.2
Income group	Lower-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**36.8**	**54**	
Innovation Output Sub-Index	32.3	42	
Innovation Input Sub-Index	41.4	73	
Innovation Efficiency Ratio	0.8	22	●
Global Innovation Index 2016 (out of 128)	38.4	46	

		Score/Value	Rank	
1	**Institutions**	**56.4**	**72**	
1.1	Political environment	40.1	96	
1.1.1	Political stability & safety*	54.3	81	
1.1.2	Government effectiveness*	25.9	103	
1.2	Regulatory environment	52.7	92	
1.2.1	Regulatory quality*	40.8	75	
1.2.2	Rule of law*	27.7	85	
1.2.3	Cost of redundancy dismissal, salary weeks	22.6	95	
1.3	Business environment	76.4	41	
1.3.1	Ease of starting a business*	92.0	37	
1.3.2	Ease of resolving insolvency*	52.6	56	
1.3.3	Ease of paying taxes*	84.8	28	●
2	**Human capital & research**	**33.2**	**59**	
2.1	Education	58.3	31	
2.1.1	Expenditure on education, % GDP	7.5	9	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	39.3	5	●
2.1.3	School life expectancy, years	11.6	90	
2.1.4	PISA scales in reading, maths, & science	421.3	51	
2.1.5	Pupil-teacher ratio, secondary	9.3	18	●
2.2	Tertiary education	37.2	58	
2.2.1	Tertiary enrolment, % gross	41.2	63	
2.2.2	Graduates in science & engineering, %	25.7	24	●
2.2.3	Tertiary inbound mobility, %	2.5	63	
2.3	Research & development (R&D)	4.0	81	
2.3.1	Researchers, FTE/mn pop.	662.1	59	
2.3.2	Gross expenditure on R&D, % GDP	0.4	74	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**41.7**	**82**	
3.1	Information & communication technologies (ICTs)	58.6	62	
3.1.1	ICT access*	66.4	61	
3.1.2	ICT use*	42.6	64	
3.1.3	Government's online service*	59.4	67	
3.1.4	E-participation*	66.1	49	
3.2	General infrastructure	27.7	98	
3.2.1	Electricity output, kWh/cap	1,503.1	87	
3.2.2	Logistics performance*	25.5	91	
3.2.3	Gross capital formation, % GDP	21.1	73	
3.3	Ecological sustainability	38.7	87	
3.3.1	GDP/unit of energy use	5.0	103	○
3.3.2	Environmental performance*	76.7	54	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.0	62	
4	**Market sophistication**	**46.8**	**62**	
4.1	Credit	29.8	79	
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	34.8	93	
4.1.3	Microfinance gross loans, % GDP	0.4	38	
4.2	Investment	63.3	[15]	
4.2.1	Ease of protecting minority investors*	63.3	41	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	47.2	111	○
4.3.1	Applied tariff rate, weighted mean, %	3.4	72	
4.3.2	Intensity of local competition†	59.1	105	○
4.3.3	Domestic market scale, bn PPP$	18.5	121	○
5	**Business sophistication**	**28.7**	**81**	
5.1	Knowledge workers	36.2	71	
5.1.1	Knowledge-intensive employment, %	28.1	50	
5.1.2	Firms offering formal training, % firms	32.4	43	
5.1.3	GERD performed by business, % of GDP	0.1	64	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total◴	14.0	43	
5.2	Innovation linkages	18.5	117	○
5.2.1	University/industry research collaboration†	25.3	117	○
5.2.2	State of cluster development†	22.2	123	○
5.2.3	GERD financed by abroad, %	11.6	44	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	27	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	47	
5.3	Knowledge absorption	31.3	73	
5.3.1	Intellectual property payments, % total trade	0.5	61	
5.3.2	High-tech imports less re-imports, % total trade	7.8	67	
5.3.3	ICT services imports, % total trade	2.5	12	●
5.3.4	FDI net inflows, % GDP	3.9	39	
5.3.5	Research talent, % in business enterprise	7.6	68	
6	**Knowledge & technology outputs**	**25.4**	**52**	
6.1	Knowledge creation	41.5	19	●
6.1.1	Patents by origin/bn PPP$ GDP	3.6	30	
6.1.2	PCT patent applications/bn PPP$ GDP	0.5	36	
6.1.3	Utility models by origin/bn PPP$ GDP	9.3	1	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	13.2	57	
6.1.5	Citable documents H index	4.8	96	
6.2	Knowledge impact	11.0	115	○
6.2.1	Growth rate of PPP$ GDP/worker, %	(3.5)	108	○
6.2.2	New businesses/th pop. 15–64◴	1.6	52	
6.2.3	Computer software spending, % GDP	0.1	83	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.2	49	
6.2.5	High- & medium-high-tech manufactures, %◴	0.1	80	
6.3	Knowledge diffusion	23.7	59	
6.3.1	Intellectual property receipts, % total trade	0.1	46	
6.3.2	High-tech exports less re-exports, % total trade	0.6	74	
6.3.3	ICT services exports, % total trade	4.7	13	●
6.3.4	FDI net outflows, % GDP	0.4	75	
7	**Creative outputs**	**39.3**	**39**	
7.1	Intangible assets	63.3	9	●
7.1.1	Trademarks by origin/bn PPP$ GDP	149.8	3	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	67.3	1	●
7.1.3	ICTs & business model creation†	49.5	104	○
7.1.4	ICTs & organizational model creation†	45.1	92	
7.2	Creative goods & services	12.5	80	
7.2.1	Cultural & creative services exports, % of total trade	0.4	32	
7.2.2	National feature films/mn pop. 15–69	0.3	96	○
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %◴	1.7	29	
7.2.5	Creative goods exports, % total trade	0.1	102	
7.3	Online creativity	18.0	71	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.1	77	
7.3.2	Country-code TLDs/th pop. 15–69	2.3	61	
7.3.3	Wikipedia edits/mn pop. 15–69◴	5.1	57	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◴ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Mongolia

Key indicators

Population (millions)	3.0
GDP (US$ billions)	11.2
GDP per capita, PPP$	12,146.6
Income group	Lower-middle income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**37.1**	**52**
Innovation Output Sub-Index	31.6	48
Innovation Input Sub-Index	42.7	67
Innovation Efficiency Ratio	0.7	27
Global Innovation Index 2016 (out of 128)	35.7	55

		Score	Rank	
1	**Institutions**	**64.6**	**60**	
1.1	Political environment	55.7	56	
1.1.1	Political stability & safety*	79.6	34	
1.1.2	Government effectiveness*	31.8	89	
1.2	Regulatory environment	64.7	64	
1.2.1	Regulatory quality*	33.6	90	
1.2.2	Rule of law*	28.0	84	
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	22	●
1.3	Business environment	73.4	56	
1.3.1	Ease of starting a business*	92.6	32	
1.3.2	Ease of resolving insolvency*	43.6	82	
1.3.3	Ease of paying taxes*	84.2	31	
2	**Human capital & research**	**26.9**	**81**	
2.1	Education	45.5	71	
2.1.1	Expenditure on education, % GDP ⓓ	4.6	64	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	15.4	78	
2.1.3	School life expectancy, years	15.0	47	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	14.5	61	
2.2	Tertiary education	34.1	70	
2.2.1	Tertiary enrolment, % gross	68.6	28	
2.2.2	Graduates in science & engineering, %	19.5	61	
2.2.3	Tertiary inbound mobility, %	0.7	86	
2.3	Research & development (R&D)	1.1	104	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.2	94	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**40.1**	**86**	
3.1	Information & communication technologies (ICTs)	52.6	73	
3.1.1	ICT access*	51.2	80	
3.1.2	ICT use*	36.4	75	
3.1.3	Government's online service*	51.4	81	
3.1.4	E-participation*	71.2	39	
3.2	General infrastructure	33.5	80	
3.2.1	Electricity output, kWh/cap	1,847.4	79	
3.2.2	Logistics performance*	20.5	102	
3.2.3	Gross capital formation, % GDP	27.0	31	
3.3	Ecological sustainability	34.3	106	
3.3.1	GDP/unit of energy use	6.1	93	
3.3.2	Environmental performance*	64.4	96	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	113	
4	**Market sophistication**	**52.6**	**35**	
4.1	Credit	60.4	14	●
4.1.1	Ease of getting credit*	60.0	55	
4.1.2	Domestic credit to private sector, % GDP	54.8	60	
4.1.3	Microfinance gross loans, % GDP	18.4	1	●
4.2	Investment	47.1	34	
4.2.1	Ease of protecting minority investors*	68.3	25	●
4.2.2	Market capitalization, % GDP ⓓ	10.5	75	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	50.4	103	
4.3.1	Applied tariff rate, weighted mean, %	4.6	85	
4.3.2	Intensity of local competition†	60.1	100	
4.3.3	Domestic market scale, bn PPP$	36.7	102	
5	**Business sophistication**	**29.3**	**76**	
5.1	Knowledge workers	42.3	50	
5.1.1	Knowledge-intensive employment, %	24.7	57	
5.1.2	Firms offering formal training, % firms	60.9	7	●
5.1.3	GERD performed by business, % of GDP	0.0	81	○
5.1.4	GERD financed by business, %	7.3	74	
5.1.5	Females employed w/advanced degrees, % total ⓓ	16.7	32	
5.2	Innovation linkages	14.5	123	○
5.2.1	University/industry research collaboration†	26.6	114	○
5.2.2	State of cluster development†	28.8	121	○
5.2.3	GERD financed by abroad, % ⓓ	2.8	68	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	59	
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.0	87	
5.3	Knowledge absorption	31.1	74	
5.3.1	Intellectual property payments, % total trade	0.3	76	
5.3.2	High-tech imports less re-imports, % total trade	5.5	103	
5.3.3	ICT services imports, % total trade	1.6	40	
5.3.4	FDI net inflows, % GDP	6.6	19	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**21.1**	**67**	
6.1	Knowledge creation	35.5	23	●
6.1.1	Patents by origin/bn PPP$ GDP	3.0	34	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	92	
6.1.3	Utility models by origin/bn PPP$ GDP	4.1	5	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.5	83	
6.1.5	Citable documents H index	4.0	103	
6.2	Knowledge impact	13.5	113	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	6.3	19	●
6.2.3	Computer software spending, % GDP	0.1	82	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.5	118	○
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	93	○
6.3	Knowledge diffusion	14.3	113	
6.3.1	Intellectual property receipts, % total trade	0.0	68	
6.3.2	High-tech exports less re-exports, % total trade	0.1	116	○
6.3.3	ICT services exports, % total trade	0.2	113	
6.3.4	FDI net outflows, % GDP	0.4	70	
7	**Creative outputs**	**42.0**	**34**	
7.1	Intangible assets	62.0	13	●
7.1.1	Trademarks by origin/bn PPP$ GDP	194.5	1	●
7.1.2	Industrial designs by origin/bn PPP$ GDP ⓓ	7.4	18	●
7.1.3	ICTs & business model creation†	55.8	82	
7.1.4	ICTs & organizational model creation†	41.2	108	
7.2	Creative goods & services	27.2	39	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.0	91	○
7.2.2	National feature films/mn pop. 15–69	20.0	5	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	2.9	9	●
7.2.5	Creative goods exports, % total trade	0.0	120	○
7.3	Online creativity	17.0	75	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.6	102	
7.3.2	Country-code TLDs/th pop. 15–69	1.4	70	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	5.1	62	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Montenegro

Key indicators

Population (millions)	0.6
GDP (US$ billions)	4.2
GDP per capita, PPP$	16,123.1
Income group	Upper-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**38.1**	**48**
Innovation Output Sub-Index	29.3	52
Innovation Input Sub-Index	46.8	50
Innovation Efficiency Ratio	0.6	62
Global Innovation Index 2016 (out of 128)	37.4	51

		Score/Value	Rank	
1	**Institutions**	**68.4**	**48**	
1.1	Political environment	56.6	54	
1.1.1	Political stability & safety*	67.0	54	
1.1.2	Government effectiveness*	46.3	61	
1.2	Regulatory environment	68.9	47	
1.2.1	Regulatory quality*	47.9	63	
1.2.2	Rule of law*	40.4	59	
1.2.3	Cost of redundancy dismissal, salary weeks	11.2	39	
1.3	Business environment	79.6	34	
1.3.1	Ease of starting a business*	90.1	49	
1.3.2	Ease of resolving insolvency*	68.4	37	
1.3.3	Ease of paying taxes*	80.4	48	
2	**Human capital & research**	**36.3**	**[49]**	
2.1	Education	56.0	[39]	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years◷	15.1	44	
2.1.4	PISA scales in reading, maths, & science	418.7	52	○
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	48.2	[25]	
2.2.1	Tertiary enrolment, % gross◷	55.3	48	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	4.6	77	
2.3.1	Researchers, FTE/mn pop.	835.8	53	
2.3.2	Gross expenditure on R&D, % GDP	0.4	72	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**49.5**	**54**	
3.1	Information & communication technologies (ICTs)	66.4	43	
3.1.1	ICT access*	68.5	55	
3.1.2	ICT use*	46.1	60	
3.1.3	Government's online service*	68.1	47	
3.1.4	E-participation*	83.1	17	●
3.2	General infrastructure	35.0	74	
3.2.1	Electricity output, kWh/cap	5,119.4	39	
3.2.2	Logistics performance*	14.7	114	○
3.2.3	Gross capital formation, % GDP	27.1	30	
3.3	Ecological sustainability	47.1	55	
3.3.1	GDP/unit of energy use	9.2	58	
3.3.2	Environmental performance*	78.9	46	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.7	52	
4	**Market sophistication**	**45.9**	**65**	
4.1	Credit	40.8	47	
4.1.1	Ease of getting credit*	85.0	7	●
4.1.2	Domestic credit to private sector, % GDP	50.6	69	
4.1.3	Microfinance gross loans, % GDP	1.0	26	
4.2	Investment	55.4	21	●
4.2.1	Ease of protecting minority investors*	63.3	41	
4.2.2	Market capitalization, % GDP◷	92.6	10	●
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	41.4	119	○
4.3.1	Applied tariff rate, weighted mean, %◷	2.6	60	
4.3.2	Intensity of local competition†	54.6	114	○
4.3.3	Domestic market scale, bn PPP$	10.6	126	○
5	**Business sophistication**	**34.1**	**58**	
5.1	Knowledge workers	37.4	62	
5.1.1	Knowledge-intensive employment, %	37.4	32	
5.1.2	Firms offering formal training, % firms	23.7	67	
5.1.3	GERD performed by business, % of GDP◷	0.1	57	
5.1.4	GERD financed by business, %◷	28.5	53	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	29.6	57	
5.2.1	University/industry research collaboration†	36.4	88	
5.2.2	State of cluster development†	34.8	103	○
5.2.3	GERD financed by abroad, %◷	20.7	20	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP◷	0.2	48	
5.3	Knowledge absorption	35.3	53	
5.3.1	Intellectual property payments, % total trade	0.2	86	○
5.3.2	High-tech imports less re-imports, % total trade	6.4	90	
5.3.3	ICT services imports, % total trade	2.3	15	●
5.3.4	FDI net inflows, % GDP	12.8	7	●
5.3.5	Research talent, % in business enterprise◷	19.0	57	
6	**Knowledge & technology outputs**	**22.5**	**57**	
6.1	Knowledge creation	11.2	60	
6.1.1	Patents by origin/bn PPP$ GDP	2.3	42	
6.1.2	PCT patent applications/bn PPP$ GDP	0.2	51	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	21.5	36	
6.1.5	Citable documents H index	0.3	125	○
6.2	Knowledge impact	36.1	45	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.4	73	
6.2.2	New businesses/th pop. 15–64	6.9	17	●
6.2.3	Computer software spending, % GDP	0.4	22	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	8.4	41	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	20.1	78	
6.3.1	Intellectual property receipts, % total trade	0.0	74	
6.3.2	High-tech exports less re-exports, % total trade	0.6	77	
6.3.3	ICT services exports, % total trade	3.2	26	
6.3.4	FDI net outflows, % GDP	0.4	72	
7	**Creative outputs**	**36.1**	**48**	
7.1	Intangible assets	41.7	65	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.8	68	
7.1.3	ICTs & business model creation†	56.7	79	
7.1.4	ICTs & organizational model creation†	45.5	90	○
7.2	Creative goods & services	16.5	70	
7.2.1	Cultural & creative services exports, % of total trade	0.1	57	
7.2.2	National feature films/mn pop. 15–69	13.3	10	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.2	75	
7.3	Online creativity	44.6	22	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.4	89	
7.3.2	Country-code TLDs/th pop. 15–69	100.0	1	●
7.3.3	Wikipedia edits/mn pop. 15–69◷	5.5	51	
7.3.4	Video uploads on YouTube/pop. 15–69	23.8	53	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Morocco

Key indicators

Population (millions)	34.8
GDP (US$ billions)	104.9
GDP per capita, PPP$	8,164.4
Income group	Lower-middle income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**32.7**	**72**	
	Innovation Output Sub-Index	24.8	68	
	Innovation Input Sub-Index	40.6	79	
	Innovation Efficiency Ratio	0.6	71	
	Global Innovation Index 2016 (out of 128)	32.3	72	
1	**Institutions**	**58.1**	**70**	
1.1	Political environment	48.1	72	
1.1.1	Political stability & safety*	55.7	79	
1.1.2	Government effectiveness*	40.6	76	
1.2	Regulatory environment	56.2	81	
1.2.1	Regulatory quality*	37.7	78	
1.2.2	Rule of law*	37.2	63	
1.2.3	Cost of redundancy dismissal, salary weeks	20.7	85	
1.3	Business environment	69.9	67	
1.3.1	Ease of starting a business*	92.3	34	●
1.3.2	Ease of resolving insolvency*	33.9	109	○
1.3.3	Ease of paying taxes*	83.5	36	●
2	**Human capital & research**	**32.3**	**63**	
2.1	Education	46.4	66	
2.1.1	Expenditure on education, % GDP◷	5.3	42	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap◷	36.1	9	●
2.1.3	School life expectancy, years◷	12.1	86	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	43.4	39	
2.2.1	Tertiary enrolment, % gross	28.1	83	
2.2.2	Graduates in science & engineering, %◷	34.9	4	●
2.2.3	Tertiary inbound mobility, %◷	1.8	71	
2.3	Research & development (R&D)	7.2	65	
2.3.1	Researchers, FTE/mn pop.◷	1,032.5	47	
2.3.2	Gross expenditure on R&D, % GDP◷	0.7	50	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**50.0**	**51**	
3.1	Information & communication technologies (ICTs)	62.9	53	
3.1.1	ICT access*	60.7	71	
3.1.2	ICT use*	34.0	79	
3.1.3	Government's online service*	73.9	36	
3.1.4	E-participation*	83.1	17	●
3.2	General infrastructure	38.0	61	
3.2.1	Electricity output, kWh/cap	847.5	97	○
3.2.2	Logistics performance*	27.9	85	
3.2.3	Gross capital formation, % GDP	30.2	18	●
3.3	Ecological sustainability	49.2	49	
3.3.1	GDP/unit of energy use	12.7	21	●
3.3.2	Environmental performance*	74.2	60	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.6	79	
4	**Market sophistication**	**42.1**	**89**	
4.1	Credit	26.7	93	
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	64.3	49	
4.1.3	Microfinance gross loans, % GDP	0.6	33	
4.2	Investment	33.2	97	
4.2.1	Ease of protecting minority investors*	53.3	80	
4.2.2	Market capitalization, % GDP	45.7	33	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	50	
4.3	Trade, competition, & market scale	66.3	49	
4.3.1	Applied tariff rate, weighted mean, %	2.8	64	
4.3.2	Intensity of local competition†	68.7	68	
4.3.3	Domestic market scale, bn PPP$	282.8	54	
5	**Business sophistication**	**20.5**	**122**	○
5.1	Knowledge workers	21.0	109	○
5.1.1	Knowledge-intensive employment, %◷	6.8	99	○
5.1.2	Firms offering formal training, % firms	26.3	59	
5.1.3	GERD performed by business, % of GDP◷	0.2	50	
5.1.4	GERD financed by business, %◷	29.9	51	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	18.8	115	○
5.2.1	University/industry research collaboration†	35.4	93	
5.2.2	State of cluster development†	43.6	74	
5.2.3	GERD financed by abroad, %◷	1.7	78	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	89	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	99	○
5.3	Knowledge absorption	21.6	118	○
5.3.1	Intellectual property payments, % total trade◷	0.2	84	
5.3.2	High-tech imports less re-imports, % total trade	7.3	75	
5.3.3	ICT services imports, % total trade◷	0.5	96	
5.3.4	FDI net inflows, % GDP	3.2	50	
5.3.5	Research talent, % in business enterprise◷	7.5	69	○
6	**Knowledge & technology outputs**	**20.3**	**77**	
6.1	Knowledge creation	6.2	81	
6.1.1	Patents by origin/bn PPP$ GDP	0.8	67	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	59	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.0	78	
6.1.5	Citable documents H index	9.3	68	
6.2	Knowledge impact	34.5	48	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.7	26	●
6.2.2	New businesses/th pop. 15–64	1.5	54	
6.2.3	Computer software spending, % GDP	0.3	62	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.5	73	
6.2.5	High- & medium-high-tech manufactures, %◷	0.3	42	
6.3	Knowledge diffusion	20.1	79	
6.3.1	Intellectual property receipts, % total trade◷	0.0	95	○
6.3.2	High-tech exports less re-exports, % total trade	1.5	59	
6.3.3	ICT services exports, % total trade◷	2.9	31	●
6.3.4	FDI net outflows, % GDP	0.5	68	
7	**Creative outputs**	**29.4**	**68**	
7.1	Intangible assets	49.4	39	
7.1.1	Trademarks by origin/bn PPP$ GDP	49.4	52	
7.1.2	Industrial designs by origin/bn PPP$ GDP	13.6	8	●
7.1.3	ICTs & business model creation†	62.3	53	
7.1.4	ICTs & organizational model creation†	48.8	78	
7.2	Creative goods & services	5.6	106	○
7.2.1	Cultural & creative services exports, % of total trade	0.1	58	
7.2.2	National feature films/mn pop. 15–69	0.8	85	
7.2.3	Global ent. & media market/th pop. 15–69	0.6	60	○
7.2.4	Printing & publishing manufactures, %◷	0.8	74	
7.2.5	Creative goods exports, % total trade	0.2	77	
7.3	Online creativity	13.3	89	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.6	85	
7.3.2	Country-code TLDs/th pop. 15–69	0.8	84	
7.3.3	Wikipedia edits/mn pop. 15–69	4.0	84	
7.3.4	Video uploads on YouTube/pop. 15–69	12.6	62	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Mozambique

Key indicators

Population (millions)	28.8
GDP (US$ billions)	12.0
GDP per capita, PPP$	1,186.2
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**24.5**	**107**	
Innovation Output Sub-Index	18.6	100	
Innovation Input Sub-Index	30.5	114	
Innovation Efficiency Ratio	0.6	70	●
Global Innovation Index 2016 (out of 128)	29.8	84	

		Score/Value	Rank	
1	**Institutions**	**44.6**	**113**	
1.1	Political environment	36.5	102	
1.1.1	Political stability & safety*	49.9	92	
1.1.2	Government effectiveness*	23.1	112	
1.2	Regulatory environment	31.7	123	○
1.2.1	Regulatory quality*	29.5	99	
1.2.2	Rule of law*	14.1	113	
1.2.3	Cost of redundancy dismissal, salary weeks	37.5	123	○
1.3	Business environment	65.5	76	
1.3.1	Ease of starting a business*	79.9	101	
1.3.2	Ease of resolving insolvency*	49.6	60	●
1.3.3	Ease of paying taxes*	67.1	81	
2	**Human capital & research**	**18.7**	**104**	
2.1	Education	46.5	64	●
2.1.1	Expenditure on education, % GDP	6.5	15	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	52.0	2	●
2.1.3	School life expectancy, years	9.6	104	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	39.7	108	○
2.2	Tertiary education	7.6	117	
2.2.1	Tertiary enrolment, % gross◷	6.0	113	
2.2.2	Graduates in science & engineering, %	8.1	99	○
2.2.3	Tertiary inbound mobility, %◷	0.4	94	
2.3	Research & development (R&D)	2.0	94	
2.3.1	Researchers, FTE/mn pop.	41.5	92	
2.3.2	Gross expenditure on R&D, % GDP	0.3	75	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**28.8**	**110**	
3.1	Information & communication technologies (ICTs)	19.0	117	
3.1.1	ICT access*	29.0	111	
3.1.2	ICT use*	6.2	119	
3.1.3	Government's online service*	20.3	115	
3.1.4	E-participation*	20.3	113	
3.2	General infrastructure	47.4	33	●
3.2.1	Electricity output, kWh/cap	651.9	102	
3.2.2	Logistics performance*	28.7	84	
3.2.3	Gross capital formation, % GDP	38.5	7	●
3.3	Ecological sustainability	20.0	125	○
3.3.1	GDP/unit of energy use	2.5	115	
3.3.2	Environmental performance*	41.8	119	○
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	87	
4	**Market sophistication**	**35.8**	**111**	
4.1	Credit	13.9	121	
4.1.1	Ease of getting credit*	25.0	119	
4.1.2	Domestic credit to private sector, % GDP	35.1	91	
4.1.3	Microfinance gross loans, % GDP	0.2	51	
4.2	Investment	43.3	[47]	
4.2.1	Ease of protecting minority investors*	43.3	101	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	50.2	104	
4.3.1	Applied tariff rate, weighted mean, %◷	4.2	80	
4.3.2	Intensity of local competition†	58.0	108	
4.3.3	Domestic market scale, bn PPP$	35.3	104	
5	**Business sophistication**	**24.4**	**106**	
5.1	Knowledge workers	10.2	122	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms◷	22.1	71	
5.1.3	GERD performed by business, % of GDP	0.0	86	
5.1.4	GERD financed by business, %	0.5	89	
5.1.5	Females employed w/advanced degrees, % total◷	0.5	87	○
5.2	Innovation linkages	34.5	46	●
5.2.1	University/industry research collaboration†	37.8	82	
5.2.2	State of cluster development†	34.5	104	
5.2.3	GERD financed by abroad, %	39.9	11	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	102	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	118	○
5.3	Knowledge absorption	28.5	85	
5.3.1	Intellectual property payments, % total trade◷	0.2	78	
5.3.2	High-tech imports less re-imports, % total trade	5.7	100	
5.3.3	ICT services imports, % total trade	0.9	72	
5.3.4	FDI net inflows, % GDP	32.5	3	●
5.3.5	Research talent, % in business enterprise	0.3	84	○
6	**Knowledge & technology outputs**	**20.8**	**72**	●
6.1	Knowledge creation	4.5	93	
6.1.1	Patents by origin/bn PPP$ GDP	0.7	70	●
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	90	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	7.4	76	
6.1.5	Citable documents H index	4.1	102	
6.2	Knowledge impact	40.6	29	●
6.2.1	Growth rate of PPP$ GDP/worker, %	4.4	10	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	113	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.7	98	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	17.3	100	
6.3.1	Intellectual property receipts, % total trade◷	0.0	102	
6.3.2	High-tech exports less re-exports, % total trade	0.4	90	
6.3.3	ICT services exports, % total trade	0.2	114	
6.3.4	FDI net outflows, % GDP	1.3	42	●
7	**Creative outputs**	**16.5**	**119**	
7.1	Intangible assets	30.3	102	
7.1.1	Trademarks by origin/bn PPP$ GDP	34.7	66	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.9	65	
7.1.3	ICTs & business model creation†	49.3	105	
7.1.4	ICTs & organizational model creation†	37.0	113	
7.2	Creative goods & services	2.0	119	
7.2.1	Cultural & creative services exports, % of total trade◷	0.0	71	
7.2.2	National feature films/mn pop. 15–69	1.7	65	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	121	○
7.3	Online creativity	3.3	117	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.0	126	○
7.3.2	Country-code TLDs/th pop. 15–69	0.1	111	
7.3.3	Wikipedia edits/mn pop. 15–69◷	1.0	116	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Namibia

Key indicators

Population (millions)	2.5
GDP (US$ billions)	10.2
GDP per capita, PPP$	11,408.2
Income group	Upper-middle income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**27.9**	**97**	
Innovation Output Sub-Index	18.1	102	
Innovation Input Sub-Index	37.8	89	
Innovation Efficiency Ratio	0.5	108	
Global Innovation Index 2016 (out of 128)	28.2	93	

		Score/Value	Rank	
1	**Institutions**	**65.2**	**58**	
1.1	Political environment	64.2	45	
1.1.1	Political stability & safety*	79.6	35	●
1.1.2	Government effectiveness*	48.8	53	
1.2	Regulatory environment	69.6	44	
1.2.1	Regulatory quality*	40.0	76	
1.2.2	Rule of law*	44.9	53	
1.2.3	Cost of redundancy dismissal, salary weeks	9.7	30	●
1.3	Business environment	61.9	87	
1.3.1	Ease of starting a business*	68.9	119	○
1.3.2	Ease of resolving insolvency*	42.0	86	
1.3.3	Ease of paying taxes*	75.0	60	
2	**Human capital & research**	**22.5**	**94**	
2.1	Education	50.1	53	
2.1.1	Expenditure on education, % GDPⓓ	8.3	4	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/capⓓ	16.0	76	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondaryⓓ	24.6	92	
2.2	Tertiary education	15.1	108	
2.2.1	Tertiary enrolment, % grossⓓ	9.3	107	
2.2.2	Graduates in science & engineering, %ⓓ	2.6	102	○
2.2.3	Tertiary inbound mobility, %ⓓ	10.2	17	●
2.3	Research & development (R&D)	2.3	89	
2.3.1	Researchers, FTE/mn pop.ⓓ	141.4	82	
2.3.2	Gross expenditure on R&D, % GDPⓓ	0.3	76	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**38.6**	**92**	
3.1	Information & communication technologies (ICTs)	30.9	108	
3.1.1	ICT access*	42.5	97	
3.1.2	ICT use*	29.1	90	
3.1.3	Government's online service*	28.3	109	
3.1.4	E-participation*	23.7	111	
3.2	General infrastructure	37.6	62	
3.2.1	Electricity output, kWh/cap	624.2	103	
3.2.2	Logistics performance*	31.5	78	
3.2.3	Gross capital formation, % GDP	29.2	21	●
3.3	Ecological sustainability	47.4	53	
3.3.1	GDP/unit of energy use	12.3	27	●
3.3.2	Environmental performance*	70.8	71	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	76	
4	**Market sophistication**	**39.3**	**97**	
4.1	Credit	27.1	91	
4.1.1	Ease of getting credit*	60.0	55	
4.1.2	Domestic credit to private sector, % GDP	53.8	63	
4.1.3	Microfinance gross loans, % GDPⓓ	0.0	65	
4.2	Investment	36.7	80	
4.2.1	Ease of protecting minority investors*	55.0	75	
4.2.2	Market capitalization, % GDPⓓ	0.0	86	○
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	54.1	97	
4.3.1	Applied tariff rate, weighted mean, %	0.9	10	●
4.3.2	Intensity of local competition†	61.1	95	
4.3.3	Domestic market scale, bn PPP$	27.0	111	
5	**Business sophistication**	**23.2**	**113**	
5.1	Knowledge workers	20.5	111	
5.1.1	Knowledge-intensive employment, %ⓓ	14.6	89	
5.1.2	Firms offering formal training, % firms	25.4	63	
5.1.3	GERD performed by business, % of GDPⓓ	0.0	74	
5.1.4	GERD financed by business, %ⓓ	11.1	71	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	27.7	65	
5.2.1	University/industry research collaboration†	37.7	83	
5.2.2	State of cluster development†	44.5	68	
5.2.3	GERD financed by abroad, %ⓓ	15.8	29	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	40	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	59	
5.3	Knowledge absorption	21.3	119	○
5.3.1	Intellectual property payments, % total trade	0.1	93	
5.3.2	High-tech imports less re-imports, % total tradeⓓ	6.0	95	
5.3.3	ICT services imports, % total trade	0.5	103	
5.3.4	FDI net inflows, % GDP	6.4	20	●
5.3.5	Research talent, % in business enterpriseⓓ	6.9	70	
6	**Knowledge & technology outputs**	**7.9**	**123**	○
6.1	Knowledge creation	4.5	92	
6.1.1	Patents by origin/bn PPP$ GDP	n/a	n/a	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	68	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.7	81	
6.1.5	Citable documents H index	4.0	103	
6.2	Knowledge impact	5.5	118	○
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64ⓓ	0.9	76	
6.2.3	Computer software spending, % GDP	0.1	84	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.8	97	
6.2.5	High- & medium-high-tech manufactures, %ⓓ	0.0	94	○
6.3	Knowledge diffusion	13.5	118	○
6.3.1	Intellectual property receipts, % total tradeⓓ	0.0	100	○
6.3.2	High-tech exports less re-exports, % total tradeⓓ	1.6	58	
6.3.3	ICT services exports, % total tradeⓓ	0.0	124	○
6.3.4	FDI net outflows, % GDP	0.2	89	
7	**Creative outputs**	**28.3**	**75**	
7.1	Intangible assets	40.1	73	
7.1.1	Trademarks by origin/bn PPP$ GDP	62.9	32	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.0	112	○
7.1.3	ICTs & business model creation†	58.0	72	
7.1.4	ICTs & organizational model creation†	50.1	76	
7.2	Creative goods & services	18.9	[62]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total tradeⓓ	0.7	51	
7.3	Online creativity	14.4	80	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	8.7	42	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	117	○
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	3.6	92	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Nepal

Key indicators

Population (millions)	28.9
GDP (US$ billions)	21.2
GDP per capita, PPP$	2,465.2
Income group	Low income
Region	Central and Southern Asia

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**24.2**	**109**	
Innovation Output Sub-Index	15.9	114	
Innovation Input Sub-Index	32.5	108	
Innovation Efficiency Ratio	0.5	105	
Global Innovation Index 2016 (out of 128)	23.1	115	

		Score/Value	Rank	
1	**Institutions**	**43.9**	**115**	
1.1	Political environment	28.4	118	
1.1.1	Political stability & safety*	41.4	107	
1.1.2	Government effectiveness*	15.3	121	○
1.2	Regulatory environment	41.2	114	
1.2.1	Regulatory quality*	22.0	110	
1.2.2	Rule of law*	18.9	103	
1.2.3	Cost of redundancy dismissal, salary weeks	27.2	105	
1.3	Business environment	62.2	86	
1.3.1	Ease of starting a business*	83.8	84	
1.3.2	Ease of resolving insolvency*	44.6	81	
1.3.3	Ease of paying taxes*	58.1	99	
2	**Human capital & research**	**15.0**	**113**	
2.1	Education	29.5	108	
2.1.1	Expenditure on education, % GDP	3.7	87	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	11.1	93	
2.1.3	School life expectancy, years	12.2	83	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	28.9	102	
2.2	Tertiary education	13.4	111	
2.2.1	Tertiary enrolment, % gross	14.9	98	
2.2.2	Graduates in science & engineering, %	12.1	95	
2.2.3	Tertiary inbound mobility, %ⓓ	0.0	107	○
2.3	Research & development (R&D)	2.2	90	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDPⓓ	0.3	79	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**33.3**	**105**	
3.1	Information & communication technologies (ICTs)	34.0	101	
3.1.1	ICT access*	31.6	108	
3.1.2	ICT use*	13.5	107	
3.1.3	Government's online service*	39.9	99	
3.1.4	E-participation*	50.8	87	
3.2	General infrastructure	38.2	58	●
3.2.1	Electricity output, kWh/cap	134.7	114	○
3.2.2	Logistics performance*	14.5	115	
3.2.3	Gross capital formation, % GDP	34.0	9	●
3.3	Ecological sustainability	27.7	119	○
3.3.1	GDP/unit of energy use	5.3	99	
3.3.2	Environmental performance*	50.2	112	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	97	
4	**Market sophistication**	**44.1**	**75**	
4.1	Credit	28.7	83	
4.1.1	Ease of getting credit*	30.0	108	
4.1.2	Domestic credit to private sector, % GDP	65.0	48	●
4.1.3	Microfinance gross loans, % GDP	1.7	18	●
4.2	Investment	58.3	[19]	
4.2.1	Ease of protecting minority investors*	58.3	62	●
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	45.2	113	
4.3.1	Applied tariff rate, weighted mean, %	11.7	119	○
4.3.2	Intensity of local competition†	65.2	80	
4.3.3	Domestic market scale, bn PPP$	71.5	85	
5	**Business sophistication**	**26.2**	**95**	
5.1	Knowledge workers	21.9	[106]	
5.1.1	Knowledge-intensive employment, %ⓓ	4.3	101	
5.1.2	Firms offering formal training, % firms	31.9	48	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	25.3	73	●
5.2.1	University/industry research collaboration†	25.9	115	
5.2.2	State of cluster development†	35.7	100	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	77	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	Knowledge absorption	31.4	72	●
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	11.4	30	●
5.3.3	ICT services imports, % total tradeⓓ	0.6	94	
5.3.4	FDI net inflows, % GDP	0.3	120	○
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**13.7**	**112**	
6.1	Knowledge creation	6.1	83	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	99	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.5	72	●
6.1.5	Citable documents H index	6.1	86	
6.2	Knowledge impact	3.8	123	○
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	0.7	82	
6.2.3	Computer software spending, % GDP	0.0	116	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.4	102	
6.2.5	High- & medium-high-tech manufactures, %ⓓ	0.1	91	
6.3	Knowledge diffusion	31.1	37	●
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.1	117	○
6.3.3	ICT services exports, % total tradeⓓ	6.6	9	●
6.3.4	FDI net outflows, % GDP	n/a	n/a	
7	**Creative outputs**	**18.1**	**109**	
7.1	Intangible assets	26.7	117	
7.1.1	Trademarks by origin/bn PPP$ GDP	35.1	64	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	93	
7.1.3	ICTs & business model creation†	41.1	119	○
7.1.4	ICTs & organizational model creation†	34.0	116	○
7.2	Creative goods & services	5.6	[108]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %ⓓ	0.4	92	
7.2.5	Creative goods exports, % total trade	0.2	73	●
7.3	Online creativity	13.7	84	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	108	
7.3.2	Country-code TLDs/th pop. 15–69	0.8	83	
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	4.1	78	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Netherlands

Key indicators

Population (millions)	17.0
GDP (US$ billions)	769.9
GDP per capita, PPP$	49,165.8
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**63.4**	**3**	●
Innovation Output Sub-Index	60.9	2	●
Innovation Input Sub-Index	65.8	9	
Innovation Efficiency Ratio	0.9	4	●
Global Innovation Index 2016 (out of 128)	58.3	9	

		Score	Rank	
1	**Institutions**	**88.2**	**11**	
1.1	Political environment	87.9	10	
1.1.1	Political stability & safety*	86.4	21	
1.1.2	Government effectiveness*	89.5	7	
1.2	Regulatory environment	88.1	16	
1.2.1	Regulatory quality*	87.4	9	
1.2.2	Rule of law*	95.9	7	
1.2.3	Cost of redundancy dismissal, salary weeks	15.8	65	○
1.3	Business environment	88.7	9	
1.3.1	Ease of starting a business*	94.2	20	
1.3.2	Ease of resolving insolvency*	84.0	10	
1.3.3	Ease of paying taxes*	88.1	18	
2	**Human capital & research**	**54.7**	**19**	
2.1	Education	61.1	18	
2.1.1	Expenditure on education, % GDP	5.6	28	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	24.4	33	
2.1.3	School life expectancy, years ⓐ	18.1	9	
2.1.4	PISA scales in reading, maths, & science	507.9	12	
2.1.5	Pupil-teacher ratio, secondary ⓐ	14.6	62	○
2.2	Tertiary education	39.4	49	○
2.2.1	Tertiary enrolment, % gross ⓐ	78.5	18	
2.2.2	Graduates in science & engineering, % ⓐ	14.4	88	○
2.2.3	Tertiary inbound mobility, % ⓐ	7.2	27	
2.3	Research & development (R&D)	63.6	14	
2.3.1	Researchers, FTE/mn pop.	4,548.1	14	
2.3.2	Gross expenditure on R&D, % GDP	2.0	18	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	83.0	10	
2.3.4	QS university ranking, average score top 3*	69.7	13	
3	**Infrastructure**	**63.3**	**14**	
3.1	Information & communication technologies (ICTs)	88.9	3	●
3.1.1	ICT access*	90.2	7	
3.1.2	ICT use*	77.7	14	
3.1.3	Government's online service*	92.8	9	
3.1.4	E-participation*	94.9	5	●
3.2	General infrastructure	48.6	30	
3.2.1	Electricity output, kWh/cap	6,497.5	31	
3.2.2	Logistics performance*	98.2	4	●
3.2.3	Gross capital formation, % GDP	19.5	87	○
3.3	Ecological sustainability	52.4	39	
3.3.1	GDP/unit of energy use	10.8	40	○
3.3.2	Environmental performance*	82.0	36	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.9	38	
4	**Market sophistication**	**59.0**	**17**	
4.1	Credit	47.2	35	
4.1.1	Ease of getting credit*	50.0	72	○
4.1.2	Domestic credit to private sector, % GDP	111.5	23	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	52.8	26	
4.2.1	Ease of protecting minority investors*	56.7	67	○
4.2.2	Market capitalization, % GDP	97.1	9	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	11	
4.3	Trade, competition, & market scale	77.0	15	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	○
4.3.2	Intensity of local competition†	81.6	10	
4.3.3	Domestic market scale, bn PPP$	865.9	26	
5	**Business sophistication**	**63.7**	**1**	●
5.1	Knowledge workers	62.3	21	
5.1.1	Knowledge-intensive employment, %	46.6	9	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	1.1	19	
5.1.4	GERD financed by business, %	48.7	21	
5.1.5	Females employed w/advanced degrees, % total	18.7	27	
5.2	Innovation linkages	50.7	7	
5.2.1	University/industry research collaboration†	75.0	5	●
5.2.2	State of cluster development†	71.2	6	
5.2.3	GERD financed by abroad, %	15.1	30	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	23	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	6.2	11	
5.3	Knowledge absorption	78.0	1	●
5.3.1	Intellectual property payments, % total trade	5.4	1	●
5.3.2	High-tech imports less re-imports, % total trade	12.9	19	
5.3.3	ICT services imports, % total trade	5.5	1	●
5.3.4	FDI net inflows, % GDP	21.0	6	●
5.3.5	Research talent, % in business enterprise	59.1	13	
6	**Knowledge & technology outputs**	**62.9**	**2**	●
6.1	Knowledge creation	64.8	6	●
6.1.1	Patents by origin/bn PPP$ GDP	11.1	10	
6.1.2	PCT patent applications/bn PPP$ GDP	5.4	8	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	42.9	13	
6.1.5	Citable documents H index	67.6	8	
6.2	Knowledge impact	44.6	17	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.1	52	○
6.2.2	New businesses/th pop. 15–64	5.3	23	
6.2.3	Computer software spending, % GDP	0.6	10	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	12.4	30	
6.2.5	High- & medium-high-tech manufactures, %	0.4	20	
6.3	Knowledge diffusion	79.3	2	●
6.3.1	Intellectual property receipts, % total trade	3.7	5	●
6.3.2	High-tech exports less re-exports, % total trade	13.0	15	
6.3.3	ICT services exports, % total trade	7.2	7	
6.3.4	FDI net outflows, % GDP	23.1	1	●
7	**Creative outputs**	**59.0**	**5**	●
7.1	Intangible assets	57.7	21	
7.1.1	Trademarks by origin/bn PPP$ GDP	61.1	33	
7.1.2	Industrial designs by origin/bn PPP$ GDP	3.1	36	
7.1.3	ICTs & business model creation†	83.2	3	●
7.1.4	ICTs & organizational model creation†	79.2	6	
7.2	Creative goods & services	42.8	8	
7.2.1	Cultural & creative services exports, % of total trade ⓐ	1.1	14	
7.2.2	National feature films/mn pop. 15–69	7.2	23	
7.2.3	Global ent. & media market/th pop. 15–69	50.3	17	
7.2.4	Printing & publishing manufactures, %	1.4	36	○
7.2.5	Creative goods exports, % total trade	4.7	11	
7.3	Online creativity	77.8	2	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	77.9	5	●
7.3.2	Country-code TLDs/th pop. 15–69	100.0	1	●
7.3.3	Wikipedia edits/mn pop. 15–69	7.2	8	
7.3.4	Video uploads on YouTube/pop. 15–69	64.0	5	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
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New Zealand

Key indicators

Population (millions)	4.6
GDP (US$ billions)	179.4
GDP per capita, PPP$	36,171.6
Income group	High income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**52.9**	**21**
Innovation Output Sub-Index	41.6	24
Innovation Input Sub-Index	64.1	13
Innovation Efficiency Ratio	0.6	56
Global Innovation Index 2016 (out of 128)	54.2	17

		Score/Value	Rank	
1	**Institutions**	**93.4**	**2**	●
1.1	Political environment	95.4	2	●
1.1.1	Political stability & safety*	100.0	1	●
1.1.2	Government effectiveness*	90.7	4	●
1.2	Regulatory environment	97.6	3	●
1.2.1	Regulatory quality*	91.9	3	●
1.2.2	Rule of law*	98.5	5	●
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	87.4	13	
1.3.1	Ease of starting a business*	100.0	1	●
1.3.2	Ease of resolving insolvency*	71.4	32	
1.3.3	Ease of paying taxes*	90.7	11	
2	**Human capital & research**	**56.0**	**17**	
2.1	Education	64.4	13	
2.1.1	Expenditure on education, % GDP	6.3	18	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	22.0	47	
2.1.3	School life expectancy, years	19.2	5	●
2.1.4	PISA scales in reading, maths, & science	505.9	14	
2.1.5	Pupil-teacher ratio, secondary ⓓ	14.0	58	○
2.2	Tertiary education	59.7	7	
2.2.1	Tertiary enrolment, % gross ⓓ	80.9	16	
2.2.2	Graduates in science & engineering, % ⓓ	18.8	66	○
2.2.3	Tertiary inbound mobility, % ⓓ	18.7	5	●
2.3	Research & development (R&D)	44.0	23	
2.3.1	Researchers, FTE/mn pop. ⓓ	4,008.7	22	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	1.2	33	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	46.3	32	
2.3.4	QS university ranking, average score top 3*	54.7	18	
3	**Infrastructure**	**61.0**	**22**	
3.1	Information & communication technologies (ICTs)	88.2	6	
3.1.1	ICT access*	83.2	17	
3.1.2	ICT use*	80.3	11	
3.1.3	Government's online service*	94.2	5	
3.1.4	E-participation*	94.9	5	
3.2	General infrastructure	46.6	36	
3.2.1	Electricity output, kWh/cap	9,821.3	15	
3.2.2	Logistics performance*	61.3	36	
3.2.3	Gross capital formation, % GDP	23.3	53	
3.3	Ecological sustainability	48.1	50	
3.3.1	GDP/unit of energy use	7.6	75	○
3.3.2	Environmental performance*	88.0	11	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.5	56	
4	**Market sophistication**	**66.3**	**8**	
4.1	Credit	78.5	4	●
4.1.1	Ease of getting credit*	100.0	1	●
4.1.2	Domestic credit to private sector, % GDP ⓓ	142.3	10	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	53.0	25	
4.2.1	Ease of protecting minority investors*	83.3	1	●
4.2.2	Market capitalization, % GDP	42.8	37	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	20	
4.3	Trade, competition, & market scale	67.4	45	
4.3.1	Applied tariff rate, weighted mean, %	1.3	19	
4.3.2	Intensity of local competition†	74.6	28	
4.3.3	Domestic market scale, bn PPP$	174.8	60	
5	**Business sophistication**	**44.0**	**28**	
5.1	Knowledge workers	54.7	29	
5.1.1	Knowledge-intensive employment, % ⓓ	42.9	19	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP ⓓ	0.5	33	
5.1.4	GERD financed by business, % ⓓ	39.8	37	
5.1.5	Females employed w/advanced degrees, % total ⓓ	19.5	25	
5.2	Innovation linkages	38.4	35	
5.2.1	University/industry research collaboration†	62.5	18	
5.2.2	State of cluster development†	49.1	45	
5.2.3	GERD financed by abroad, % ⓓ	7.2	55	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	14	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	4.7	15	
5.3	Knowledge absorption	38.8	36	
5.3.1	Intellectual property payments, % total trade	1.7	15	
5.3.2	High-tech imports less re-imports, % total trade	11.6	27	
5.3.3	ICT services imports, % total trade	1.4	50	
5.3.4	FDI net inflows, % GDP	0.5	116	○
5.3.5	Research talent, % in business enterprise ⓓ	34.1	41	
6	**Knowledge & technology outputs**	**34.2**	**29**	
6.1	Knowledge creation	41.5	20	
6.1.1	Patents by origin/bn PPP$ GDP	7.1	17	
6.1.2	PCT patent applications/bn PPP$ GDP	1.8	21	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	50.9	7	
6.1.5	Citable documents H index	33.5	27	
6.2	Knowledge impact	41.1	27	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.9	59	○
6.2.2	New businesses/th pop. 15–64	16.6	3	●
6.2.3	Computer software spending, % GDP	0.3	58	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.2	52	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	73	○
6.3	Knowledge diffusion	20.1	80	○
6.3.1	Intellectual property receipts, % total trade	0.6	21	
6.3.2	High-tech exports less re-exports, % total trade	1.4	64	
6.3.3	ICT services exports, % total trade	1.2	75	○
6.3.4	FDI net outflows, % GDP	0.0	107	○
7	**Creative outputs**	**49.0**	**16**	
7.1	Intangible assets	56.8	22	
7.1.1	Trademarks by origin/bn PPP$ GDP	93.9	16	
7.1.2	Industrial designs by origin/bn PPP$ GDP	2.1	44	
7.1.3	ICTs & business model creation†	76.1	21	
7.1.4	ICTs & organizational model creation†	69.1	23	
7.2	Creative goods & services	26.3	42	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	8.8	17	
7.2.3	Global ent. & media market/th pop. 15–69	56.8	12	
7.2.4	Printing & publishing manufactures, % ⓓ	1.8	27	
7.2.5	Creative goods exports, % total trade	0.3	66	○
7.3	Online creativity	56.1	13	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	34.3	20	
7.3.2	Country-code TLDs/th pop. 15–69	62.4	10	
7.3.3	Wikipedia edits/mn pop. 15–69	6.9	13	
7.3.4	Video uploads on YouTube/pop. 15–69	60.9	8	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Niger

Key indicators

Population (millions)	20.7
GDP (US$ billions)	7.6
GDP per capita, PPP$	1,079.7
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**21.2**	**123**
Innovation Output Sub-Index	11.2	123
Innovation Input Sub-Index	31.2	111
Innovation Efficiency Ratio	0.4	123
Global Innovation Index 2016 (out of 128)	20.4	124

		Score/Value	Rank	
1	**Institutions**	**49.2**	**97**	
1.1	Political environment	33.3	110	
1.1.1	Political stability & safety*	40.1	109	
1.1.2	Government effectiveness*	26.6	101	
1.2	Regulatory environment	55.4	86	
1.2.1	Regulatory quality*	23.6	108	
1.2.2	Rule of law*	21.7	98	
1.2.3	Cost of redundancy dismissal, salary weeks	14.0	55	
1.3	Business environment	58.9	100	
1.3.1	Ease of starting a business*	86.2	71	
1.3.2	Ease of resolving insolvency*	40.4	93	
1.3.3	Ease of paying taxes*	50.2	113	
2	**Human capital & research**	**20.6**	**98**	
2.1	Education	52.9	49	
2.1.1	Expenditure on education, % GDP	6.7	14	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	72.6	1	●
2.1.3	School life expectancy, years ⓓ	5.3	115	○
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	28.0	100	
2.2	Tertiary education	9.0	112	
2.2.1	Tertiary enrolment, % gross ⓓ	1.7	120	○
2.2.2	Graduates in science & engineering, % ⓓ	4.3	101	
2.2.3	Tertiary inbound mobility, % ⓓ	5.4	34	●
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**27.5**	**112**	
3.1	Information & communication technologies (ICTs)	9.4	127	○
3.1.1	ICT access*	20.4	125	○
3.1.2	ICT use*	1.4	126	○
3.1.3	Government's online service*	7.2	124	
3.1.4	E-participation*	8.5	123	
3.2	General infrastructure	49.9	27	●
3.2.1	Electricity output, kWh/cap	36.1	117	
3.2.2	Logistics performance*	23.1	97	
3.2.3	Gross capital formation, % GDP	42.5	4	●
3.3	Ecological sustainability	23.1	122	
3.3.1	GDP/unit of energy use	5.8	94	
3.3.2	Environmental performance*	37.5	122	○
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	114	
4	**Market sophistication**	**28.0**	**125**	
4.1	Credit	16.1	118	
4.1.1	Ease of getting credit*	30.0	108	
4.1.2	Domestic credit to private sector, % GDP	14.2	122	
4.1.3	Microfinance gross loans, % GDP	0.8	27	●
4.2	Investment	40.0	[64]	
4.2.1	Ease of protecting minority investors*	40.0	111	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	27.9	126	○
4.3.1	Applied tariff rate, weighted mean, %	11.8	120	
4.3.2	Intensity of local competition†	n/a	n/a	
4.3.3	Domestic market scale, bn PPP$	20.3	120	
5	**Business sophistication**	**30.6**	**[72]**	
5.1	Knowledge workers	37.9	[59]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms ⓓ	32.1	44	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	1.9	[127]	
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	52	
5.3	Knowledge absorption	52.1	10	●
5.3.1	Intellectual property payments, % total trade ⓓ	0.1	94	
5.3.2	High-tech imports less re-imports, % total trade ⓓ	7.6	68	
5.3.3	ICT services imports, % total trade ⓓ	5.0	3	●
5.3.4	FDI net inflows, % GDP	8.9	14	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**19.7**	**78**	
6.1	Knowledge creation	3.2	109	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	85	
6.1.2	PCT patent applications/bn PPP$ GDP ⓓ	0.1	75	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.0	90	
6.1.5	Citable documents H index	2.8	112	
6.2	Knowledge impact	26.9	83	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.9	21	●
6.2.2	New businesses/th pop. 15–64 ⓓ	0.0	105	○
6.2.3	Computer software spending, % GDP	0.0	109	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.4	120	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	29.0	42	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	106	
6.3.2	High-tech exports less re-exports, % total trade ⓓ	2.9	47	
6.3.3	ICT services exports, % total trade ⓓ	6.0	10	●
6.3.4	FDI net outflows, % GDP	1.0	51	
7	**Creative outputs**	**2.7**	**126**	○
7.1	Intangible assets	0.0	127	○
7.1.1	Trademarks by origin/bn PPP$ GDP	1.0	116	○
7.1.2	Industrial designs by origin/bn PPP$ GDP ⓓ	0.1	108	
7.1.3	ICTs & business model creation†	n/a	n/a	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	Creative goods & services	10.2	88	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.7	20	●
7.2.2	National feature films/mn pop. 15–69 ⓓ	0.7	86	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⓓ	0.0	112	
7.3	Online creativity	0.3	126	○
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.0	97	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	125	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	0.0	127	○
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Nigeria

Key indicators

Population (millions)	187.0
GDP (US$ billions)	415.1
GDP per capita, PPP$	6,108.4
Income group	Lower-middle income
Region	Sub-Saharan Africa

		Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)		**21.9**	**119**	
Innovation Output Sub-Index		14.9	119	
Innovation Input Sub-Index		28.9	118	
Innovation Efficiency Ratio		0.5	102	
Global Innovation Index 2016 (out of 128)		23.1	114	
1	**Institutions**	**39.6**	**123**	○
1.1	Political environment	15.7	125	○
1.1.1	Political stability & safety*	13.6	125	○
1.1.2	Government effectiveness*	17.7	120	
1.2	Regulatory environment	57.4	78	
1.2.1	Regulatory quality*	20.6	114	
1.2.2	Rule of law*	8.9	122	○
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	45.8	125	○
1.3.1	Ease of starting a business*	78.6	103	
1.3.2	Ease of resolving insolvency*	30.6	113	
1.3.3	Ease of paying taxes*	28.1	125	○
2	**Human capital & research**	**15.1**	**[112]**	
2.1	Education	35.7	[98]	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⓓ	8.6	109	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	19.3	79	
2.2	Tertiary education	8.2	[114]	
2.2.1	Tertiary enrolment, % gross ⓓ	10.1	104	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	1.3	100	
2.3.1	Researchers, FTE/mn pop. ⓓ	38.6	95	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.2	89	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**28.2**	**111**	
3.1	Information & communication technologies (ICTs)	32.3	105	
3.1.1	ICT access*	29.6	110	
3.1.2	ICT use*	22.8	94	
3.1.3	Government's online service*	41.3	98	
3.1.4	E-participation*	35.6	105	
3.2	General infrastructure	18.5	121	
3.2.1	Electricity output, kWh/cap	171.2	113	
3.2.2	Logistics performance*	26.1	88	
3.2.3	Gross capital formation, % GDP	13.8	117	
3.3	Ecological sustainability	33.6	108	
3.3.1	GDP/unit of energy use	7.3	82	
3.3.2	Environmental performance*	58.3	104	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	121	
4	**Market sophistication**	**40.2**	**94**	
4.1	Credit	23.8	103	
4.1.1	Ease of getting credit*	65.0	40	●
4.1.2	Domestic credit to private sector, % GDP	14.2	121	
4.1.3	Microfinance gross loans, % GDP	0.1	56	
4.2	Investment	33.9	90	
4.2.1	Ease of protecting minority investors*	65.0	31	●
4.2.2	Market capitalization, % GDP	10.4	76	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	86	
4.3	Trade, competition, & market scale	62.7	58	●
4.3.1	Applied tariff rate, weighted mean, %	9.8	114	
4.3.2	Intensity of local competition†	67.2	72	●
4.3.3	Domestic market scale, bn PPP$	1,088.9	22	●
5	**Business sophistication**	**21.7**	**118**	
5.1	Knowledge workers	24.0	[99]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	30.7	51	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⓓ	0.2	92	○
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	16.4	122	○
5.2.1	University/industry research collaboration†	27.8	111	
5.2.2	State of cluster development†	41.5	80	
5.2.3	GERD financed by abroad, % ⓓ	1.0	86	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	106	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	115	○
5.3	Knowledge absorption	24.6	98	
5.3.1	Intellectual property payments, % total trade	0.4	67	●
5.3.2	High-tech imports less re-imports, % total trade ⓓ	3.4	119	
5.3.3	ICT services imports, % total trade	1.7	32	●
5.3.4	FDI net inflows, % GDP	0.8	107	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**9.9**	**119**	
6.1	Knowledge creation	3.1	112	
6.1.1	Patents by origin/bn PPP$ GDP ⓓ	0.1	116	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	104	○
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.3	117	
6.1.5	Citable documents H index	9.5	66	●
6.2	Knowledge impact	10.3	116	
6.2.1	Growth rate of PPP$ GDP/worker, %	(2.7)	107	○
6.2.2	New businesses/th pop. 15–64	0.8	79	
6.2.3	Computer software spending, % GDP	0.1	81	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.2	122	○
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	16.4	105	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade ⓓ	0.2	103	
6.3.3	ICT services exports, % total trade	0.1	119	
6.3.4	FDI net outflows, % GDP	0.3	78	
7	**Creative outputs**	**19.9**	**102**	
7.1	Intangible assets	32.8	97	
7.1.1	Trademarks by origin/bn PPP$ GDP ⓓ	19.8	83	
7.1.2	Industrial designs by origin/bn PPP$ GDP ⓓ	0.9	67	
7.1.3	ICTs & business model creation†	57.5	75	
7.1.4	ICTs & organizational model creation†	45.2	91	
7.2	Creative goods & services	10.7	86	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69 ⓓ	11.2	13	●
7.2.3	Global ent. & media market/th pop. 15–69	0.8	59	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⓓ	0.0	115	
7.3	Online creativity	3.4	116	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.5	105	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	109	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	1.3	112	
7.3.4	Video uploads on YouTube/pop. 15–69	0.4	72	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Norway

Key indicators

Population (millions)	5.3
GDP (US$ billions)	376.3
GDP per capita, PPP$	68,430.2
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**53.1**	**19**	
Innovation Output Sub-Index	42.3	22	
Innovation Input Sub-Index	64.0	14	
Innovation Efficiency Ratio	0.7	51	
Global Innovation Index 2016 (out of 128)	52.0	22	

		Score	Rank	
1	**Institutions**	**91.8**	**5**	●
1.1	Political environment	90.8	5	●
1.1.1	Political stability & safety*	91.7	9	
1.1.2	Government effectiveness*	90.0	5	●
1.2	Regulatory environment	94.9	6	●
1.2.1	Regulatory quality*	83.9	16	
1.2.2	Rule of law*	98.5	4	●
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	22	
1.3	Business environment	89.6	6	●
1.3.1	Ease of starting a business*	94.3	19	
1.3.2	Ease of resolving insolvency*	89.1	6	●
1.3.3	Ease of paying taxes*	85.5	24	
2	**Human capital & research**	**53.3**	**21**	
2.1	Education	64.3	14	
2.1.1	Expenditure on education, % GDP	7.4	10	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ◔	25.8	26	
2.1.3	School life expectancy, years	17.7	13	
2.1.4	PISA scales in reading, maths, & science	504.5	15	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	40.2	47	
2.2.1	Tertiary enrolment, % gross	76.7	20	
2.2.2	Graduates in science & engineering, %	20.0	57	○
2.2.3	Tertiary inbound mobility, %	3.5	52	○
2.3	Research & development (R&D)	55.5	20	
2.3.1	Researchers, FTE/mn pop.	5,915.6	7	
2.3.2	Gross expenditure on R&D, % GDP	1.9	20	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	55.8	24	
2.3.4	QS university ranking, average score top 3*	49.8	20	
3	**Infrastructure**	**69.3**	**1**	●
3.1	Information & communication technologies (ICTs)	80.9	19	
3.1.1	ICT access*	82.1	21	
3.1.2	ICT use*	84.8	4	●
3.1.3	Government's online service*	80.4	25	
3.1.4	E-participation*	76.3	27	
3.2	General infrastructure	72.4	1	●
3.2.1	Electricity output, kWh/cap	27,803.7	1	●
3.2.2	Logistics performance*	77.2	22	
3.2.3	Gross capital formation, % GDP	28.3	27	
3.3	Ecological sustainability	54.7	30	
3.3.1	GDP/unit of energy use	10.4	43	
3.3.2	Environmental performance*	86.9	17	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.5	29	
4	**Market sophistication**	**57.2**	**22**	
4.1	Credit	55.2	18	
4.1.1	Ease of getting credit*	55.0	67	○
4.1.2	Domestic credit to private sector, % GDP	138.4	12	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	46.3	38	
4.2.1	Ease of protecting minority investors*	75.0	9	
4.2.2	Market capitalization, % GDP	50.2	32	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	33	
4.3	Trade, competition, & market scale	70.2	36	
4.3.1	Applied tariff rate, weighted mean, %	1.0	13	
4.3.2	Intensity of local competition†	68.9	67	○
4.3.3	Domestic market scale, bn PPP$	364.7	45	
5	**Business sophistication**	**48.3**	**23**	
5.1	Knowledge workers	67.7	9	
5.1.1	Knowledge-intensive employment, %	51.7	4	●
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	1.0	22	
5.1.4	GERD financed by business, % ◔	43.1	29	
5.1.5	Females employed w/advanced degrees, % total	24.7	9	
5.2	Innovation linkages	40.0	30	
5.2.1	University/industry research collaboration†	62.4	19	
5.2.2	State of cluster development†	70.2	8	●
5.2.3	GERD financed by abroad, % ◔	9.5	48	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	22	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.2	23	
5.3	Knowledge absorption	37.1	45	
5.3.1	Intellectual property payments, % total trade	0.5	64	○
5.3.2	High-tech imports less re-imports, % total trade	7.0	77	○
5.3.3	ICT services imports, % total trade	2.1	20	
5.3.4	FDI net inflows, % GDP	0.0	125	○
5.3.5	Research talent, % in business enterprise	49.4	25	
6	**Knowledge & technology outputs**	**37.5**	**22**	
6.1	Knowledge creation	34.0	27	
6.1.1	Patents by origin/bn PPP$ GDP	4.7	24	
6.1.2	PCT patent applications/bn PPP$ GDP	1.8	20	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	35.0	20	
6.1.5	Citable documents H index	38.3	20	
6.2	Knowledge impact	44.1	18	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.0	54	○
6.2.2	New businesses/th pop. 15–64	7.7	15	
6.2.3	Computer software spending, % GDP	0.6	9	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.9	53	
6.2.5	High- & medium-high-tech manufactures, %	0.3	32	
6.3	Knowledge diffusion	34.4	28	
6.3.1	Intellectual property receipts, % total trade	0.4	29	
6.3.2	High-tech exports less re-exports, % total trade	3.9	41	
6.3.3	ICT services exports, % total trade	1.6	65	○
6.3.4	FDI net outflows, % GDP	3.7	14	
7	**Creative outputs**	**47.1**	**20**	
7.1	Intangible assets	51.5	32	
7.1.1	Trademarks by origin/bn PPP$ GDP	32.0	69	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.7	47	
7.1.3	ICTs & business model creation†	79.1	13	
7.1.4	ICTs & organizational model creation†	80.6	3	●
7.2	Creative goods & services	27.4	37	
7.2.1	Cultural & creative services exports, % of total trade	0.1	62	○
7.2.2	National feature films/mn pop. 15–69	6.2	32	
7.2.3	Global ent. & media market/th pop. 15–69	100.0	1	●
7.2.4	Printing & publishing manufactures, %	1.3	39	
7.2.5	Creative goods exports, % total trade	0.5	59	
7.3	Online creativity	57.8	10	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	51.5	14	
7.3.2	Country-code TLDs/th pop. 15–69	56.8	13	
7.3.3	Wikipedia edits/mn pop. 15–69	7.8	2	●
7.3.4	Video uploads on YouTube/pop. 15–69	47.5	17	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◔ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Oman

Key indicators

Population (millions)	4.7
GDP (US$ billions)	59.7
GDP per capita, PPP$	44,628.3
Income group	High income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**31.8**	**77**	
	Innovation Output Sub-Index	20.2	90	
	Innovation Input Sub-Index	43.5	62	
	Innovation Efficiency Ratio	0.5	115	○
	Global Innovation Index 2016 (out of 128)	32.2	73	
1	**Institutions**	**71.8**	**39**	●
1.1	Political environment	62.6	47	
1.1.1	Political stability & safety*	80.7	33	●
1.1.2	Government effectiveness*	44.6	67	
1.2	Regulatory environment	77.5	31	●
1.2.1	Regulatory quality*	57.0	46	
1.2.2	Rule of law*	52.9	43	
1.2.3	Cost of redundancy dismissal, salary weeks ⓐ	8.0	1	●
1.3	Business environment	75.4	46	
1.3.1	Ease of starting a business*	92.9	29	●
1.3.2	Ease of resolving insolvency*	42.7	84	
1.3.3	Ease of paying taxes*	90.6	12	●
2	**Human capital & research**	**35.8**	**51**	
2.1	Education	42.8	81	
2.1.1	Expenditure on education, % GDP	5.0	48	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	21.5	49	
2.1.3	School life expectancy, years	14.1	61	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	60.5	6	●
2.2.1	Tertiary enrolment, % gross	31.9	76	
2.2.2	Graduates in science & engineering, %	48.7	1	●
2.2.3	Tertiary inbound mobility, %	2.8	60	
2.3	Research & development (R&D)	4.2	78	
2.3.1	Researchers, FTE/mn pop.	202.0	74	
2.3.2	Gross expenditure on R&D, % GDP	0.2	85	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	9.1	64	
3	**Infrastructure**	**48.4**	**56**	
3.1	Information & communication technologies (ICTs)	60.7	57	
3.1.1	ICT access*	73.7	41	●
3.1.2	ICT use*	53.9	53	
3.1.3	Government's online service*	59.4	67	
3.1.4	E-participation*	55.9	74	
3.2	General infrastructure	50.8	24	●
3.2.1	Electricity output, kWh/cap	6,869.8	29	●
3.2.2	Logistics performance*	54.2	47	
3.2.3	Gross capital formation, % GDP	31.0	15	●
3.3	Ecological sustainability	33.7	107	
3.3.1	GDP/unit of energy use	6.3	90	
3.3.2	Environmental performance*	60.1	100	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	77	
4	**Market sophistication**	**44.2**	**72**	
4.1	Credit	30.3	78	
4.1.1	Ease of getting credit*	35.0	104	
4.1.2	Domestic credit to private sector, % GDP	65.6	46	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	39.5	68	
4.2.1	Ease of protecting minority investors*	46.7	95	
4.2.2	Market capitalization, % GDP	58.9	29	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	62.9	57	
4.3.1	Applied tariff rate, weighted mean, %	1.9	54	
4.3.2	Intensity of local competition†	60.0	103	
4.3.3	Domestic market scale, bn PPP$	173.1	62	
5	**Business sophistication**	**17.0**	**126**	○
5.1	Knowledge workers	14.2	[118]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	0.0	73	
5.1.4	GERD financed by business, %	21.4	61	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	21.1	97	
5.2.1	University/industry research collaboration†	43.4	51	
5.2.2	State of cluster development†	45.7	61	
5.2.3	GERD financed by abroad, % ⓐ	0.0	99	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	37	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓐ	0.0	103	
5.3	Knowledge absorption	15.6	127	○
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade ⓐ	3.1	120	○
5.3.3	ICT services imports, % total trade ⓐ	0.2	116	○
5.3.4	FDI net inflows, % GDP	0.0	124	○
5.3.5	Research talent, % in business enterprise	10.6	65	
6	**Knowledge & technology outputs**	**15.6**	**100**	
6.1	Knowledge creation	2.9	114	○
6.1.1	Patents by origin/bn PPP$ GDP	0.0	122	○
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	87	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.2	103	
6.1.5	Citable documents H index	5.8	89	
6.2	Knowledge impact	23.2	95	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.7)	96	
6.2.2	New businesses/th pop. 15–64 ⓐ	1.0	69	
6.2.3	Computer software spending, % GDP	0.1	99	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.2	76	
6.2.5	High- & medium-high-tech manufactures, %	0.4	24	●
6.3	Knowledge diffusion	20.7	71	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade ⓐ	0.5	85	
6.3.3	ICT services exports, % total trade ⓐ	0.2	115	○
6.3.4	FDI net outflows, % GDP	1.1	49	
7	**Creative outputs**	**24.8**	**91**	
7.1	Intangible assets	40.9	70	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.0	113	○
7.1.3	ICTs & business model creation†	55.3	83	
7.1.4	ICTs & organizational model creation†	47.0	83	
7.2	Creative goods & services	3.9	114	○
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69 ⓐ	0.0	104	○
7.2.3	Global ent. & media market/th pop. 15–69	4.8	46	
7.2.4	Printing & publishing manufactures, %	0.7	78	
7.2.5	Creative goods exports, % total trade ⓐ	0.0	110	○
7.3	Online creativity	13.3	88	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.8	81	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	105	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓐ	4.0	83	
7.3.4	Video uploads on YouTube/pop. 15–69	13.0	61	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Pakistan

Key indicators

Population (millions)	192.8
GDP (US$ billions)	271.1
GDP per capita, PPP$	5,000.0
Income group	Lower-middle income
Region	Central and Southern Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**23.8**	**113**	
	Innovation Output Sub-Index	18.2	101	
	Innovation Input Sub-Index	29.4	116	○
	Innovation Efficiency Ratio	0.6	64	
	Global Innovation Index 2016 (out of 128)	22.6	119	
1	**Institutions**	**38.0**	**124**	○
1.1	Political environment	13.7	126	○
1.1.1	Political stability & safety*	2.1	126	○
1.1.2	Government effectiveness*	25.2	107	
1.2	Regulatory environment	41.6	113	
1.2.1	Regulatory quality*	26.2	106	
1.2.2	Rule of law*	16.4	108	
1.2.3	Cost of redundancy dismissal, salary weeks	27.2	105	
1.3	Business environment	58.8	101	
1.3.1	Ease of starting a business*	77.9	105	
1.3.2	Ease of resolving insolvency*	45.0	77	
1.3.3	Ease of paying taxes*	53.4	109	
2	**Human capital & research**	**12.8**	**121**	○
2.1	Education	23.4	120	○
2.1.1	Expenditure on education, % GDP	2.7	105	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	15.2	79	
2.1.3	School life expectancy, years	8.2	112	○
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	21.1	84	
2.2	Tertiary education	8.1	[115]	
2.2.1	Tertiary enrolment, % gross	9.9	106	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	6.9	67	
2.3.1	Researchers, FTE/mn pop.	294.4	71	
2.3.2	Gross expenditure on R&D, % GDP	0.2	84	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	19.0	51	●
3	**Infrastructure**	**29.0**	**109**	
3.1	Information & communication technologies (ICTs)	28.7	109	
3.1.1	ICT access*	33.9	104	
3.1.2	ICT use*	10.9	112	
3.1.3	Government's online service*	32.6	106	
3.1.4	E-participation*	37.3	101	
3.2	General infrastructure	23.9	111	
3.2.1	Electricity output, kWh/cap	569.1	105	
3.2.2	Logistics performance*	39.8	67	
3.2.3	Gross capital formation, % GDP	15.2	111	
3.3	Ecological sustainability	34.5	104	
3.3.1	GDP/unit of energy use	9.3	57	●
3.3.2	Environmental performance*	51.4	109	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	83	
4	**Market sophistication**	**38.3**	**102**	
4.1	Credit	19.7	113	
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	15.4	115	○
4.1.3	Microfinance gross loans, % GDP	0.2	50	
4.2	Investment	35.1	83	
4.2.1	Ease of protecting minority investors*	66.7	26	●
4.2.2	Market capitalization, % GDPⓓ	15.2	67	
4.2.3	Venture capital deals/bn PPP$ GDPⓓ	0.0	89	○
4.3	Trade, competition, & market scale	60.2	68	
4.3.1	Applied tariff rate, weighted mean, %	9.5	111	
4.3.2	Intensity of local competition†	57.8	109	
4.3.3	Domestic market scale, bn PPP$	988.2	24	●
5	**Business sophistication**	**29.0**	**78**	
5.1	Knowledge workers	35.6	[74]	
5.1.1	Knowledge-intensive employment, %ⓓ	19.5	75	
5.1.2	Firms offering formal training, % firms	32.0	46	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	20.8	99	
5.2.1	University/industry research collaboration†	40.7	65	
5.2.2	State of cluster development†	44.2	71	
5.2.3	GERD financed by abroad, %	2.7	69	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	57	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	109	○
5.3	Knowledge absorption	30.6	78	
5.3.1	Intellectual property payments, % total trade	0.5	63	
5.3.2	High-tech imports less re-imports, % total trade	10.3	41	●
5.3.3	ICT services imports, % total trade	1.1	61	●
5.3.4	FDI net inflows, % GDP	0.6	113	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**18.9**	**84**	
6.1	Knowledge creation	8.5	69	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	95	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.7	71	
6.1.5	Citable documents H index	12.8	53	●
6.2	Knowledge impact	31.2	62	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.5	30	●
6.2.2	New businesses/th pop. 15–64	0.0	103	○
6.2.3	Computer software spending, % GDP	0.3	59	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.7	83	
6.2.5	High- & medium-high-tech manufactures, %	0.2	52	
6.3	Knowledge diffusion	16.9	102	
6.3.1	Intellectual property receipts, % total trade	0.0	71	
6.3.2	High-tech exports less re-exports, % total trade	0.7	71	
6.3.3	ICT services exports, % total trade	2.2	50	●
6.3.4	FDI net outflows, % GDP	0.1	100	
7	**Creative outputs**	**17.4**	**112**	
7.1	Intangible assets	29.4	105	
7.1.1	Trademarks by origin/bn PPP$ GDP	25.3	78	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.4	84	
7.1.3	ICTs & business model creation†	51.3	96	
7.1.4	ICTs & organizational model creation†	38.0	112	
7.2	Creative goods & services	1.4	123	○
7.2.1	Cultural & creative services exports, % of total tradeⓓ	0.0	78	
7.2.2	National feature films/mn pop. 15–69	0.0	103	○
7.2.3	Global ent. & media market/th pop. 15–69	0.2	62	○
7.2.4	Printing & publishing manufactures, %	0.3	96	○
7.2.5	Creative goods exports, % total trade	0.1	99	
7.3	Online creativity	9.7	100	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.6	103	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	108	
7.3.3	Wikipedia edits/mn pop. 15–69	2.9	101	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Panama

Key indicators

Population (millions)	4.0
GDP (US$ billions)	55.2
GDP per capita, PPP$	21,764.6
Income group	Upper-middle income
Region	Latin America and the Caribbean

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**35.0**	**63**	
	Innovation Output Sub-Index	28.7	55	
	Innovation Input Sub-Index	41.3	74	
	Innovation Efficiency Ratio	0.7	38	
	Global Innovation Index 2016 (out of 128)	33.5	68	
1	**Institutions**	**60.5**	**66**	
1.1	Political environment	61.8	48	
1.1.1	Political stability & safety*	73.8	43	
1.1.2	Government effectiveness*	49.8	51	
1.2	Regulatory environment	61.9	69	
1.2.1	Regulatory quality*	51.7	56	
1.2.2	Rule of law*	35.9	66	
1.2.3	Cost of redundancy dismissal, salary weeks	18.1	75	
1.3	Business environment	57.8	107	
1.3.1	Ease of starting a business*	92.0	36	
1.3.2	Ease of resolving insolvency*	33.4	110	
1.3.3	Ease of paying taxes*	48.1	117	
2	**Human capital & research**	**21.4**	**96**	
2.1	Education	33.6	102	
2.1.1	Expenditure on education, % GDP ⓓ	3.2	97	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	9.2	98	
2.1.3	School life expectancy, years ⓓ	12.8	77	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	15.5	67	
2.2	Tertiary education	30.3	80	
2.2.1	Tertiary enrolment, % gross ⓓ	38.7	67	
2.2.2	Graduates in science & engineering, %	15.9	80	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	0.4	110	
2.3.1	Researchers, FTE/mn pop. ⓓ	39.4	94	○
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.1	108	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**55.1**	**36**	
3.1	Information & communication technologies (ICTs)	40.7	94	
3.1.1	ICT access*	59.9	72	
3.1.2	ICT use*	32.4	82	
3.1.3	Government's online service*	33.3	104	
3.1.4	E-participation*	37.3	101	
3.2	General infrastructure	66.2	4	●
3.2.1	Electricity output, kWh/cap	2,399.7	72	
3.2.2	Logistics performance*	58.9	39	
3.2.3	Gross capital formation, % GDP	47.2	2	●
3.3	Ecological sustainability	58.4	21	●
3.3.1	GDP/unit of energy use	17.9	3	●
3.3.2	Environmental performance*	78.0	50	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	98	
4	**Market sophistication**	**43.0**	**83**	
4.1	Credit	38.4	53	
4.1.1	Ease of getting credit*	75.0	19	●
4.1.2	Domestic credit to private sector, % GDP	88.5	33	
4.1.3	Microfinance gross loans, % GDP	0.3	43	
4.2	Investment	33.5	92	
4.2.1	Ease of protecting minority investors*	56.7	67	
4.2.2	Market capitalization, % GDP ⓓ	31.1	44	
4.2.3	Venture capital deals/bn PPP$ GDP ⓓ	0.0	46	
4.3	Trade, competition, & market scale	57.0	83	
4.3.1	Applied tariff rate, weighted mean, % ⓓ	6.1	99	
4.3.2	Intensity of local competition†	73.7	33	
4.3.3	Domestic market scale, bn PPP$	93.1	74	
5	**Business sophistication**	**26.4**	**94**	
5.1	Knowledge workers	23.7	101	
5.1.1	Knowledge-intensive employment, % ⓓ	24.0	59	
5.1.2	Firms offering formal training, % firms ⓓ	11.0	88	○
5.1.3	GERD performed by business, % of GDP ⓓ	0.0	88	○
5.1.4	GERD financed by business, % ⓓ	10.8	72	
5.1.5	Females employed w/advanced degrees, % total ⓓ	16.6	33	
5.2	Innovation linkages	21.3	93	
5.2.1	University/industry research collaboration†	39.7	72	
5.2.2	State of cluster development†	53.3	36	
5.2.3	GERD financed by abroad, % ⓓ	0.3	94	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	104	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	64	
5.3	Knowledge absorption	34.3	57	
5.3.1	Intellectual property payments, % total trade	0.4	70	
5.3.2	High-tech imports less re-imports, % total trade ⓓ	18.8	7	●
5.3.3	ICT services imports, % total trade	0.3	114	
5.3.4	FDI net inflows, % GDP	10.1	9	●
5.3.5	Research talent, % in business enterprise ⓓ	0.9	79	○
6	**Knowledge & technology outputs**	**21.7**	**60**	
6.1	Knowledge creation	4.6	91	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	98	
6.1.2	PCT patent applications/bn PPP$ GDP	0.6	31	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	58	
6.1.4	Scientific & technical articles/bn PPP$ GDP	4.5	102	
6.1.5	Citable documents H index	10.6	58	
6.2	Knowledge impact	28.2	76	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64 ⓓ	14.1	6	●
6.2.3	Computer software spending, % GDP	0.2	70	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.3	88	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	89	
6.3	Knowledge diffusion	32.5	35	
6.3.1	Intellectual property receipts, % total trade	0.0	81	
6.3.2	High-tech exports less re-exports, % total trade ⓓ	17.1	6	●
6.3.3	ICT services exports, % total trade	1.1	79	
6.3.4	FDI net outflows, % GDP	1.8	37	
7	**Creative outputs**	**35.6**	**50**	
7.1	Intangible assets	46.6	50	
7.1.1	Trademarks by origin/bn PPP$ GDP	56.4	39	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	94	
7.1.3	ICTs & business model creation†	71.8	27	●
7.1.4	ICTs & organizational model creation†	62.1	34	
7.2	Creative goods & services	17.9	65	
7.2.1	Cultural & creative services exports, % of total trade	0.1	50	
7.2.2	National feature films/mn pop. 15–69 ⓓ	0.4	94	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	3.2	6	●
7.2.5	Creative goods exports, % total trade	0.0	116	○
7.3	Online creativity	31.3	37	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	44.6	16	●
7.3.2	Country-code TLDs/th pop. 15–69	1.2	77	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	5.0	63	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Paraguay

Key indicators

Population (millions)	6.7
GDP (US$ billions)	27.3
GDP per capita, PPP$	8,707.8
Income group	Upper-middle income
Region	Latin America and the Caribbean

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**30.3**	**85**	
	Innovation Output Sub-Index	23.0	79	
	Innovation Input Sub-Index	37.6	90	
	Innovation Efficiency Ratio	0.6	72	
	Global Innovation Index 2016 (out of 128)	28.2	94	
1	**Institutions**	**46.9**	**105**	
1.1	Political environment	40.6	93	
1.1.1	Political stability & safety*	63.3	62	
1.1.2	Government effectiveness*	17.9	119	○
1.2	Regulatory environment	42.4	112	
1.2.1	Regulatory quality*	35.3	86	
1.2.2	Rule of law*	19.1	101	
1.2.3	Cost of redundancy dismissal, salary weeks	29.4	114	
1.3	Business environment	57.6	108	
1.3.1	Ease of starting a business*	77.5	107	
1.3.2	Ease of resolving insolvency*	40.7	91	
1.3.3	Ease of paying taxes*	54.6	106	
2	**Human capital & research**	**24.0**	**87**	
2.1	Education	40.5	86	
2.1.1	Expenditure on education, % GDPⓓ	5.0	51	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/capⓓ	16.6	70	
2.1.3	School life expectancy, yearsⓓ	12.3	82	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondaryⓓ	18.4	77	
2.2	Tertiary education	30.3	[79]	
2.2.1	Tertiary enrolment, % grossⓓ	35.1	74	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	1.2	103	
2.3.1	Researchers, FTE/mn pop.	184.1	76	
2.3.2	Gross expenditure on R&D, % GDP	0.1	98	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**39.9**	**89**	
3.1	Information & communication technologies (ICTs)	48.3	84	
3.1.1	ICT access*	45.9	91	
3.1.2	ICT use*	29.6	86	
3.1.3	Government's online service*	60.1	64	
3.1.4	E-participation*	57.6	70	
3.2	General infrastructure	27.5	99	
3.2.1	Electricity output, kWh/cap	8,440.0	18	●
3.2.2	Logistics performance*	23.0	98	
3.2.3	Gross capital formation, % GDP	15.8	107	
3.3	Ecological sustainability	43.8	67	
3.3.1	GDP/unit of energy use	10.5	42	●
3.3.2	Environmental performance*	70.4	75	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	104	
4	**Market sophistication**	**50.5**	**45**	●
4.1	Credit	54.1	19	●
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	57.9	53	●
4.1.3	Microfinance gross loans, % GDP	5.3	5	●
4.2	Investment	41.7	[55]	
4.2.1	Ease of protecting minority investors*	41.7	105	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	55.7	92	
4.3.1	Applied tariff rate, weighted mean, %	4.4	84	
4.3.2	Intensity of local competition†	67.3	71	
4.3.3	Domestic market scale, bn PPP$	64.1	89	
5	**Business sophistication**	**26.9**	**92**	
5.1	Knowledge workers	34.0	79	
5.1.1	Knowledge-intensive employment, %	19.0	76	
5.1.2	Firms offering formal training, % firmsⓓ	54.9	15	●
5.1.3	GERD performed by business, % of GDPⓓ	0.0	89	○
5.1.4	GERD financed by business, %	0.3	90	○
5.1.5	Females employed w/advanced degrees, % totalⓓ	12.4	54	
5.2	Innovation linkages	18.7	116	
5.2.1	University/industry research collaboration†	24.6	119	○
5.2.2	State of cluster development†	31.9	116	○
5.2.3	GERD financed by abroad, %	10.3	47	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	58	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	106	
5.3	Knowledge absorption	28.0	87	
5.3.1	Intellectual property payments, % total trade	0.2	87	
5.3.2	High-tech imports less re-imports, % total trade	13.3	18	●
5.3.3	ICT services imports, % total trade	0.0	126	○
5.3.4	FDI net inflows, % GDP	1.0	105	
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**9.5**	**120**	○
6.1	Knowledge creation	2.2	119	○
6.1.1	Patents by origin/bn PPP$ GDPⓓ	0.4	80	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.6	119	○
6.1.5	Citable documents H index	2.9	111	
6.2	Knowledge impact	10.1	117	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	106	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.5	59	●
6.2.5	High- & medium-high-tech manufactures, %ⓓ	0.1	72	
6.3	Knowledge diffusion	16.3	108	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.5	88	
6.3.3	ICT services exports, % total trade	0.1	118	○
6.3.4	FDI net outflows, % GDP	0.2	86	
7	**Creative outputs**	**36.4**	**46**	●
7.1	Intangible assets	62.0	12	●
7.1.1	Trademarks by origin/bn PPP$ GDPⓓ	296.3	1	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	49.9	100	
7.1.4	ICTs & organizational model creation†	36.2	114	
7.2	Creative goods & services	8.6	93	
7.2.1	Cultural & creative services exports, % of total trade	0.0	82	
7.2.2	National feature films/mn pop. 15–69ⓓ	1.3	74	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %ⓓ	1.3	37	●
7.2.5	Creative goods exports, % total trade	0.1	83	
7.3	Online creativity	13.1	90	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.7	84	
7.3.2	Country-code TLDs/th pop. 15–69	1.3	75	
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	3.8	88	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Peru

Key indicators

Population (millions)	31.8
GDP (US$ billions)	180.3
GDP per capita, PPP$	12,194.7
Income group	Upper-middle income
Region	Latin America and the Caribbean

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**32.9**	**70**	
	Innovation Output Sub-Index	21.6	85	
	Innovation Input Sub-Index	44.2	56	
	Innovation Efficiency Ratio	0.5	106	○
	Global Innovation Index 2016 (out of 128)	32.5	71	
1	**Institutions**	**58.7**	**67**	
1.1	Political environment	43.3	86	
1.1.1	Political stability & safety*	51.6	87	
1.1.2	Government effectiveness*	35.0	86	
1.2	Regulatory environment	66.3	57	
1.2.1	Regulatory quality*	54.7	48	
1.2.2	Rule of law*	23.9	93	
1.2.3	Cost of redundancy dismissal, salary weeks	11.4	40	●
1.3	Business environment	66.6	73	
1.3.1	Ease of starting a business*	85.0	78	
1.3.2	Ease of resolving insolvency*	45.9	72	
1.3.3	Ease of paying taxes*	69.0	78	
2	**Human capital & research**	**26.6**	**84**	
2.1	Education	38.2	94	
2.1.1	Expenditure on education, % GDP	3.9	81	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	14.1	86	
2.1.3	School life expectancy, years ⓘ	13.4	65	
2.1.4	PISA scales in reading, maths, & science	393.6	65	○
2.1.5	Pupil-teacher ratio, secondary	14.1	59	
2.2	Tertiary education	35.1	[66]	
2.2.1	Tertiary enrolment, % gross ⓘ	40.5	64	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	6.5	72	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP	0.1	97	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	16.6	54	
3	**Infrastructure**	**45.2**	**69**	
3.1	Information & communication technologies (ICTs)	48.7	82	
3.1.1	ICT access*	48.0	86	
3.1.2	ICT use*	29.4	87	
3.1.3	Government's online service*	63.0	57	
3.1.4	E-participation*	54.2	80	
3.2	General infrastructure	34.9	75	
3.2.1	Electricity output, kWh/cap	1,470.0	88	
3.2.2	Logistics performance*	38.4	68	
3.2.3	Gross capital formation, % GDP	24.6	47	
3.3	Ecological sustainability	52.1	40	●
3.3.1	GDP/unit of energy use	14.5	12	●
3.3.2	Environmental performance*	73.0	67	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.0	61	
4	**Market sophistication**	**54.8**	**27**	●
4.1	Credit	60.0	15	●
4.1.1	Ease of getting credit*	80.0	15	●
4.1.2	Domestic credit to private sector, % GDP	37.4	86	
4.1.3	Microfinance gross loans, % GDP	4.8	6	●
4.2	Investment	34.1	87	
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDP	29.9	47	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	64	
4.3	Trade, competition, & market scale	70.4	35	●
4.3.1	Applied tariff rate, weighted mean, % ⓘ	1.4	22	●
4.3.2	Intensity of local competition†	69.6	66	
4.3.3	Domestic market scale, bn PPP$	409.9	44	●
5	**Business sophistication**	**35.7**	**49**	
5.1	Knowledge workers	47.8	38	●
5.1.1	Knowledge-intensive employment, %	14.6	90	○
5.1.2	Firms offering formal training, % firms ⓘ	60.1	8	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	13.5	45	
5.2	Innovation linkages	21.7	88	
5.2.1	University/industry research collaboration†	31.8	100	○
5.2.2	State of cluster development†	37.4	93	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	95	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	105	○
5.3	Knowledge absorption	37.5	43	●
5.3.1	Intellectual property payments, % total trade	0.7	49	
5.3.2	High-tech imports less re-imports, % total trade	11.1	33	●
5.3.3	ICT services imports, % total trade	1.4	46	
5.3.4	FDI net inflows, % GDP	4.2	33	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**15.8**	**97**	
6.1	Knowledge creation	6.3	80	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	97	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	81	
6.1.3	Utility models by origin/bn PPP$ GDP	0.5	36	
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.7	113	○
6.1.5	Citable documents H index	11.7	56	
6.2	Knowledge impact	27.6	80	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.8	39	
6.2.2	New businesses/th pop. 15–64	2.4	42	
6.2.3	Computer software spending, % GDP	0.2	64	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.3	75	
6.2.5	High- & medium-high-tech manufactures, % ⓘ	0.1	83	○
6.3	Knowledge diffusion	13.4	119	○
6.3.1	Intellectual property receipts, % total trade	0.1	66	
6.3.2	High-tech exports less re-exports, % total trade	0.5	84	
6.3.3	ICT services exports, % total trade	0.3	108	○
6.3.4	FDI net outflows, % GDP	0.1	98	
7	**Creative outputs**	**27.4**	**82**	
7.1	Intangible assets	38.1	80	
7.1.1	Trademarks by origin/bn PPP$ GDP	51.1	46	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.3	90	
7.1.3	ICTs & business model creation†	59.8	65	
7.1.4	ICTs & organizational model creation†	47.0	84	
7.2	Creative goods & services	16.3	71	
7.2.1	Cultural & creative services exports, % of total trade	0.1	54	
7.2.2	National feature films/mn pop. 15–69	1.4	70	
7.2.3	Global ent. & media market/th pop. 15–69	5.9	42	
7.2.4	Printing & publishing manufactures, % ⓘ	2.7	11	●
7.2.5	Creative goods exports, % total trade	0.3	67	
7.3	Online creativity	17.1	74	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	5.3	55	
7.3.2	Country-code TLDs/th pop. 15–69	1.4	72	
7.3.3	Wikipedia edits/mn pop. 15–69	4.3	74	
7.3.4	Video uploads on YouTube/pop. 15–69	20.3	57	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓘ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Philippines

Key indicators

Population (millions)	102.3
GDP (US$ billions)	311.7
GDP per capita, PPP$	7,254.2
Income group	Lower-middle income
Region	South East Asia, East Asia, and Oceania

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**32.5**	**73**	
	Innovation Output Sub-Index	25.6	65	
	Innovation Input Sub-Index	39.4	83	
	Innovation Efficiency Ratio	0.6	55	
	Global Innovation Index 2016 (out of 128)	31.8	74	
1	**Institutions**	**52.0**	**89**	
1.1	Political environment	44.2	84	
1.1.1	Political stability & safety*	43.5	98	
1.1.2	Government effectiveness*	44.9	65	
1.2	Regulatory environment	48.4	105	
1.2.1	Regulatory quality*	41.2	72	
1.2.2	Rule of law*	29.3	81	
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	111	○
1.3	Business environment	63.3	81	
1.3.1	Ease of starting a business*	68.9	120	○
1.3.2	Ease of resolving insolvency*	55.2	53	
1.3.3	Ease of paying taxes*	65.7	84	
2	**Human capital & research**	**22.3**	**95**	
2.1	Education	26.9	113	○
2.1.1	Expenditure on education, % GDP ⓓ	2.7	106	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	9.1	99	○
2.1.3	School life expectancy, years ⓓ	12.7	81	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	27.0	99	○
2.2	Tertiary education	32.7	74	
2.2.1	Tertiary enrolment, % gross ⓓ	35.8	73	
2.2.2	Graduates in science & engineering, %	25.5	27	●
2.2.3	Tertiary inbound mobility, % ⓓ	0.1	105	○
2.3	Research & development (R&D)	7.4	64	
2.3.1	Researchers, FTE/mn pop. ⓓ	189.4	75	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.1	96	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	24.4	47	
3	**Infrastructure**	**44.6**	**72**	
3.1	Information & communication technologies (ICTs)	50.6	78	
3.1.1	ICT access*	47.0	89	
3.1.2	ICT use*	29.3	88	
3.1.3	Government's online service*	66.7	51	
3.1.4	E-participation*	59.3	65	
3.2	General infrastructure	32.9	84	
3.2.1	Electricity output, kWh/cap	779.3	99	
3.2.2	Logistics performance*	36.7	70	
3.2.3	Gross capital formation, % GDP	23.7	50	
3.3	Ecological sustainability	50.4	44	
3.3.1	GDP/unit of energy use	13.5	16	●
3.3.2	Environmental performance*	73.7	62	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.7	75	
4	**Market sophistication**	**41.3**	**92**	
4.1	Credit	20.7	110	
4.1.1	Ease of getting credit*	40.0	98	
4.1.2	Domestic credit to private sector, % GDP	41.8	79	
4.1.3	Microfinance gross loans, % GDP	0.3	39	
4.2	Investment	30.2	111	
4.2.1	Ease of protecting minority investors*	41.7	105	
4.2.2	Market capitalization, % GDP	81.7	17	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	74	
4.3	Trade, competition, & market scale	72.9	27	●
4.3.1	Applied tariff rate, weighted mean, % ⓓ	2.2	56	
4.3.2	Intensity of local competition†	70.2	59	
4.3.3	Domestic market scale, bn PPP$	801.9	28	●
5	**Business sophistication**	**36.9**	**45**	
5.1	Knowledge workers	45.5	45	
5.1.1	Knowledge-intensive employment, %	24.0	58	
5.1.2	Firms offering formal training, % firms	59.8	9	●
5.1.3	GERD performed by business, % of GDP ⓓ	0.0	69	
5.1.4	GERD financed by business, % ⓓ	36.9	41	
5.1.5	Females employed w/advanced degrees, % total	13.0	47	
5.2	Innovation linkages	21.2	95	
5.2.1	University/industry research collaboration†	41.4	59	
5.2.2	State of cluster development†	45.7	62	
5.2.3	GERD financed by abroad, % ⓓ	1.8	77	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	50	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	79	
5.3	Knowledge absorption	43.8	25	●
5.3.1	Intellectual property payments, % total trade	0.8	45	
5.3.2	High-tech imports less re-imports, % total trade	n/a	n/a	
5.3.3	ICT services imports, % total trade	1.0	68	
5.3.4	FDI net inflows, % GDP	1.8	86	
5.3.5	Research talent, % in business enterprise ⓓ	63.2	8	●
6	**Knowledge & technology outputs**	**28.3**	**42**	
6.1	Knowledge creation	10.6	65	
6.1.1	Patents by origin/bn PPP$ GDP	0.5	75	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	89	
6.1.3	Utility models by origin/bn PPP$ GDP	1.1	23	
6.1.4	Scientific & technical articles/bn PPP$ GDP	1.6	120	○
6.1.5	Citable documents H index	12.5	54	
6.2	Knowledge impact	40.3	31	●
6.2.1	Growth rate of PPP$ GDP/worker, %	4.0	15	●
6.2.2	New businesses/th pop. 15–64 ⓓ	0.3	92	○
6.2.3	Computer software spending, % GDP	0.3	61	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.0	81	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.4	18	●
6.3	Knowledge diffusion	34.0	30	●
6.3.1	Intellectual property receipts, % total trade	0.0	84	
6.3.2	High-tech exports less re-exports, % total trade	n/a	n/a	
6.3.3	ICT services exports, % total trade	4.3	16	●
6.3.4	FDI net outflows, % GDP	1.9	33	●
7	**Creative outputs**	**22.8**	**94**	
7.1	Intangible assets	37.6	86	
7.1.1	Trademarks by origin/bn PPP$ GDP	28.2	74	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.7	71	
7.1.3	ICTs & business model creation†	60.9	60	
7.1.4	ICTs & organizational model creation†	54.8	57	
7.2	Creative goods & services	3.7	115	○
7.2.1	Cultural & creative services exports, % of total trade	0.1	63	
7.2.2	National feature films/mn pop. 15–69 ⓓ	0.8	83	
7.2.3	Global ent. & media market/th pop. 15–69	2.3	51	
7.2.4	Printing & publishing manufactures, % ⓓ	0.5	90	○
7.2.5	Creative goods exports, % total trade	n/a	n/a	
7.3	Online creativity	12.4	92	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.2	91	
7.3.2	Country-code TLDs/th pop. 15–69	0.3	97	
7.3.3	Wikipedia edits/mn pop. 15–69	4.0	82	
7.3.4	Video uploads on YouTube/pop. 15–69	9.2	63	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Poland

Key indicators

Population (millions)	38.6
GDP (US$ billions)	467.4
GDP per capita, PPP$	26,455.3
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**42.0**	**38**
Innovation Output Sub-Index	33.8	41
Innovation Input Sub-Index	50.2	37
Innovation Efficiency Ratio	0.7	48
Global Innovation Index 2016 (out of 128)	40.2	39

		Score/Value	Rank	
1	**Institutions**	**75.6**	**33**	
1.1	Political environment	73.9	33	
1.1.1	Political stability & safety*	85.0	26	
1.1.2	Government effectiveness*	62.7	40	
1.2	Regulatory environment	71.9	41	
1.2.1	Regulatory quality*	67.6	33	
1.2.2	Rule of law*	62.7	35	
1.2.3	Cost of redundancy dismissal, salary weeks	18.8	78	
1.3	Business environment	81.1	30	
1.3.1	Ease of starting a business*	84.2	82	○
1.3.2	Ease of resolving insolvency*	76.4	25	●
1.3.3	Ease of paying taxes*	82.7	40	

		Score/Value	Rank	
2	**Human capital & research**	**36.5**	**48**	
2.1	Education	57.1	36	
2.1.1	Expenditure on education, % GDP	4.9	55	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	22.1	45	
2.1.3	School life expectancy, years ⓓ	16.4	25	
2.1.4	PISA scales in reading, maths, & science	503.9	17	
2.1.5	Pupil-teacher ratio, secondary ⓓ	9.5	20	●
2.2	Tertiary education	33.5	71	
2.2.1	Tertiary enrolment, % gross ⓓ	71.2	24	●
2.2.2	Graduates in science & engineering, %	17.4	71	○
2.2.3	Tertiary inbound mobility, % ⓓ	1.5	77	○
2.3	Research & development (R&D)	19.0	46	
2.3.1	Researchers, FTE/mn pop.	2,139.1	34	
2.3.2	Gross expenditure on R&D, % GDP	1.0	36	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	26.9	44	

		Score/Value	Rank	
3	**Infrastructure**	**53.3**	**41**	
3.1	Information & communication technologies (ICTs)	70.7	35	
3.1.1	ICT access*	70.9	48	
3.1.2	ICT use*	53.5	54	
3.1.3	Government's online service*	70.3	45	
3.1.4	E-participation*	88.1	14	●
3.2	General infrastructure	38.7	55	
3.2.1	Electricity output, kWh/cap	4,263.4	49	
3.2.2	Logistics performance*	63.0	32	
3.2.3	Gross capital formation, % GDP	20.3	78	○
3.3	Ecological sustainability	50.3	45	
3.3.1	GDP/unit of energy use	9.7	55	
3.3.2	Environmental performance*	81.3	38	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.8	40	

		Score/Value	Rank	
4	**Market sophistication**	**48.2**	**55**	
4.1	Credit	32.6	70	
4.1.1	Ease of getting credit*	75.0	19	
4.1.2	Domestic credit to private sector, % GDP	53.6	65	
4.1.3	Microfinance gross loans, % GDP	0.1	55	○
4.2	Investment	36.6	81	○
4.2.1	Ease of protecting minority investors*	63.3	41	
4.2.2	Market capitalization, % GDP	28.9	50	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	47	
4.3	Trade, competition, & market scale	75.6	20	●
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	71.8	46	
4.3.3	Domestic market scale, bn PPP$	1,052.2	23	●

		Score/Value	Rank	
5	**Business sophistication**	**37.4**	**42**	
5.1	Knowledge workers	47.8	39	
5.1.1	Knowledge-intensive employment, %	37.6	29	
5.1.2	Firms offering formal training, % firms	34.6	40	
5.1.3	GERD performed by business, % of GDP	0.5	35	
5.1.4	GERD financed by business, %	39.0	38	
5.1.5	Females employed w/advanced degrees, % total	19.5	26	
5.2	Innovation linkages	27.5	66	
5.2.1	University/industry research collaboration†	38.2	80	○
5.2.2	State of cluster development†	44.9	66	
5.2.3	GERD financed by abroad, %	16.7	27	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	83	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.4	40	
5.3	Knowledge absorption	36.9	47	
5.3.1	Intellectual property payments, % total trade	1.1	30	
5.3.2	High-tech imports less re-imports, % total trade	10.7	37	
5.3.3	ICT services imports, % total trade	1.2	60	
5.3.4	FDI net inflows, % GDP	2.2	76	
5.3.5	Research talent, % in business enterprise	34.8	40	

		Score/Value	Rank	
6	**Knowledge & technology outputs**	**27.9**	**44**	
6.1	Knowledge creation	24.2	37	
6.1.1	Patents by origin/bn PPP$ GDP	5.2	23	●
6.1.2	PCT patent applications/bn PPP$ GDP	0.3	47	
6.1.3	Utility models by origin/bn PPP$ GDP	1.0	25	
6.1.4	Scientific & technical articles/bn PPP$ GDP	25.1	32	
6.1.5	Citable documents H index	34.8	24	●
6.2	Knowledge impact	35.7	46	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.2	35	
6.2.2	New businesses/th pop. 15–64 ⓓ	0.5	85	○
6.2.3	Computer software spending, % GDP	0.3	44	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	10.6	35	
6.2.5	High- & medium-high-tech manufactures, %	0.3	35	
6.3	Knowledge diffusion	23.8	58	
6.3.1	Intellectual property receipts, % total trade	0.2	41	
6.3.2	High-tech exports less re-exports, % total trade	7.3	25	
6.3.3	ICT services exports, % total trade	1.9	54	
6.3.4	FDI net outflows, % GDP	0.5	67	

		Score/Value	Rank	
7	**Creative outputs**	**39.7**	**37**	
7.1	Intangible assets	45.9	54	
7.1.1	Trademarks by origin/bn PPP$ GDP	45.0	55	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	61.0	59	
7.1.4	ICTs & organizational model creation†	54.0	62	
7.2	Creative goods & services	34.1	22	●
7.2.1	Cultural & creative services exports, % of total trade ⓓ	1.0	16	●
7.2.2	National feature films/mn pop. 15–69	1.5	69	○
7.2.3	Global ent. & media market/th pop. 15–69	11.1	34	
7.2.4	Printing & publishing manufactures, %	1.1	57	
7.2.5	Creative goods exports, % total trade	5.5	9	●
7.3	Online creativity	32.7	35	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	7.1	46	
7.3.2	Country-code TLDs/th pop. 15–69	27.9	22	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.2	31	
7.3.4	Video uploads on YouTube/pop. 15–69	35.8	39	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Portugal

Key indicators

Population (millions)	10.3
GDP (US$ billions)	205.9
GDP per capita, PPP$	27,834.8
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**46.1**	**31**
Innovation Output Sub-Index	38.3	31
Innovation Input Sub-Index	53.8	33
Innovation Efficiency Ratio	0.7	33
Global Innovation Index 2016 (out of 128)	46.4	30

		Score/Value	Rank	
1	**Institutions**	**80.8**	**23**	
1.1	Political environment	79.4	22	
1.1.1	Political stability & safety*	85.0	27	
1.1.2	Government effectiveness*	73.8	24	
1.2	Regulatory environment	75.8	34	
1.2.1	Regulatory quality*	66.2	34	
1.2.2	Rule of law*	72.8	26	
1.2.3	Cost of redundancy dismissal, salary weeks	17.0	70	○
1.3	Business environment	87.3	15	●
1.3.1	Ease of starting a business*	92.9	29	
1.3.2	Ease of resolving insolvency*	85.2	7	●
1.3.3	Ease of paying taxes*	83.8	34	
2	**Human capital & research**	**47.6**	**29**	
2.1	Education	60.9	19	
2.1.1	Expenditure on education, % GDP	5.3	38	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	30.3	14	●
2.1.3	School life expectancy, years	16.6	19	
2.1.4	PISA scales in reading, maths, & science	497.0	22	
2.1.5	Pupil-teacher ratio, secondary ◷	9.9	24	
2.2	Tertiary education	45.1	33	
2.2.1	Tertiary enrolment, % gross ◷	65.6	35	
2.2.2	Graduates in science & engineering, %	26.1	23	
2.2.3	Tertiary inbound mobility, % ◷	4.1	49	
2.3	Research & development (R&D)	36.9	30	
2.3.1	Researchers, FTE/mn pop.	3,824.2	23	
2.3.2	Gross expenditure on R&D, % GDP	1.3	28	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	38.0	39	
2.3.4	QS university ranking, average score top 3*	34.0	36	
3	**Infrastructure**	**54.0**	**39**	
3.1	Information & communication technologies (ICTs)	69.2	37	
3.1.1	ICT access*	79.3	26	
3.1.2	ICT use*	56.7	46	
3.1.3	Government's online service*	74.6	33	
3.1.4	E-participation*	66.1	49	
3.2	General infrastructure	33.1	82	○
3.2.1	Electricity output, kWh/cap	4,900.3	43	
3.2.2	Logistics performance*	62.3	35	
3.2.3	Gross capital formation, % GDP	15.0	112	○
3.3	Ecological sustainability	59.5	18	●
3.3.1	GDP/unit of energy use	12.3	25	
3.3.2	Environmental performance*	88.6	7	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	4.4	21	
4	**Market sophistication**	**51.1**	**43**	
4.1	Credit	46.4	37	
4.1.1	Ease of getting credit*	45.0	84	○
4.1.2	Domestic credit to private sector, % GDP	120.1	19	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	38.2	74	○
4.2.1	Ease of protecting minority investors*	56.7	67	○
4.2.2	Market capitalization, % GDP	30.1	46	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	21	
4.3	Trade, competition, & market scale	68.8	42	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	70.5	55	
4.3.3	Domestic market scale, bn PPP$	297.1	51	
5	**Business sophistication**	**35.4**	**50**	
5.1	Knowledge workers	47.8	37	
5.1.1	Knowledge-intensive employment, %	35.5	37	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	0.6	31	
5.1.4	GERD financed by business, % ◷	41.8	30	
5.1.5	Females employed w/advanced degrees, % total	15.3	40	
5.2	Innovation linkages	26.8	68	
5.2.1	University/industry research collaboration†	50.5	35	
5.2.2	State of cluster development†	52.6	37	
5.2.3	GERD financed by abroad, % ◷	5.6	62	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	72	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.7	32	
5.3	Knowledge absorption	31.6	71	○
5.3.1	Intellectual property payments, % total trade	0.9	40	
5.3.2	High-tech imports less re-imports, % total trade	6.5	87	○
5.3.3	ICT services imports, % total trade	1.2	58	
5.3.4	FDI net inflows, % GDP	3.6	46	
5.3.5	Research talent, % in business enterprise	29.0	44	
6	**Knowledge & technology outputs**	**29.9**	**39**	
6.1	Knowledge creation	22.9	41	
6.1.1	Patents by origin/bn PPP$ GDP	3.7	28	
6.1.2	PCT patent applications/bn PPP$ GDP	0.6	34	
6.1.3	Utility models by origin/bn PPP$ GDP	0.4	38	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	45.5	12	●
6.1.5	Citable documents H index	28.5	30	
6.2	Knowledge impact	41.1	26	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.1	86	○
6.2.2	New businesses/th pop. 15–64	4.6	26	
6.2.3	Computer software spending, % GDP	0.6	11	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	25.8	11	●
6.2.5	High- & medium-high-tech manufactures, %	0.3	47	
6.3	Knowledge diffusion	25.9	50	
6.3.1	Intellectual property receipts, % total trade	0.1	49	
6.3.2	High-tech exports less re-exports, % total trade	2.6	48	
6.3.3	ICT services exports, % total trade	1.4	70	○
6.3.4	FDI net outflows, % GDP	2.3	27	
7	**Creative outputs**	**46.7**	**21**	
7.1	Intangible assets	61.2	14	●
7.1.1	Trademarks by origin/bn PPP$ GDP	95.4	15	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	9.7	14	●
7.1.3	ICTs & business model creation†	76.8	16	●
7.1.4	ICTs & organizational model creation†	62.6	32	
7.2	Creative goods & services	24.6	47	
7.2.1	Cultural & creative services exports, % of total trade ◷	0.6	26	
7.2.2	National feature films/mn pop. 15–69	4.2	47	
7.2.3	Global ent. & media market/th pop. 15–69	32.2	22	
7.2.4	Printing & publishing manufactures, %	1.3	43	
7.2.5	Creative goods exports, % total trade	1.2	37	
7.3	Online creativity	39.6	28	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	18.9	29	
7.3.2	Country-code TLDs/th pop. 15–69	35.6	18	●
7.3.3	Wikipedia edits/mn pop. 15–69	5.8	45	
7.3.4	Video uploads on YouTube/pop. 15–69	47.5	17	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Qatar

Key indicators

Population (millions)	2.3
GDP (US$ billions)	156.6
GDP per capita, PPP$	132,098.7
Income group	High income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)		**37.9**	**49**	
Innovation Output Sub-Index		28.8	54	
Innovation Input Sub-Index		47.0	48	
Innovation Efficiency Ratio		0.6	68	
Global Innovation Index 2016 (out of 128)		37.5	50	
1	**Institutions**	**72.8**	**37**	
1.1	Political environment	77.6	26	
1.1.1	Political stability & safety*	87.5	16	●
1.1.2	Government effectiveness*	67.7	35	
1.2	Regulatory environment	66.2	58	
1.2.1	Regulatory quality*	59.8	43	
1.2.2	Rule of law*	65.3	33	
1.2.3	Cost of redundancy dismissal, salary weeks	23.2	98	
1.3	Business environment	74.6	52	
1.3.1	Ease of starting a business*	86.1	74	
1.3.2	Ease of resolving insolvency*	38.2	102	
1.3.3	Ease of paying taxes*	99.4	1	●
2	**Human capital & research**	**33.3**	**58**	
2.1	Education	37.2	97	
2.1.1	Expenditure on education, % GDP	3.5	90	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ◷	10.5	95	○
2.1.3	School life expectancy, years ◷	13.1	73	
2.1.4	PISA scales in reading, maths, & science	407.3	60	○
2.1.5	Pupil-teacher ratio, secondary	10.7	30	
2.2	Tertiary education	55.7	13	●
2.2.1	Tertiary enrolment, % gross	17.2	96	
2.2.2	Graduates in science & engineering, %	27.6	18	
2.2.3	Tertiary inbound mobility, %	37.7	1	●
2.3	Research & development (R&D)	7.0	66	
2.3.1	Researchers, FTE/mn pop. ◷	597.1	60	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.5	66	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	10.2	63	
3	**Infrastructure**	**58.1**	**26**	
3.1	Information & communication technologies (ICTs)	68.5	39	
3.1.1	ICT access*	79.1	29	
3.1.2	ICT use*	63.2	31	
3.1.3	Government's online service*	67.4	49	
3.1.4	E-participation*	64.4	54	
3.2	General infrastructure	67.6	2	●
3.2.1	Electricity output, kWh/cap	17,830.4	4	●
3.2.2	Logistics performance*	71.0	29	
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	Ecological sustainability	38.3	88	
3.3.1	GDP/unit of energy use	6.5	88	
3.3.2	Environmental performance*	69.9	78	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.0	64	
4	**Market sophistication**	**42.6**	**85**	
4.1	Credit	28.6	85	
4.1.1	Ease of getting credit*	30.0	108	○
4.1.2	Domestic credit to private sector, % GDP	69.6	43	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	30.1	113	○
4.2.1	Ease of protecting minority investors*	26.7	127	○
4.2.2	Market capitalization, % GDP	86.6	15	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	68.9	40	
4.3.1	Applied tariff rate, weighted mean, %	3.4	74	
4.3.2	Intensity of local competition†	79.0	16	●
4.3.3	Domestic market scale, bn PPP$	334.5	48	
5	**Business sophistication**	**28.0**	**84**	
5.1	Knowledge workers	20.4	112	○
5.1.1	Knowledge-intensive employment, %	16.1	84	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP ◷	0.1	60	
5.1.4	GERD financed by business, % ◷	24.2	58	
5.1.5	Females employed w/advanced degrees, % total ◷	4.5	79	○
5.2	Innovation linkages	33.0	51	
5.2.1	University/industry research collaboration†	70.5	10	●
5.2.2	State of cluster development†	70.0	9	●
5.2.3	GERD financed by abroad, % ◷	2.4	73	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	41	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	82	
5.3	Knowledge absorption	30.6	79	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	4.4	113	○
5.3.3	ICT services imports, % total trade	2.0	23	
5.3.4	FDI net inflows, % GDP	0.2	121	○
5.3.5	Research talent, % in business enterprise ◷	28.0	45	
6	**Knowledge & technology outputs**	**23.1**	**55**	
6.1	Knowledge creation	3.5	103	
6.1.1	Patents by origin/bn PPP$ GDP	0.0	120	○
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	86	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.3	86	
6.1.5	Citable documents H index	5.3	92	
6.2	Knowledge impact	33.9	51	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.6	70	
6.2.2	New businesses/th pop. 15–64	1.7	51	
6.2.3	Computer software spending, % GDP	0.4	31	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.1	90	
6.2.5	High- & medium-high-tech manufactures, % ◷	0.4	12	●
6.3	Knowledge diffusion	32.0	36	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.3	94	
6.3.3	ICT services exports, % total trade	0.7	91	
6.3.4	FDI net outflows, % GDP	3.3	19	
7	**Creative outputs**	**34.5**	**54**	
7.1	Intangible assets	51.8	31	
7.1.1	Trademarks by origin/bn PPP$ GDP ◷	4.6	112	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	79.4	11	●
7.1.4	ICTs & organizational model creation†	74.1	16	●
7.2	Creative goods & services	12.2	81	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	25.9	25	
7.2.4	Printing & publishing manufactures, % ◷	0.9	68	
7.2.5	Creative goods exports, % total trade	0.2	78	
7.3	Online creativity	22.4	57	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	4.4	58	
7.3.2	Country-code TLDs/th pop. 15–69	3.4	56	
7.3.3	Wikipedia edits/mn pop. 15–69 ◷	4.6	70	
7.3.4	Video uploads on YouTube/pop. 15–69	37.7	34	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Romania

Key indicators

Population (millions)	19.4
GDP (US$ billions)	186.5
GDP per capita, PPP$	20,786.9
Income group	Upper-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**39.2**	**42**	
Innovation Output Sub-Index	32.0	44	
Innovation Input Sub-Index	46.4	51	
Innovation Efficiency Ratio	0.7	39	
Global Innovation Index 2016 (out of 128)	37.9	48	

		Score	Rank	
1	**Institutions**	**69.0**	**43**	
1.1	Political environment	54.9	57	
1.1.1	Political stability & safety*	68.6	51	
1.1.2	Government effectiveness*	41.2	73	
1.2	Regulatory environment	75.3	35	
1.2.1	Regulatory quality*	57.2	45	
1.2.2	Rule of law*	43.9	54	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	76.8	39	
1.3.1	Ease of starting a business*	89.5	53	
1.3.2	Ease of resolving insolvency*	59.2	46	
1.3.3	Ease of paying taxes*	81.6	43	
2	**Human capital & research**	**30.5**	**75**	
2.1	Education	40.9	84	
2.1.1	Expenditure on education, % GDPⓓ	2.9	100	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	13.4	87	○
2.1.3	School life expectancy, years	14.9	52	
2.1.4	PISA scales in reading, maths, & science	437.5	47	
2.1.5	Pupil-teacher ratio, secondary	12.1	41	
2.2	Tertiary education	41.9	42	
2.2.1	Tertiary enrolment, % gross	53.2	50	
2.2.2	Graduates in science & engineering, %	25.5	29	
2.2.3	Tertiary inbound mobility, %	4.3	42	
2.3	Research & development (R&D)	8.6	62	
2.3.1	Researchers, FTE/mn pop.	894.8	50	
2.3.2	Gross expenditure on R&D, % GDP	0.5	64	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	12.8	59	
3	**Infrastructure**	**55.1**	**37**	
3.1	Information & communication technologies (ICTs)	57.0	66	
3.1.1	ICT access*	69.0	52	
3.1.2	ICT use*	50.8	58	
3.1.3	Government's online service*	45.7	91	○
3.1.4	E-participation*	62.7	59	
3.2	General infrastructure	38.1	60	
3.2.1	Electricity output, kWh/cap	3,274.8	60	
3.2.2	Logistics performance*	43.0	59	
3.2.3	Gross capital formation, % GDP	25.0	43	
3.3	Ecological sustainability	70.1	3	●
3.3.1	GDP/unit of energy use	11.5	31	
3.3.2	Environmental performance*	83.2	34	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	25.5	1	●
4	**Market sophistication**	**44.2**	**73**	
4.1	Credit	32.1	72	
4.1.1	Ease of getting credit*	85.0	7	●
4.1.2	Domestic credit to private sector, % GDP	29.9	100	○
4.1.3	Microfinance gross loans, % GDP	0.0	72	○
4.2	Investment	31.7	102	○
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDPⓓ	7.6	79	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	67	
4.3	Trade, competition, & market scale	69.0	39	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	63.1	88	
4.3.3	Domestic market scale, bn PPP$	441.0	40	
5	**Business sophistication**	**33.0**	**63**	
5.1	Knowledge workers	37.4	63	
5.1.1	Knowledge-intensive employment, %	22.7	63	
5.1.2	Firms offering formal training, % firms	40.7	32	
5.1.3	GERD performed by business, % of GDP	0.2	49	
5.1.4	GERD financed by business, %	37.3	39	
5.1.5	Females employed w/advanced degrees, % total	10.6	63	
5.2	Innovation linkages	25.5	71	
5.2.1	University/industry research collaboration†	38.8	77	
5.2.2	State of cluster development†	37.0	95	○
5.2.3	GERD financed by abroad, %	19.2	21	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	108	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	75	
5.3	Knowledge absorption	36.1	50	
5.3.1	Intellectual property payments, % total trade	1.1	28	
5.3.2	High-tech imports less re-imports, % total trade	10.3	43	
5.3.3	ICT services imports, % total trade	1.8	26	●
5.3.4	FDI net inflows, % GDP	2.1	79	
5.3.5	Research talent, % in business enterprise	24.3	51	
6	**Knowledge & technology outputs**	**31.0**	**37**	
6.1	Knowledge creation	9.5	66	
6.1.1	Patents by origin/bn PPP$ GDP	2.4	41	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	65	
6.1.3	Utility models by origin/bn PPP$ GDP	0.1	48	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	16.5	45	
6.1.5	Citable documents H index	14.8	47	
6.2	Knowledge impact	57.9	4	●
6.2.1	Growth rate of PPP$ GDP/worker, %	4.7	8	●
6.2.2	New businesses/th pop. 15–64	4.1	31	
6.2.3	Computer software spending, % GDP	0.3	45	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	49.5	2	●
6.2.5	High- & medium-high-tech manufactures, %ⓓ	0.4	27	
6.3	Knowledge diffusion	25.6	51	
6.3.1	Intellectual property receipts, % total trade	0.1	47	
6.3.2	High-tech exports less re-exports, % total trade	6.0	29	
6.3.3	ICT services exports, % total trade	4.1	18	●
6.3.4	FDI net outflows, % GDP	0.2	82	
7	**Creative outputs**	**32.9**	**57**	
7.1	Intangible assets	39.8	75	
7.1.1	Trademarks by origin/bn PPP$ GDP	52.7	42	
7.1.2	Industrial designs by origin/bn PPP$ GDP	2.5	40	
7.1.3	ICTs & business model creation†	57.2	77	
7.1.4	ICTs & organizational model creation†	48.7	79	
7.2	Creative goods & services	25.2	46	
7.2.1	Cultural & creative services exports, % of total tradeⓓ	1.6	5	●
7.2.2	National feature films/mn pop. 15–69	1.8	62	
7.2.3	Global ent. & media market/th pop. 15–69	4.9	45	
7.2.4	Printing & publishing manufactures, %ⓓ	1.1	62	
7.2.5	Creative goods exports, % total trade	1.2	39	
7.3	Online creativity	26.9	43	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	4.5	57	
7.3.2	Country-code TLDs/th pop. 15–69	18.4	29	●
7.3.3	Wikipedia edits/mn pop. 15–69	5.1	59	
7.3.4	Video uploads on YouTube/pop. 15–69	35.4	40	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Russian Federation

Key indicators

Population (millions)	143.4
GDP (US$ billions)	1,267.8
GDP per capita, PPP$	25,410.9
Income group	Upper-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**38.8**	**45**
Innovation Output Sub-Index	29.3	51
Innovation Input Sub-Index	48.2	43
Innovation Efficiency Ratio	0.6	75
Global Innovation Index 2016 (out of 128)	38.5	43

		Score/Value	Rank	
1	**Institutions**	**56.1**	**73**	
1.1	Political environment	37.9	100	○
1.1.1	Political stability & safety*	38.4	112	○
1.1.2	Government effectiveness*	37.5	80	
1.2	Regulatory environment	52.5	94	○
1.2.1	Regulatory quality*	28.8	102	○
1.2.2	Rule of law*	18.4	104	○
1.2.3	Cost of redundancy dismissal, salary weeks	17.3	73	
1.3	Business environment	77.7	36	
1.3.1	Ease of starting a business*	93.6	23	
1.3.2	Ease of resolving insolvency*	56.7	48	
1.3.3	Ease of paying taxes*	83.0	38	
2	**Human capital & research**	**50.0**	**23**	
2.1	Education	59.7	23	
2.1.1	Expenditure on education, % GDP◷	3.9	83	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	15.0	50	
2.1.4	PISA scales in reading, maths, & science	491.8	26	
2.1.5	Pupil-teacher ratio, secondary◷	8.8	14	●
2.2	Tertiary education	48.8	23	
2.2.1	Tertiary enrolment, % gross◷	78.7	17	●
2.2.2	Graduates in science & engineering, %◷	28.1	13	●
2.2.3	Tertiary inbound mobility, %◷	3.0	56	
2.3	Research & development (R&D)	41.5	25	
2.3.1	Researchers, FTE/mn pop.	3,131.1	29	
2.3.2	Gross expenditure on R&D, % GDP	1.1	34	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	55.6	25	
2.3.4	QS university ranking, average score top 3*	46.5	25	
3	**Infrastructure**	**47.5**	**62**	
3.1	Information & communication technologies (ICTs)	69.7	36	
3.1.1	ICT access*	72.3	44	
3.1.2	ICT use*	58.7	40	
3.1.3	Government's online service*	73.2	37	
3.1.4	E-participation*	74.6	32	
3.2	General infrastructure	33.1	81	
3.2.1	Electricity output, kWh/cap	7,386.5	25	
3.2.2	Logistics performance*	23.5	96	○
3.2.3	Gross capital formation, % GDP	21.6	69	
3.3	Ecological sustainability	39.8	83	
3.3.1	GDP/unit of energy use	4.5	108	○
3.3.2	Environmental performance*	83.5	32	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	94	○
4	**Market sophistication**	**47.1**	**60**	
4.1	Credit	29.4	81	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	56.4	57	
4.1.3	Microfinance gross loans, % GDP	0.1	60	
4.2	Investment	33.2	95	○
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDP	29.5	48	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	90	○
4.3	Trade, competition, & market scale	78.7	12	●
4.3.1	Applied tariff rate, weighted mean, %	2.8	66	
4.3.2	Intensity of local competition†	65.8	78	
4.3.3	Domestic market scale, bn PPP$	3,745.1	6	●
5	**Business sophistication**	**40.3**	**33**	
5.1	Knowledge workers	59.8	24	
5.1.1	Knowledge-intensive employment, %	44.3	15	●
5.1.2	Firms offering formal training, % firms◷	46.2	26	
5.1.3	GERD performed by business, % of GDP	0.7	28	
5.1.4	GERD financed by business, %	26.5	56	
5.1.5	Females employed w/advanced degrees, % total	33.2	2	●
5.2	Innovation linkages	20.2	105	○
5.2.1	University/industry research collaboration†	44.6	44	
5.2.2	State of cluster development†	39.4	86	
5.2.3	GERD financed by abroad, %	2.6	70	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	62	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	50	
5.3	Knowledge absorption	41.0	31	
5.3.1	Intellectual property payments, % total trade	1.7	16	●
5.3.2	High-tech imports less re-imports, % total trade	8.5	59	
5.3.3	ICT services imports, % total trade	1.6	35	
5.3.4	FDI net inflows, % GDP	1.6	94	○
5.3.5	Research talent, % in business enterprise	46.4	29	
6	**Knowledge & technology outputs**	**27.6**	**45**	
6.1	Knowledge creation	38.4	22	●
6.1.1	Patents by origin/bn PPP$ GDP	7.9	15	●
6.1.2	PCT patent applications/bn PPP$ GDP	0.2	49	
6.1.3	Utility models by origin/bn PPP$ GDP	3.1	8	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.8	70	
6.1.5	Citable documents H index	36.6	22	●
6.2	Knowledge impact	15.6	111	○
6.2.1	Growth rate of PPP$ GDP/worker, %	(4.8)	110	○
6.2.2	New businesses/th pop. 15–64	4.2	29	
6.2.3	Computer software spending, % GDP	0.3	35	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.4	85	
6.2.5	High- & medium-high-tech manufactures, %	0.2	51	
6.3	Knowledge diffusion	28.7	43	
6.3.1	Intellectual property receipts, % total trade	0.2	37	
6.3.2	High-tech exports less re-exports, % total trade	3.4	44	
6.3.3	ICT services exports, % total trade	1.2	76	
6.3.4	FDI net outflows, % GDP	2.8	24	
7	**Creative outputs**	**31.0**	**62**	
7.1	Intangible assets	37.6	87	
7.1.1	Trademarks by origin/bn PPP$ GDP	43.4	56	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.7	72	
7.1.3	ICTs & business model creation†	52.7	91	
7.1.4	ICTs & organizational model creation†	55.1	55	
7.2	Creative goods & services	18.9	61	
7.2.1	Cultural & creative services exports, % of total trade◷	0.9	17	
7.2.2	National feature films/mn pop. 15–69	1.1	76	
7.2.3	Global ent. & media market/th pop. 15–69	4.6	48	○
7.2.4	Printing & publishing manufactures, %	1.2	47	
7.2.5	Creative goods exports, % total trade	0.8	49	
7.3	Online creativity	30.1	39	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	3.3	61	
7.3.2	Country-code TLDs/th pop. 15–69	15.2	34	
7.3.3	Wikipedia edits/mn pop. 15–69	6.2	34	
7.3.4	Video uploads on YouTube/pop. 15–69	42.1	28	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Rwanda

Key indicators

Population (millions)	11.9
GDP (US$ billions)	8.3
GDP per capita, PPP$	1,807.0
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**27.4**	**99**	
Innovation Output Sub-Index	13.7	121	○
Innovation Input Sub-Index	41.1	76	
Innovation Efficiency Ratio	0.3	125	○
Global Innovation Index 2016 (out of 128)	30.0	83	

		Score/Value	Rank	
1	**Institutions**	**63.5**	**61**	
1.1	Political environment	51.5	65	
1.1.1	Political stability & safety*	61.8	67	
1.1.2	Government effectiveness*	41.1	74	
1.2	Regulatory environment	67.6	50	
1.2.1	Regulatory quality*	48.5	62	
1.2.2	Rule of law*	41.5	55	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	45	
1.3	Business environment	71.6	60	
1.3.1	Ease of starting a business*	87.2	63	
1.3.2	Ease of resolving insolvency*	47.9	67	
1.3.3	Ease of paying taxes*	79.7	50	
2	**Human capital & research**	**23.5**	**90**	
2.1	Education	46.4	67	
2.1.1	Expenditure on education, % GDP	5.0	47	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	39.0	6	●
2.1.3	School life expectancy, years[a]	11.0	95	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary[a]	21.7	85	
2.2	Tertiary education	24.2	95	
2.2.1	Tertiary enrolment, % gross[a]	7.5	111	
2.2.2	Graduates in science & engineering, %[a]	22.5	39	
2.2.3	Tertiary inbound mobility, %[a]	1.0	82	
2.3	Research & development (R&D)	0.0	115	○
2.3.1	Researchers, FTE/mn pop.[a]	12.3	101	○
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**40.4**	**85**	
3.1	Information & communication technologies (ICTs)	34.0	100	
3.1.1	ICT access*	26.5	117	○
3.1.2	ICT use*	14.7	104	
3.1.3	Government's online service*	45.7	91	
3.1.4	E-participation*	49.2	89	
3.2	General infrastructure	53.6	14	●
3.2.1	Electricity output, kWh/cap	n/a	n/a	
3.2.2	Logistics performance*	42.7	61	
3.2.3	Gross capital formation, % GDP	29.5	20	●
3.3	Ecological sustainability	33.6	109	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	50.3	111	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.0	123	○
4	**Market sophistication**	**40.9**	**93**	
4.1	Credit	38.3	54	
4.1.1	Ease of getting credit*	95.0	2	●
4.1.2	Domestic credit to private sector, % GDP	21.6	109	
4.1.3	Microfinance gross loans, % GDP	0.7	31	
4.2	Investment	39.6	67	
4.2.1	Ease of protecting minority investors*	51.7	86	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP[a]	0.0	31	●
4.3	Trade, competition, & market scale	44.8	116	
4.3.1	Applied tariff rate, weighted mean, %	7.2	104	
4.3.2	Intensity of local competition†	66.4	74	
4.3.3	Domestic market scale, bn PPP$	22.0	117	
5	**Business sophistication**	**37.0**	**44**	
5.1	Knowledge workers	37.0	[66]	
5.1.1	Knowledge-intensive employment, %[a]	3.8	105	○
5.1.2	Firms offering formal training, % firms[a]	55.4	13	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	41.7	25	●
5.2.1	University/industry research collaboration†	38.9	75	
5.2.2	State of cluster development†	52.1	40	●
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	21	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	Knowledge absorption	32.2	68	
5.3.1	Intellectual property payments, % total trade[a]	0.1	108	○
5.3.2	High-tech imports less re-imports, % total trade	12.8	20	●
5.3.3	ICT services imports, % total trade[a]	0.5	95	
5.3.4	FDI net inflows, % GDP	3.7	40	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**7.7**	**125**	○
6.1	Knowledge creation	4.5	94	
6.1.1	Patents by origin/bn PPP$ GDP	0.2	91	
6.1.2	PCT patent applications/bn PPP$ GDP[a]	0.0	80	
6.1.3	Utility models by origin/bn PPP$ GDP	0.2	41	
6.1.4	Scientific & technical articles/bn PPP$ GDP	9.5	69	
6.1.5	Citable documents H index	2.3	114	
6.2	Knowledge impact	4.3	120	○
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	1.5	57	
6.2.3	Computer software spending, % GDP	0.1	100	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.1	125	○
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	14.2	115	
6.3.1	Intellectual property receipts, % total trade[a]	0.0	83	
6.3.2	High-tech exports less re-exports, % total trade	0.5	89	
6.3.3	ICT services exports, % total trade[a]	0.9	86	
6.3.4	FDI net outflows, % GDP	0.1	93	
7	**Creative outputs**	**19.6**	**103**	
7.1	Intangible assets	36.0	93	
7.1.1	Trademarks by origin/bn PPP$ GDP	12.0	98	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	92	
7.1.3	ICTs & business model creation†	68.0	36	●
7.1.4	ICTs & organizational model creation†	51.7	68	
7.2	Creative goods & services	3.3	[116]	
7.2.1	Cultural & creative services exports, % of total trade[a]	0.0	87	○
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.1	84	
7.3	Online creativity	3.2	119	○
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	118	○
7.3.2	Country-code TLDs/th pop. 15–69	0.1	112	
7.3.3	Wikipedia edits/mn pop. 15–69[a]	1.0	117	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
[a] indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Saudi Arabia

Key indicators

Population (millions)	32.2
GDP (US$ billions)	637.8
GDP per capita, PPP$	53,624.4
Income group	High income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**36.2**	**55**	
	Innovation Output Sub-Index	25.0	66	
	Innovation Input Sub-Index	47.3	46	
	Innovation Efficiency Ratio	0.5	96	
	Global Innovation Index 2016 (out of 128)	37.8	49	
1	**Institutions**	**52.4**	**88**	
1.1	Political environment	49.1	71	
1.1.1	Political stability & safety*	50.6	89	
1.1.2	Government effectiveness*	47.5	60	
1.2	Regulatory environment	56.9	79	
1.2.1	Regulatory quality*	42.9	70	
1.2.2	Rule of law*	46.8	49	
1.2.3	Cost of redundancy dismissal, salary weeks	23.7	99	
1.3	Business environment	51.4	120	○
1.3.1	Ease of starting a business*	77.1	108	○
1.3.2	Ease of resolving insolvency*	0.0	127	○
1.3.3	Ease of paying taxes*	77.0	58	
2	**Human capital & research**	**46.5**	**31**	
2.1	Education	52.0	50	
2.1.1	Expenditure on education, % GDP ◷	5.1	45	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ◷	18.2	61	
2.1.3	School life expectancy, years	16.1	28	●
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	11.0	31	
2.2	Tertiary education	46.3	29	●
2.2.1	Tertiary enrolment, % gross	63.1	40	
2.2.2	Graduates in science & engineering, %	26.9	20	●
2.2.3	Tertiary inbound mobility, %	4.8	38	
2.3	Research & development (R&D)	41.2	26	●
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.8	44	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	61.9	23	●
2.3.4	QS university ranking, average score top 3*	43.1	30	●
3	**Infrastructure**	**53.3**	**40**	
3.1	Information & communication technologies (ICTs)	68.7	38	
3.1.1	ICT access*	72.9	42	
3.1.2	ICT use*	63.2	31	
3.1.3	Government's online service*	67.4	49	
3.1.4	E-participation*	71.2	39	
3.2	General infrastructure	53.6	13	●
3.2.1	Electricity output, kWh/cap	10,094.1	14	●
3.2.2	Logistics performance*	50.6	51	
3.2.3	Gross capital formation, % GDP	31.7	13	●
3.3	Ecological sustainability	37.6	89	
3.3.1	GDP/unit of energy use	7.0	85	
3.3.2	Environmental performance*	68.6	84	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	106	○
4	**Market sophistication**	**49.4**	**51**	
4.1	Credit	36.0	59	
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	56.6	56	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	36.5	82	
4.2.1	Ease of protecting minority investors*	58.3	62	
4.2.2	Market capitalization, % GDP	65.2	25	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	84	○
4.3	Trade, competition, & market scale	75.8	19	●
4.3.1	Applied tariff rate, weighted mean, % ◷	3.4	75	
4.3.2	Intensity of local competition†	73.4	36	
4.3.3	Domestic market scale, bn PPP$	1,731.2	14	●
5	**Business sophistication**	**35.0**	**54**	
5.1	Knowledge workers	37.2	[64]	
5.1.1	Knowledge-intensive employment, %	27.3	52	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total ◷	5.8	75	○
5.2	Innovation linkages	33.8	49	
5.2.1	University/industry research collaboration†	41.9	54	
5.2.2	State of cluster development†	60.6	22	●
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	80	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.2	51	
5.3	Knowledge absorption	34.0	59	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	9.1	53	
5.3.3	ICT services imports, % total trade	1.4	49	
5.3.4	FDI net inflows, % GDP	1.2	101	○
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**21.6**	**62**	
6.1	Knowledge creation	7.8	75	
6.1.1	Patents by origin/bn PPP$ GDP	0.5	74	
6.1.2	PCT patent applications/bn PPP$ GDP	0.2	55	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	8.0	74	
6.1.5	Citable documents H index	15.5	42	
6.2	Knowledge impact	38.6	39	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.0	53	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.4	23	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.8	95	
6.2.5	High- & medium-high-tech manufactures, % ◷	0.4	29	
6.3	Knowledge diffusion	18.6	93	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.1	109	○
6.3.3	ICT services exports, % total trade	0.1	120	○
6.3.4	FDI net outflows, % GDP	0.7	62	
7	**Creative outputs**	**28.4**	**74**	
7.1	Intangible assets	36.4	92	
7.1.1	Trademarks by origin/bn PPP$ GDP	4.4	113	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.2	97	○
7.1.3	ICTs & business model creation†	68.8	33	
7.1.4	ICTs & organizational model creation†	56.5	51	
7.2	Creative goods & services	17.1	69	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	11.3	31	
7.2.4	Printing & publishing manufactures, % ◷	2.3	17	●
7.2.5	Creative goods exports, % total trade	0.1	96	
7.3	Online creativity	23.5	54	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	3.1	63	
7.3.2	Country-code TLDs/th pop. 15–69	0.6	87	
7.3.3	Wikipedia edits/mn pop. 15–69	4.6	66	
7.3.4	Video uploads on YouTube/pop. 15–69	45.4	21	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Senegal

Key indicators

Population (millions)	15.6
GDP (US$ billions)	14.9
GDP per capita, PPP$	2,451.3
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**27.1**	**100**
Innovation Output Sub-Index	19.0	98
Innovation Input Sub-Index	35.2	102
Innovation Efficiency Ratio	0.5	95
Global Innovation Index 2016 (out of 128)	26.1	106

		Score/Value	Rank	
1	**Institutions**	**54.5**	**80**	
1.1	Political environment	45.4	81	
1.1.1	Political stability & safety*	59.7	72	
1.1.2	Government effectiveness*	31.0	90	
1.2	Regulatory environment	61.4	71	
1.2.1	Regulatory quality*	37.5	79	
1.2.2	Rule of law*	35.0	69	
1.2.3	Cost of redundancy dismissal, salary weeks	14.8	59	
1.3	Business environment	56.8	109	
1.3.1	Ease of starting a business*	86.1	73	
1.3.2	Ease of resolving insolvency*	40.7	90	
1.3.3	Ease of paying taxes*	43.7	120	○
2	**Human capital & research**	**31.7**	**67**	
2.1	Education	45.6	69	
2.1.1	Expenditure on education, % GDP	7.2	12	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	27.6	16	●
2.1.3	School life expectancy, years	9.0	107	○
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	20.4	82	
2.2	Tertiary education	45.4	32	●
2.2.1	Tertiary enrolment, % gross	10.4	103	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	15.8	11	●
2.3	Research & development (R&D)	4.1	79	
2.3.1	Researchers, FTE/mn pop. ⓓ	361.1	68	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.5	61	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**33.1**	**106**	
3.1	Information & communication technologies (ICTs)	32.2	106	
3.1.1	ICT access*	35.9	102	
3.1.2	ICT use*	16.4	103	
3.1.3	Government's online service*	37.7	100	
3.1.4	E-participation*	39.0	98	
3.2	General infrastructure	29.5	94	
3.2.1	Electricity output, kWh/cap	254.2	110	
3.2.2	Logistics performance*	12.2	119	○
3.2.3	Gross capital formation, % GDP	26.6	33	●
3.3	Ecological sustainability	37.6	90	
3.3.1	GDP/unit of energy use	8.1	69	
3.3.2	Environmental performance*	63.7	97	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	84	
4	**Market sophistication**	**32.4**	**115**	
4.1	Credit	23.2	106	
4.1.1	Ease of getting credit*	30.0	108	
4.1.2	Domestic credit to private sector, % GDP	33.3	96	
4.1.3	Microfinance gross loans, % GDP	1.5	20	●
4.2	Investment	30.6	108	
4.2.1	Ease of protecting minority investors*	41.7	105	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP ⓓ	0.0	43	
4.3	Trade, competition, & market scale	43.3	118	
4.3.1	Applied tariff rate, weighted mean, %	11.6	118	○
4.3.2	Intensity of local competition†	70.6	53	●
4.3.3	Domestic market scale, bn PPP$	39.7	97	
5	**Business sophistication**	**24.5**	**105**	
5.1	Knowledge workers	8.8	124	○
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	17.4	82	
5.1.3	GERD performed by business, % of GDP ⓓ	0.0	85	○
5.1.4	GERD financed by business, % ⓓ	4.1	80	
5.1.5	Females employed w/advanced degrees, % total ⓓ	0.7	86	○
5.2	Innovation linkages	39.0	33	●
5.2.1	University/industry research collaboration†	44.0	47	●
5.2.2	State of cluster development†	44.4	69	
5.2.3	GERD financed by abroad, % ⓓ	40.5	9	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	86	
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.1	76	
5.3	Knowledge absorption	25.5	95	
5.3.1	Intellectual property payments, % total trade ⓓ	0.1	98	
5.3.2	High-tech imports less re-imports, % total trade	5.5	102	
5.3.3	ICT services imports, % total trade ⓓ	2.6	10	●
5.3.4	FDI net inflows, % GDP	2.4	74	
5.3.5	Research talent, % in business enterprise ⓓ	0.1	85	○
6	**Knowledge & technology outputs**	**18.4**	**86**	
6.1	Knowledge creation	6.1	82	
6.1.1	Patents by origin/bn PPP$ GDP	0.4	79	
6.1.2	PCT patent applications/bn PPP$ GDP	0.2	53	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	10.3	65	
6.1.5	Citable documents H index	6.2	85	
6.2	Knowledge impact	25.7	89	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.3	49	
6.2.2	New businesses/th pop. 15–64	0.3	90	
6.2.3	Computer software spending, % GDP	0.3	56	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.7	99	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.2	64	
6.3	Knowledge diffusion	23.4	62	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.1	63	
6.3.2	High-tech exports less re-exports, % total trade	0.6	78	
6.3.3	ICT services exports, % total trade ⓓ	5.2	11	●
6.3.4	FDI net outflows, % GDP	0.2	85	
7	**Creative outputs**	**19.6**	**104**	
7.1	Intangible assets	34.2	95	
7.1.1	Trademarks by origin/bn PPP$ GDP	11.5	100	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.6	74	
7.1.3	ICTs & business model creation†	59.7	66	
7.1.4	ICTs & organizational model creation†	53.0	65	
7.2	Creative goods & services	6.5	100	
7.2.1	Cultural & creative services exports, % of total trade	0.2	47	
7.2.2	National feature films/mn pop. 15–69	0.4	95	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	0.8	72	
7.2.5	Creative goods exports, % total trade	0.1	93	
7.3	Online creativity	3.4	115	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.0	95	
7.3.2	Country-code TLDs/th pop. 15–69	0.2	103	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	1.1	114	
7.3.4	Video uploads on YouTube/pop. 15–69	1.9	69	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Serbia

Key indicators

Population (millions)	8.8
GDP (US$ billions)	37.8
GDP per capita, PPP$	13,671.4
Income group	Upper-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**35.3**	**62**
Innovation Output Sub-Index	26.9	61
Innovation Input Sub-Index	43.8	58
Innovation Efficiency Ratio	0.6	67
Global Innovation Index 2016 (out of 128)	33.8	65

		Score/Value	Rank	
1	**Institutions**	**67.7**	**50**	
1.1	Political environment	57.2	52	
1.1.1	Political stability & safety*	69.3	50	
1.1.2	Government effectiveness*	45.1	64	
1.2	Regulatory environment	70.6	43	
1.2.1	Regulatory quality*	45.6	67	
1.2.2	Rule of law*	36.6	64	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	75.2	48	
1.3.1	Ease of starting a business*	91.7	40	
1.3.2	Ease of resolving insolvency*	59.7	44	
1.3.3	Ease of paying taxes*	74.4	63	
2	**Human capital & research**	**33.9**	**54**	
2.1	Education	45.6	70	
2.1.1	Expenditure on education, % GDP	4.2	74	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ◷	13.1	88	○
2.1.3	School life expectancy, years	14.6	58	
2.1.4	PISA scales in reading, maths, & science ◷	446.6	43	
2.1.5	Pupil-teacher ratio, secondary	8.5	13	●
2.2	Tertiary education	43.7	38	
2.2.1	Tertiary enrolment, % gross	58.3	43	
2.2.2	Graduates in science & engineering, %	26.2	22	
2.2.3	Tertiary inbound mobility, %	4.1	48	
2.3	Research & development (R&D)	12.6	53	
2.3.1	Researchers, FTE/mn pop.	2,071.2	35	
2.3.2	Gross expenditure on R&D, % GDP	0.9	40	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	5.1	71	
3	**Infrastructure**	**49.7**	**52**	
3.1	Information & communication technologies (ICTs)	73.0	31	
3.1.1	ICT access*	72.2	45	
3.1.2	ICT use*	55.0	49	
3.1.3	Government's online service*	81.9	24	●
3.1.4	E-participation*	83.1	17	●
3.2	General infrastructure	29.1	95	
3.2.1	Electricity output, kWh/cap	4,690.9	45	
3.2.2	Logistics performance*	32.4	76	
3.2.3	Gross capital formation, % GDP	18.3	97	
3.3	Ecological sustainability	47.0	56	
3.3.1	GDP/unit of energy use	0.7	119	○
3.3.2	Environmental performance*	78.7	47	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	11.5	4	●
4	**Market sophistication**	**38.7**	**99**	
4.1	Credit	28.7	84	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	43.4	78	
4.1.3	Microfinance gross loans, % GDP	0.3	45	
4.2	Investment	39.0	69	
4.2.1	Ease of protecting minority investors*	56.7	67	
4.2.2	Market capitalization, % GDP ◷	8.7	78	○
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	48.4	107	○
4.3.1	Applied tariff rate, weighted mean, %	n/a	n/a	
4.3.2	Intensity of local competition†	53.9	118	○
4.3.3	Domestic market scale, bn PPP$	101.5	72	
5	**Business sophistication**	**28.9**	**79**	
5.1	Knowledge workers	35.9	72	
5.1.1	Knowledge-intensive employment, %	28.9	48	
5.1.2	Firms offering formal training, % firms	37.8	34	
5.1.3	GERD performed by business, % of GDP	0.3	48	
5.1.4	GERD financed by business, %	12.8	69	
5.1.5	Females employed w/advanced degrees, % total ◷	12.2	56	
5.2	Innovation linkages	21.8	87	
5.2.1	University/industry research collaboration†	35.9	89	
5.2.2	State of cluster development†	35.1	102	○
5.2.3	GERD financed by abroad, %	12.6	40	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP ◷	0.0	91	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	58	
5.3	Knowledge absorption	29.1	82	
5.3.1	Intellectual property payments, % total trade	0.9	37	
5.3.2	High-tech imports less re-imports, % total trade	6.8	81	
5.3.3	ICT services imports, % total trade	1.6	39	
5.3.4	FDI net inflows, % GDP	5.1	27	●
5.3.5	Research talent, % in business enterprise	9.6	67	
6	**Knowledge & technology outputs**	**24.7**	**53**	
6.1	Knowledge creation	19.2	49	
6.1.1	Patents by origin/bn PPP$ GDP	1.9	47	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	57	
6.1.3	Utility models by origin/bn PPP$ GDP	0.6	33	
6.1.4	Scientific & technical articles/bn PPP$ GDP	49.2	8	●
6.1.5	Citable documents H index	8.3	74	
6.2	Knowledge impact	30.4	68	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.4	74	
6.2.2	New businesses/th pop. 15–64	1.6	53	
6.2.3	Computer software spending, % GDP	0.0	103	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	25.7	12	●
6.2.5	High- & medium-high-tech manufactures, %	0.3	45	
6.3	Knowledge diffusion	24.5	55	
6.3.1	Intellectual property receipts, % total trade	0.2	39	
6.3.2	High-tech exports less re-exports, % total trade	2.2	53	
6.3.3	ICT services exports, % total trade	3.4	23	●
6.3.4	FDI net outflows, % GDP	0.8	56	
7	**Creative outputs**	**29.1**	**70**	
7.1	Intangible assets	31.7	100	
7.1.1	Trademarks by origin/bn PPP$ GDP	32.0	70	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.2	55	
7.1.3	ICTs & business model creation†	49.7	101	○
7.1.4	ICTs & organizational model creation†	42.1	103	○
7.2	Creative goods & services	19.8	59	
7.2.1	Cultural & creative services exports, % of total trade	0.2	45	
7.2.2	National feature films/mn pop. 15–69	5.4	37	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	1.6	32	
7.2.5	Creative goods exports, % total trade	0.8	50	
7.3	Online creativity	33.2	34	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	1.5	88	
7.3.2	Country-code TLDs/th pop. 15–69	4.4	53	
7.3.3	Wikipedia edits/mn pop. 15–69	10.4	1	●
7.3.4	Video uploads on YouTube/pop. 15–69	27.0	47	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Singapore

Key indicators

Population (millions)	5.7
GDP (US$ billions)	296.6
GDP per capita, PPP$	85,253.2
Income group	High income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**58.7**	**7**	
Innovation Output Sub-Index	45.1	17	
Innovation Input Sub-Index	72.3	1	●
Innovation Efficiency Ratio	0.6	63	○
Global Innovation Index 2016 (out of 128)	59.2	6	

		Score	Rank	
1	**Institutions**	**94.4**	**1**	●
1.1	Political environment	96.9	1	●
1.1.1	Political stability & safety*	93.9	6	
1.1.2	Government effectiveness*	100.0	1	●
1.2	Regulatory environment	98.6	1	●
1.2.1	Regulatory quality*	100.0	1	●
1.2.2	Rule of law*	94.4	8	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	87.6	11	
1.3.1	Ease of starting a business*	96.5	6	
1.3.2	Ease of resolving insolvency*	74.3	27	
1.3.3	Ease of paying taxes*	91.9	8	
2	**Human capital & research**	**63.7**	**5**	
2.1	Education	44.0	76	○
2.1.1	Expenditure on education, % GDP	2.9	102	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ◷	16.7	68	○
2.1.3	School life expectancy, years ◷	12.8	78	○
2.1.4	PISA scales in reading, maths, & science	551.6	1	●
2.1.5	Pupil-teacher ratio, secondary ◷	14.9	64	○
2.2	Tertiary education	80.5	1	●
2.2.1	Tertiary enrolment, % gross ◷	69.8	25	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % ◷	19.2	1	●
2.3	Research & development (R&D)	66.5	11	
2.3.1	Researchers, FTE/mn pop. ◷	6,658.5	6	
2.3.2	Gross expenditure on R&D, % GDP ◷	2.2	15	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	64.0	22	
2.3.4	QS university ranking, average score top 3*	70.3	12	
3	**Infrastructure**	**69.1**	**2**	●
3.1	Information & communication technologies (ICTs)	87.8	7	
3.1.1	ICT access*	87.0	11	
3.1.2	ICT use*	75.4	18	
3.1.3	Government's online service*	97.1	3	●
3.1.4	E-participation*	91.5	8	
3.2	General infrastructure	57.7	10	
3.2.1	Electricity output, kWh/cap	9,027.4	16	
3.2.2	Logistics performance*	96.2	5	
3.2.3	Gross capital formation, % GDP	26.0	39	
3.3	Ecological sustainability	62.0	14	
3.3.1	GDP/unit of energy use	15.2	9	
3.3.2	Environmental performance*	87.0	14	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.4	30	
4	**Market sophistication**	**71.2**	**4**	
4.1	Credit	63.4	11	
4.1.1	Ease of getting credit*	75.0	19	
4.1.2	Domestic credit to private sector, % GDP	129.7	15	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	75.0	1	●
4.2.1	Ease of protecting minority investors*	83.3	1	●
4.2.2	Market capitalization, % GDP	218.6	4	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	14	
4.3	Trade, competition, & market scale	75.2	22	
4.3.1	Applied tariff rate, weighted mean, %	0.0	1	●
4.3.2	Intensity of local competition†	76.9	19	
4.3.3	Domestic market scale, bn PPP$	486.9	38	
5	**Business sophistication**	**62.9**	**2**	●
5.1	Knowledge workers	73.2	4	
5.1.1	Knowledge-intensive employment, %	54.3	2	●
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP ◷	1.3	16	
5.1.4	GERD financed by business, % ◷	54.1	16	
5.1.5	Females employed w/advanced degrees, % total ◷	23.3	13	
5.2	Innovation linkages	46.5	16	
5.2.1	University/industry research collaboration†	74.5	7	
5.2.2	State of cluster development†	69.5	11	
5.2.3	GERD financed by abroad, % ◷	6.8	57	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.2	4	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.8	19	
5.3	Knowledge absorption	68.9	2	●
5.3.1	Intellectual property payments, % total trade	3.6	1	●
5.3.2	High-tech imports less re-imports, % total trade	21.4	5	
5.3.3	ICT services imports, % total trade	1.7	33	
5.3.4	FDI net inflows, % GDP	22.2	5	
5.3.5	Research talent, % in business enterprise ◷	50.5	23	
6	**Knowledge & technology outputs**	**47.3**	**11**	
6.1	Knowledge creation	27.7	34	
6.1.1	Patents by origin/bn PPP$ GDP	3.1	33	
6.1.2	PCT patent applications/bn PPP$ GDP	1.8	19	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	26.1	28	
6.1.5	Citable documents H index	33.9	25	
6.2	Knowledge impact	47.2	14	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.2)	91	○
6.2.2	New businesses/th pop. 15–64	9.5	11	
6.2.3	Computer software spending, % GDP	0.3	34	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	12.2	31	
6.2.5	High- & medium-high-tech manufactures, %	0.6	2	●
6.3	Knowledge diffusion	67.1	4	
6.3.1	Intellectual property receipts, % total trade	0.7	20	
6.3.2	High-tech exports less re-exports, % total trade	29.1	3	●
6.3.3	ICT services exports, % total trade	1.0	84	○
6.3.4	FDI net outflows, % GDP	12.7	1	●
7	**Creative outputs**	**42.9**	**32**	
7.1	Intangible assets	49.0	42	
7.1.1	Trademarks by origin/bn PPP$ GDP	17.9	85	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.7	48	○
7.1.3	ICTs & business model creation†	81.5	7	
7.1.4	ICTs & organizational model creation†	76.7	9	
7.2	Creative goods & services	36.0	16	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	4.8	38	
7.2.3	Global ent. & media market/th pop. 15–69	42.2	20	
7.2.4	Printing & publishing manufactures, %	0.8	75	○
7.2.5	Creative goods exports, % total trade	5.2	10	
7.3	Online creativity	37.8	30	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	25.8	23	
7.3.2	Country-code TLDs/th pop. 15–69	11.9	36	
7.3.3	Wikipedia edits/mn pop. 15–69	6.0	44	
7.3.4	Video uploads on YouTube/pop. 15–69	55.9	13	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Slovakia

Key indicators

Population (millions)	5.4
GDP (US$ billions)	90.3
GDP per capita, PPP$	29,720.1
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**43.4**	**34**	
	Innovation Output Sub-Index	37.2	35	
	Innovation Input Sub-Index	49.7	39	
	Innovation Efficiency Ratio	0.7	25	
	Global Innovation Index 2016 (out of 128)	41.7	37	
1	**Institutions**	**74.5**	**34**	
1.1	Political environment	75.4	30	
1.1.1	Political stability & safety*	87.0	19	●
1.1.2	Government effectiveness*	63.7	39	
1.2	Regulatory environment	68.3	48	
1.2.1	Regulatory quality*	62.3	38	
1.2.2	Rule of law*	53.6	41	
1.2.3	Cost of redundancy dismissal, salary weeks	18.8	77	
1.3	Business environment	79.9	32	
1.3.1	Ease of starting a business*	88.6	56	
1.3.2	Ease of resolving insolvency*	70.5	33	
1.3.3	Ease of paying taxes*	80.6	47	
2	**Human capital & research**	**34.4**	**53**	
2.1	Education	48.5	60	
2.1.1	Expenditure on education, % GDP	4.1	79	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	19.7	53	
2.1.3	School life expectancy, years	15.0	49	
2.1.4	PISA scales in reading, maths, & science	462.8	41	
2.1.5	Pupil-teacher ratio, secondary◷	11.1	32	
2.2	Tertiary education	38.2	53	
2.2.1	Tertiary enrolment, % gross◷	52.9	51	
2.2.2	Graduates in science & engineering, %	20.5	51	
2.2.3	Tertiary inbound mobility, %◷	5.6	33	
2.3	Research & development (R&D)	16.4	48	
2.3.1	Researchers, FTE/mn pop.	2,654.8	31	
2.3.2	Gross expenditure on R&D, % GDP	1.2	31	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	6.1	68	
3	**Infrastructure**	**55.3**	**35**	
3.1	Information & communication technologies (ICTs)	58.6	63	
3.1.1	ICT access*	72.2	45	
3.1.2	ICT use*	63.8	30	
3.1.3	Government's online service*	44.2	95	○
3.1.4	E-participation*	54.2	80	
3.2	General infrastructure	40.9	50	
3.2.1	Electricity output, kWh/cap	4,787.3	44	
3.2.2	Logistics performance*	58.9	40	
3.2.3	Gross capital formation, % GDP	22.8	58	
3.3	Ecological sustainability	66.4	5	●
3.3.1	GDP/unit of energy use	9.1	59	
3.3.2	Environmental performance*	85.4	24	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	14.1	3	●
4	**Market sophistication**	**45.8**	**67**	
4.1	Credit	42.8	45	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	53.5	66	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	27.6	119	○
4.2.1	Ease of protecting minority investors*	53.3	80	○
4.2.2	Market capitalization, % GDP◷	4.9	82	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	83	○
4.3	Trade, competition, & market scale	67.1	46	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	75.4	24	
4.3.3	Domestic market scale, bn PPP$	169.1	63	
5	**Business sophistication**	**38.3**	**38**	
5.1	Knowledge workers	42.1	51	
5.1.1	Knowledge-intensive employment, %	31.9	44	
5.1.2	Firms offering formal training, % firms	43.5	27	
5.1.3	GERD performed by business, % of GDP	0.3	43	
5.1.4	GERD financed by business, %	25.1	57	
5.1.5	Females employed w/advanced degrees, % total	12.5	53	
5.2	Innovation linkages	38.7	34	
5.2.1	University/industry research collaboration†	38.6	78	
5.2.2	State of cluster development†	48.5	49	
5.2.3	GERD financed by abroad, %	39.4	12	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	110	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.3	44	
5.3	Knowledge absorption	34.0	60	
5.3.1	Intellectual property payments, % total trade	0.7	50	
5.3.2	High-tech imports less re-imports, % total trade	15.6	13	●
5.3.3	ICT services imports, % total trade	0.9	74	
5.3.4	FDI net inflows, % GDP	0.7	112	○
5.3.5	Research talent, % in business enterprise	19.4	56	
6	**Knowledge & technology outputs**	**33.5**	**30**	
6.1	Knowledge creation	26.5	35	
6.1.1	Patents by origin/bn PPP$ GDP	1.7	50	
6.1.2	PCT patent applications/bn PPP$ GDP	0.3	48	
6.1.3	Utility models by origin/bn PPP$ GDP	2.3	10	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	19.6	39	
6.1.5	Citable documents H index	15.5	42	
6.2	Knowledge impact	50.0	11	●
6.2.1	Growth rate of PPP$ GDP/worker, %	1.6	41	
6.2.2	New businesses/th pop. 15–64	3.1	37	
6.2.3	Computer software spending, % GDP	0.3	43	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	35.2	4	●
6.2.5	High- & medium-high-tech manufactures, %	0.6	4	●
6.3	Knowledge diffusion	24.1	56	
6.3.1	Intellectual property receipts, % total trade	0.0	75	○
6.3.2	High-tech exports less re-exports, % total trade	9.3	20	●
6.3.3	ICT services exports, % total trade	1.1	80	
6.3.4	FDI net outflows, % GDP	1.0	52	
7	**Creative outputs**	**40.8**	**35**	
7.1	Intangible assets	48.3	46	
7.1.1	Trademarks by origin/bn PPP$ GDP	66.0	30	
7.1.2	Industrial designs by origin/bn PPP$ GDP	2.1	43	
7.1.3	ICTs & business model creation†	67.1	40	
7.1.4	ICTs & organizational model creation†	62.7	31	
7.2	Creative goods & services	38.3	14	●
7.2.1	Cultural & creative services exports, % of total trade◷	0.3	34	
7.2.2	National feature films/mn pop. 15–69	6.3	30	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	0.6	86	○
7.2.5	Creative goods exports, % total trade	9.3	6	●
7.3	Online creativity	28.5	41	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	3.1	64	
7.3.2	Country-code TLDs/th pop. 15–69	25.5	24	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.1	38	
7.3.4	Video uploads on YouTube/pop. 15–69	26.6	48	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Slovenia

Key indicators

Population (millions)	2.1
GDP (US$ billions)	44.1
GDP per capita, PPP$	31,007.4
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**45.8**	**32**
Innovation Output Sub-Index	37.2	34
Innovation Input Sub-Index	54.4	30
Innovation Efficiency Ratio	0.7	44
Global Innovation Index 2016 (out of 128)	46.0	32

		Score/Value	Rank	
1	**Institutions**	**80.9**	**22**	
1.1	Political environment	76.7	28	
1.1.1	Political stability & safety*	86.1	23	
1.1.2	Government effectiveness*	67.2	36	
1.2	Regulatory environment	78.7	28	
1.2.1	Regulatory quality*	58.0	44	
1.2.2	Rule of law*	67.3	31	
1.2.3	Cost of redundancy dismissal, salary weeks	10.7	37	
1.3	Business environment	87.3	14	●
1.3.1	Ease of starting a business*	91.4	42	
1.3.2	Ease of resolving insolvency*	84.0	11	●
1.3.3	Ease of paying taxes*	86.6	22	
2	**Human capital & research**	**49.2**	**24**	
2.1	Education	61.8	16	
2.1.1	Expenditure on education, % GDP	5.5	33	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	25.9	25	
2.1.3	School life expectancy, years	17.3	14	
2.1.4	PISA scales in reading, maths, & science	509.3	9	
2.1.5	Pupil-teacher ratio, secondary ⓓ	10.1	25	
2.2	Tertiary education	45.7	30	
2.2.1	Tertiary enrolment, % gross ⓓ	82.9	10	●
2.2.2	Graduates in science & engineering, % ⓓ	24.7	31	
2.2.3	Tertiary inbound mobility, % ⓓ	2.7	62	
2.3	Research & development (R&D)	40.1	27	
2.3.1	Researchers, FTE/mn pop.	3,821.0	24	
2.3.2	Gross expenditure on R&D, % GDP	2.2	14	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	51.4	28	
2.3.4	QS university ranking, average score top 3*	11.6	61	
3	**Infrastructure**	**55.4**	**34**	
3.1	Information & communication technologies (ICTs)	73.5	29	
3.1.1	ICT access*	79.3	26	
3.1.2	ICT use*	57.1	44	
3.1.3	Government's online service*	84.8	19	
3.1.4	E-participation*	72.9	37	
3.2	General infrastructure	36.8	65	
3.2.1	Electricity output, kWh/cap	7,153.1	28	
3.2.2	Logistics performance*	51.9	49	
3.2.3	Gross capital formation, % GDP	18.8	94	○
3.3	Ecological sustainability	55.9	27	
3.3.1	GDP/unit of energy use	8.8	61	
3.3.2	Environmental performance*	89.0	5	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	5.6	19	
4	**Market sophistication**	**43.1**	**82**	○
4.1	Credit	27.2	90	○
4.1.1	Ease of getting credit*	35.0	104	○
4.1.2	Domestic credit to private sector, % GDP	50.2	71	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	41.4	59	
4.2.1	Ease of protecting minority investors*	75.0	9	●
4.2.2	Market capitalization, % GDP	14.1	70	○
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	41	
4.3	Trade, competition, & market scale	60.8	64	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	70.5	54	
4.3.3	Domestic market scale, bn PPP$	66.1	87	○
5	**Business sophistication**	**43.4**	**30**	
5.1	Knowledge workers	62.9	19	
5.1.1	Knowledge-intensive employment, %	41.7	21	
5.1.2	Firms offering formal training, % firms	41.5	31	
5.1.3	GERD performed by business, % of GDP	1.7	12	
5.1.4	GERD financed by business, %	69.2	5	●
5.1.5	Females employed w/advanced degrees, % total	20.1	23	
5.2	Innovation linkages	28.7	61	
5.2.1	University/industry research collaboration†	46.0	41	
5.2.2	State of cluster development†	41.5	79	○
5.2.3	GERD financed by abroad, %	10.6	46	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	33	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.0	24	
5.3	Knowledge absorption	38.5	39	
5.3.1	Intellectual property payments, % total trade	0.7	48	
5.3.2	High-tech imports less re-imports, % total trade	6.0	97	○
5.3.3	ICT services imports, % total trade	1.9	25	
5.3.4	FDI net inflows, % GDP	2.1	82	○
5.3.5	Research talent, % in business enterprise	53.1	20	
6	**Knowledge & technology outputs**	**28.0**	**43**	
6.1	Knowledge creation	20.7	45	
6.1.1	Patents by origin/bn PPP$ GDP	1.9	48	
6.1.2	PCT patent applications/bn PPP$ GDP	1.0	27	
6.1.3	Utility models by origin/bn PPP$ GDP ⓓ	0.2	43	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	55.5	4	●
6.1.5	Citable documents H index	16.4	40	
6.2	Knowledge impact	41.6	25	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.4	42	
6.2.2	New businesses/th pop. 15–64	4.4	27	
6.2.3	Computer software spending, % GDP	0.1	92	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	23.2	14	●
6.2.5	High- & medium-high-tech manufactures, %	0.5	10	●
6.3	Knowledge diffusion	21.8	65	
6.3.1	Intellectual property receipts, % total trade	0.2	40	
6.3.2	High-tech exports less re-exports, % total trade	5.0	35	
6.3.3	ICT services exports, % total trade	1.8	56	
6.3.4	FDI net outflows, % GDP	0.4	73	
7	**Creative outputs**	**46.4**	**23**	
7.1	Intangible assets	59.3	17	
7.1.1	Trademarks by origin/bn PPP$ GDP ⓓ	111.2	9	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	62.1	54	
7.1.4	ICTs & organizational model creation†	58.9	42	
7.2	Creative goods & services	32.0	26	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.9	18	
7.2.2	National feature films/mn pop. 15–69	13.4	9	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	1.8	28	
7.2.5	Creative goods exports, % total trade	0.9	45	
7.3	Online creativity	34.8	33	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	21.1	28	
7.3.2	Country-code TLDs/th pop. 15–69	24.4	25	
7.3.3	Wikipedia edits/mn pop. 15–69	6.7	20	
7.3.4	Video uploads on YouTube/pop. 15–69	28.9	45	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

South Africa

Key indicators

Population (millions)	55.0
GDP (US$ billions)	280.4
GDP per capita, PPP$	13,165.2
Income group	Upper-middle income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**35.8**	**57**	
Innovation Output Sub-Index	24.7	69	
Innovation Input Sub-Index	46.9	49	
Innovation Efficiency Ratio	0.5	97	
Global Innovation Index 2016 (out of 128)	35.8	54	

		Score/Value	Rank	
1	**Institutions**	**66.3**	**54**	
1.1	Political environment	54.3	58	
1.1.1	Political stability & safety*	59.6	74	
1.1.2	Government effectiveness*	49.0	52	
1.2	Regulatory environment	71.4	42	
1.2.1	Regulatory quality*	49.9	59	
1.2.2	Rule of law*	41.0	57	
1.2.3	Cost of redundancy dismissal, salary weeks	9.3	27	●
1.3	Business environment	73.2	58	
1.3.1	Ease of starting a business*	80.5	98	○
1.3.2	Ease of resolving insolvency*	57.9	47	
1.3.3	Ease of paying taxes*	81.1	44	
2	**Human capital & research**	**32.8**	**60**	
2.1	Education	44.1	75	
2.1.1	Expenditure on education, % GDP	6.1	20	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	20.9	50	
2.1.3	School life expectancy, years ⓓ	12.8	79	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	25.0	93	○
2.2	Tertiary education	27.3	89	
2.2.1	Tertiary enrolment, % gross ⓓ	19.4	93	○
2.2.2	Graduates in science & engineering, %	19.0	64	
2.2.3	Tertiary inbound mobility, % ⓓ	4.2	46	
2.3	Research & development (R&D)	27.1	39	
2.3.1	Researchers, FTE/mn pop. ⓓ	437.1	65	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.7	48	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	49.6	31	
2.3.4	QS university ranking, average score top 3*	37.0	33	
3	**Infrastructure**	**43.4**	**75**	
3.1	Information & communication technologies (ICTs)	51.6	76	
3.1.1	ICT access*	54.6	76	
3.1.2	ICT use*	40.0	68	
3.1.3	Government's online service*	55.8	75	
3.1.4	E-participation*	55.9	74	
3.2	General infrastructure	42.3	46	
3.2.1	Electricity output, kWh/cap	4,619.8	46	
3.2.2	Logistics performance*	79.2	20	●
3.2.3	Gross capital formation, % GDP	19.6	85	
3.3	Ecological sustainability	36.3	98	○
3.3.1	GDP/unit of energy use	4.5	110	○
3.3.2	Environmental performance*	70.5	74	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.6	54	
4	**Market sophistication**	**57.4**	**21**	●
4.1	Credit	40.0	49	
4.1.1	Ease of getting credit*	60.0	55	
4.1.2	Domestic credit to private sector, % GDP	149.2	9	●
4.1.3	Microfinance gross loans, % GDP	0.0	74	○
4.2	Investment	61.6	17	●
4.2.1	Ease of protecting minority investors*	70.0	22	●
4.2.2	Market capitalization, % GDP	234.0	1	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	51	
4.3	Trade, competition, & market scale	70.5	34	
4.3.1	Applied tariff rate, weighted mean, %	4.2	82	
4.3.2	Intensity of local competition†	74.3	29	
4.3.3	Domestic market scale, bn PPP$	736.3	29	●
5	**Business sophistication**	**34.4**	**57**	
5.1	Knowledge workers	36.8	67	
5.1.1	Knowledge-intensive employment, %	22.5	64	
5.1.2	Firms offering formal training, % firms ⓓ	36.8	35	
5.1.3	GERD performed by business, % of GDP ⓓ	0.3	42	
5.1.4	GERD financed by business, % ⓓ	41.4	31	
5.1.5	Females employed w/advanced degrees, % total ⓓ	10.2	64	
5.2	Innovation linkages	33.4	50	
5.2.1	University/industry research collaboration†	57.4	26	●
5.2.2	State of cluster development†	56.4	29	
5.2.3	GERD financed by abroad, % ⓓ	12.9	36	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	36	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.7	33	
5.3	Knowledge absorption	33.0	62	
5.3.1	Intellectual property payments, % total trade	1.7	14	●
5.3.2	High-tech imports less re-imports, % total trade	10.0	44	
5.3.3	ICT services imports, % total trade	1.1	63	
5.3.4	FDI net inflows, % GDP	1.5	98	○
5.3.5	Research talent, % in business enterprise ⓓ	19.4	55	
6	**Knowledge & technology outputs**	**21.5**	**65**	
6.1	Knowledge creation	15.6	52	
6.1.1	Patents by origin/bn PPP$ GDP	1.2	60	
6.1.2	PCT patent applications/bn PPP$ GDP	0.4	42	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	17.2	44	
6.1.5	Citable documents H index	27.2	33	
6.2	Knowledge impact	26.5	84	
6.2.1	Growth rate of PPP$ GDP/worker, %	(2.5)	105	○
6.2.2	New businesses/th pop. 15–64 ⓓ	6.5	18	●
6.2.3	Computer software spending, % GDP	0.4	30	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	6.0	57	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.3	44	
6.3	Knowledge diffusion	22.4	63	
6.3.1	Intellectual property receipts, % total trade	0.1	50	
6.3.2	High-tech exports less re-exports, % total trade	2.3	52	
6.3.3	ICT services exports, % total trade	0.6	97	○
6.3.4	FDI net outflows, % GDP	1.9	34	
7	**Creative outputs**	**28.0**	**78**	
7.1	Intangible assets	40.5	72	
7.1.1	Trademarks by origin/bn PPP$ GDP	29.7	73	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.0	63	
7.1.3	ICTs & business model creation†	65.5	45	
7.1.4	ICTs & organizational model creation†	59.0	41	
7.2	Creative goods & services	17.9	64	
7.2.1	Cultural & creative services exports, % of total trade	0.2	48	
7.2.2	National feature films/mn pop. 15–69	0.6	89	○
7.2.3	Global ent. & media market/th pop. 15–69	8.6	37	
7.2.4	Printing & publishing manufactures, % ⓓ	2.4	15	●
7.2.5	Creative goods exports, % total trade	0.6	55	
7.3	Online creativity	12.8	91	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	3.2	62	
7.3.2	Country-code TLDs/th pop. 15–69	8.9	41	
7.3.3	Wikipedia edits/mn pop. 15–69	3.8	89	
7.3.4	Video uploads on YouTube/pop. 15–69	2.9	67	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Spain

Key indicators

Population (millions)	46.1
GDP (US$ billions)	1,252.2
GDP per capita, PPP$	34,819.5
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**48.8**	**28**	
	Innovation Output Sub-Index	40.3	26	
	Innovation Input Sub-Index	57.3	25	
	Innovation Efficiency Ratio	0.7	36	
	Global Innovation Index 2016 (out of 128)	49.2	28	
1	**Institutions**	**75.9**	**32**	
1.1	Political environment	71.6	39	
1.1.1	Political stability & safety*	70.8	47	
1.1.2	Government effectiveness*	72.4	26	
1.2	Regulatory environment	72.7	39	
1.2.1	Regulatory quality*	62.2	39	
1.2.2	Rule of law*	65.6	32	
1.2.3	Cost of redundancy dismissal, salary weeks	17.4	74	○
1.3	Business environment	83.3	23	
1.3.1	Ease of starting a business*	86.6	69	○
1.3.2	Ease of resolving insolvency*	79.6	17	
1.3.3	Ease of paying taxes*	83.8	33	
2	**Human capital & research**	**48.9**	**27**	
2.1	Education	56.2	38	
2.1.1	Expenditure on education, % GDP	4.3	71	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	22.5	42	
2.1.3	School life expectancy, years	17.9	11	●
2.1.4	PISA scales in reading, maths, & science	491.4	27	
2.1.5	Pupil-teacher ratio, secondary	12.0	39	
2.2	Tertiary education	44.6	34	
2.2.1	Tertiary enrolment, % gross	89.7	4	●
2.2.2	Graduates in science & engineering, % ◷	22.2	42	
2.2.3	Tertiary inbound mobility, % ◷	2.9	58	○
2.3	Research & development (R&D)	45.8	22	
2.3.1	Researchers, FTE/mn pop.	2,654.7	32	
2.3.2	Gross expenditure on R&D, % GDP	1.2	30	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	74.9	13	●
2.3.4	QS university ranking, average score top 3*	48.2	23	
3	**Infrastructure**	**64.3**	**10**	●
3.1	Information & communication technologies (ICTs)	83.3	15	
3.1.1	ICT access*	79.2	28	
3.1.2	ICT use*	69.3	23	
3.1.3	Government's online service*	91.3	11	●
3.1.4	E-participation*	93.2	7	●
3.2	General infrastructure	44.5	40	
3.2.1	Electricity output, kWh/cap	5,940.7	35	
3.2.2	Logistics performance*	77.0	23	
3.2.3	Gross capital formation, % GDP	21.0	74	○
3.3	Ecological sustainability	65.1	6	●
3.3.1	GDP/unit of energy use	12.5	23	
3.3.2	Environmental performance*	88.9	6	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	8.2	11	●
4	**Market sophistication**	**59.0**	**18**	
4.1	Credit	53.7	20	
4.1.1	Ease of getting credit*	60.0	55	○
4.1.2	Domestic credit to private sector, % GDP	118.9	20	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	43.9	43	
4.2.1	Ease of protecting minority investors*	65.0	31	
4.2.2	Market capitalization, % GDP	65.7	24	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	27	
4.3	Trade, competition, & market scale	79.3	11	●
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	
4.3.2	Intensity of local competition†	77.3	17	
4.3.3	Domestic market scale, bn PPP$	1,689.7	15	
5	**Business sophistication**	**38.4**	**37**	
5.1	Knowledge workers	51.1	33	
5.1.1	Knowledge-intensive employment, %	32.9	42	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	0.6	30	
5.1.4	GERD financed by business, % ◷	46.4	24	
5.1.5	Females employed w/advanced degrees, % total	21.7	19	
5.2	Innovation linkages	27.2	67	○
5.2.1	University/industry research collaboration†	41.8	55	
5.2.2	State of cluster development†	54.2	32	
5.2.3	GERD financed by abroad, % ◷	7.4	52	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	60	○
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.8	30	
5.3	Knowledge absorption	36.9	46	
5.3.1	Intellectual property payments, % total trade	1.2	25	
5.3.2	High-tech imports less re-imports, % total trade	7.3	74	○
5.3.3	ICT services imports, % total trade	1.7	31	
5.3.4	FDI net inflows, % GDP	2.8	65	
5.3.5	Research talent, % in business enterprise	36.9	37	
6	**Knowledge & technology outputs**	**36.3**	**24**	
6.1	Knowledge creation	31.6	29	
6.1.1	Patents by origin/bn PPP$ GDP	2.7	38	
6.1.2	PCT patent applications/bn PPP$ GDP	0.9	28	
6.1.3	Utility models by origin/bn PPP$ GDP	1.4	20	
6.1.4	Scientific & technical articles/bn PPP$ GDP	32.1	23	
6.1.5	Citable documents H index	57.9	12	●
6.2	Knowledge impact	41.0	28	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.3	78	○
6.2.2	New businesses/th pop. 15–64	3.0	38	
6.2.3	Computer software spending, % GDP	0.7	7	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	20.2	19	
6.2.5	High- & medium-high-tech manufactures, %	0.3	33	
6.3	Knowledge diffusion	36.2	27	
6.3.1	Intellectual property receipts, % total trade	0.4	26	
6.3.2	High-tech exports less re-exports, % total trade	4.0	39	
6.3.3	ICT services exports, % total trade	2.9	35	
6.3.4	FDI net outflows, % GDP	3.4	17	
7	**Creative outputs**	**44.4**	**28**	
7.1	Intangible assets	56.5	23	
7.1.1	Trademarks by origin/bn PPP$ GDP	59.2	36	
7.1.2	Industrial designs by origin/bn PPP$ GDP	12.8	10	●
7.1.3	ICTs & business model creation†	73.7	25	
7.1.4	ICTs & organizational model creation†	59.4	39	
7.2	Creative goods & services	23.9	48	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	7.7	19	
7.2.3	Global ent. & media market/th pop. 15–69	26.0	24	
7.2.4	Printing & publishing manufactures, %	1.5	35	
7.2.5	Creative goods exports, % total trade	0.9	46	
7.3	Online creativity	40.8	27	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	28.1	22	
7.3.2	Country-code TLDs/th pop. 15–69	16.6	32	
7.3.3	Wikipedia edits/mn pop. 15–69	6.8	18	
7.3.4	Video uploads on YouTube/pop. 15–69	53.3	15	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Sri Lanka

Key indicators

Population (millions)	20.8
GDP (US$ billions)	82.2
GDP per capita, PPP$	10,566.2
Income group	Lower-middle income
Region	Central and Southern Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**29.9**	**90**
Innovation Output Sub-Index	23.4	77
Innovation Input Sub-Index	36.3	94
Innovation Efficiency Ratio	0.6	58
Global Innovation Index 2016 (out of 128)	28.9	91

1	**Institutions**	**45.3**	**111**	○
1.1	Political environment	52.7	62	
1.1.1	Political stability & safety*	63.1	63	
1.1.2	Government effectiveness*	42.4	70	
1.2	Regulatory environment	20.6	125	○
1.2.1	Regulatory quality*	40.8	74	
1.2.2	Rule of law*	41.4	56	
1.2.3	Cost of redundancy dismissal, salary weeks	58.5	126	○
1.3	Business environment	62.5	84	
1.3.1	Ease of starting a business*	87.5	61	
1.3.2	Ease of resolving insolvency*	46.7	69	
1.3.3	Ease of paying taxes*	53.2	110	○
2	**Human capital & research**	**18.6**	**105**	
2.1	Education	30.5	107	
2.1.1	Expenditure on education, % GDP	2.2	110	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	6.3	102	○
2.1.3	School life expectancy, years◷	14.0	63	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary◷	17.3	75	
2.2	Tertiary education	23.4	97	
2.2.1	Tertiary enrolment, % gross	19.8	91	
2.2.2	Graduates in science & engineering, %	19.9	58	
2.2.3	Tertiary inbound mobility, %	0.3	95	○
2.3	Research & development (R&D)	2.0	93	
2.3.1	Researchers, FTE/mn pop.◷	110.9	85	
2.3.2	Gross expenditure on R&D, % GDP◷	0.1	102	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	4.9	72	
3	**Infrastructure**	**47.3**	**63**	
3.1	Information & communication technologies (ICTs)	48.4	83	
3.1.1	ICT access*	45.1	92	
3.1.2	ICT use*	17.0	102	
3.1.3	Government's online service*	65.2	53	
3.1.4	E-participation*	66.1	49	
3.2	General infrastructure	36.0	70	
3.2.1	Electricity output, kWh/cap	603.7	104	○
3.2.2	Logistics performance*◷	29.2	83	
3.2.3	Gross capital formation, % GDP	28.3	26	●
3.3	Ecological sustainability	57.5	23	●
3.3.1	GDP/unit of energy use	20.0	2	●
3.3.2	Environmental performance*	65.6	92	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.9	68	
4	**Market sophistication**	**42.2**	**86**	
4.1	Credit	18.7	115	○
4.1.1	Ease of getting credit*	40.0	98	
4.1.2	Domestic credit to private sector, % GDP	40.7	82	
4.1.3	Microfinance gross loans, % GDP	0.0	63	
4.2	Investment	45.8	39	●
4.2.1	Ease of protecting minority investors*	63.3	41	●
4.2.2	Market capitalization, % GDP	25.3	57	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	62.1	61	
4.3.1	Applied tariff rate, weighted mean, %◷	5.3	93	
4.3.2	Intensity of local competition†	69.7	65	
4.3.3	Domestic market scale, bn PPP$	237.8	57	
5	**Business sophistication**	**28.0**	**83**	
5.1	Knowledge workers	25.2	97	
5.1.1	Knowledge-intensive employment, %◷	16.9	82	
5.1.2	Firms offering formal training, % firms◷	18.4	80	○
5.1.3	GERD performed by business, % of GDP◷	0.0	71	
5.1.4	GERD financed by business, %◷	40.7	34	●
5.1.5	Females employed w/advanced degrees, % total◷	8.8	68	
5.2	Innovation linkages	24.4	79	
5.2.1	University/industry research collaboration†	43.8	49	
5.2.2	State of cluster development†	46.3	57	
5.2.3	GERD financed by abroad, %◷	5.0	64	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	31	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	84	
5.3	Knowledge absorption	34.6	56	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	6.0	94	
5.3.3	ICT services imports, % total trade	2.1	19	●
5.3.4	FDI net inflows, % GDP	1.1	103	
5.3.5	Research talent, % in business enterprise◷	30.7	43	
6	**Knowledge & technology outputs**	**21.0**	**68**	
6.1	Knowledge creation	4.7	89	
6.1.1	Patents by origin/bn PPP$ GDP	1.0	64	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	70	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.5	105	
6.1.5	Citable documents H index	8.5	73	
6.2	Knowledge impact	33.6	53	
6.2.1	Growth rate of PPP$ GDP/worker, %	4.3	11	●
6.2.2	New businesses/th pop. 15–64◷	0.5	88	
6.2.3	Computer software spending, % GDP	0.3	33	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.6	72	
6.2.5	High- & medium-high-tech manufactures, %◷	0.1	92	○
6.3	Knowledge diffusion	24.8	53	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.3	92	
6.3.3	ICT services exports, % total trade	4.0	19	●
6.3.4	FDI net outflows, % GDP	0.1	95	
7	**Creative outputs**	**25.8**	**86**	
7.1	Intangible assets	37.8	84	
7.1.1	Trademarks by origin/bn PPP$ GDP	26.8	75	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.7	46	
7.1.3	ICTs & business model creation†	60.6	62	
7.1.4	ICTs & organizational model creation†	53.6	63	
7.2	Creative goods & services	14.1	76	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69◷	1.0	77	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %◷	1.7	31	●
7.2.5	Creative goods exports, % total trade	0.3	69	
7.3	Online creativity	13.6	85	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.8	99	
7.3.2	Country-code TLDs/th pop. 15–69	0.2	102	
7.3.3	Wikipedia edits/mn pop. 15–69◷	4.1	77	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Sweden

Key indicators

Population (millions)	9.9
GDP (US$ billions)	517.4
GDP per capita, PPP$	47,922.2
Income group	High income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**63.8**	**2**	●
Innovation Output Sub-Index	57.9	3	●
Innovation Input Sub-Index	69.7	2	●
Innovation Efficiency Ratio	0.8	12	
Global Innovation Index 2016 (out of 128)	63.6	2	

		Score	Rank	
1	**Institutions**	**88.3**	**10**	
1.1	Political environment	88.0	9	
1.1.1	Political stability & safety*	87.3	17	
1.1.2	Government effectiveness*	88.7	9	
1.2	Regulatory environment	90.5	12	
1.2.1	Regulatory quality*	88.4	7	
1.2.2	Rule of law*	99.2	2	●
1.2.3	Cost of redundancy dismissal, salary weeks	14.4	57	○
1.3	Business environment	86.5	17	
1.3.1	Ease of starting a business*	94.6	14	
1.3.2	Ease of resolving insolvency*	79.4	18	
1.3.3	Ease of paying taxes*	85.3	26	
2	**Human capital & research**	**63.7**	**4**	●
2.1	Education	67.7	10	
2.1.1	Expenditure on education, % GDP	7.7	7	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	24.6	32	
2.1.3	School life expectancy, years	18.2	8	
2.1.4	PISA scales in reading, maths, & science	495.8	23	
2.1.5	Pupil-teacher ratio, secondary ⓓ	12.3	44	○
2.2	Tertiary education	46.3	28	
2.2.1	Tertiary enrolment, % gross ⓓ	62.4	41	
2.2.2	Graduates in science & engineering, %	25.7	25	
2.2.3	Tertiary inbound mobility, % ⓓ	5.9	32	
2.3	Research & development (R&D)	77.1	5	
2.3.1	Researchers, FTE/mn pop.	7,021.9	4	●
2.3.2	Gross expenditure on R&D, % GDP	3.3	4	●
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	82.0	11	
2.3.4	QS university ranking, average score top 3*	65.0	14	
3	**Infrastructure**	**69.1**	**3**	●
3.1	Information & communication technologies (ICTs)	83.6	13	
3.1.1	ICT access*	86.9	13	
3.1.2	ICT use*	83.6	6	
3.1.3	Government's online service*	87.7	15	
3.1.4	E-participation*	76.3	27	
3.2	General infrastructure	64.7	5	
3.2.1	Electricity output, kWh/cap	16,520.7	7	
3.2.2	Logistics performance*	99.0	3	●
3.2.3	Gross capital formation, % GDP	25.6	41	
3.3	Ecological sustainability	59.0	20	
3.3.1	GDP/unit of energy use	8.6	62	○
3.3.2	Environmental performance*	90.4	3	●
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	7.8	13	
4	**Market sophistication**	**64.9**	**10**	
4.1	Credit	53.3	21	
4.1.1	Ease of getting credit*	55.0	67	○
4.1.2	Domestic credit to private sector, % GDP	128.9	16	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	68.4	7	
4.2.1	Ease of protecting minority investors*	71.7	19	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	8	
4.3	Trade, competition, & market scale	72.9	28	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	○
4.3.2	Intensity of local competition†	76.5	21	
4.3.3	Domestic market scale, bn PPP$	498.1	36	
5	**Business sophistication**	**62.6**	**4**	●
5.1	Knowledge workers	80.7	2	●
5.1.1	Knowledge-intensive employment, %	50.4	5	
5.1.2	Firms offering formal training, % firms	70.3	2	●
5.1.3	GERD performed by business, % of GDP	2.3	4	
5.1.4	GERD financed by business, % ⓓ	61.0	11	
5.1.5	Females employed w/advanced degrees, % total	24.1	10	
5.2	Innovation linkages	52.4	6	
5.2.1	University/industry research collaboration†	69.3	12	
5.2.2	State of cluster development†	66.4	15	
5.2.3	GERD financed by abroad, % ⓓ	6.7	58	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	9	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	8.8	5	
5.3	Knowledge absorption	54.6	7	
5.3.1	Intellectual property payments, % total trade	2.1	10	
5.3.2	High-tech imports less re-imports, % total trade	9.3	51	○
5.3.3	ICT services imports, % total trade	3.3	6	
5.3.4	FDI net inflows, % GDP	0.7	110	○
5.3.5	Research talent, % in business enterprise	68.6	6	
6	**Knowledge & technology outputs**	**62.5**	**3**	●
6.1	Knowledge creation	74.9	3	●
6.1.1	Patents by origin/bn PPP$ GDP	12.4	9	
6.1.2	PCT patent applications/bn PPP$ GDP	7.5	1	●
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	52.8	6	
6.1.5	Citable documents H index	59.5	11	
6.2	Knowledge impact	50.5	10	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.6	28	
6.2.2	New businesses/th pop. 15–64	6.9	16	
6.2.3	Computer software spending, % GDP	0.6	16	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	9.1	39	
6.2.5	High- & medium-high-tech manufactures, %	0.5	11	
6.3	Knowledge diffusion	62.1	5	
6.3.1	Intellectual property receipts, % total trade	4.2	3	●
6.3.2	High-tech exports less re-exports, % total trade	9.0	23	
6.3.3	ICT services exports, % total trade	7.1	8	
6.3.4	FDI net outflows, % GDP	3.4	18	
7	**Creative outputs**	**53.3**	**11**	
7.1	Intangible assets	58.7	18	
7.1.1	Trademarks by origin/bn PPP$ GDP	55.7	40	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	5.0	26	
7.1.3	ICTs & business model creation†	83.0	5	
7.1.4	ICTs & organizational model creation†	80.5	4	●
7.2	Creative goods & services	35.8	18	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	0.9	19	
7.2.2	National feature films/mn pop. 15–69	7.4	20	
7.2.3	Global ent. & media market/th pop. 15–69	71.5	6	
7.2.4	Printing & publishing manufactures, %	1.3	40	○
7.2.5	Creative goods exports, % total trade	1.6	32	
7.3	Online creativity	60.2	9	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	43.0	17	
7.3.2	Country-code TLDs/th pop. 15–69	63.6	9	
7.3.3	Wikipedia edits/mn pop. 15–69	7.4	4	●
7.3.4	Video uploads on YouTube/pop. 15–69	63.2	6	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Key indicators

Population (millions)	8.4
GDP (US$ billions)	662.5
GDP per capita, PPP$	58,551.5
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**67.7**	**1**	●
	Innovation Output Sub-Index	65.8	1	●
	Innovation Input Sub-Index	69.6	3	●
	Innovation Efficiency Ratio	0.9	2	●
	Global Innovation Index 2016 (out of 128)	66.3	1	
1	**Institutions**	**89.5**	**8**	
1.1	Political environment	94.7	3	●
1.1.1	Political stability & safety*	95.6	3	●
1.1.2	Government effectiveness*	93.8	2	●
1.2	Regulatory environment	93.9	8	
1.2.1	Regulatory quality*	87.0	10	
1.2.2	Rule of law*	96.9	6	
1.2.3	Cost of redundancy dismissal, salary weeks	10.1	33	
1.3	Business environment	79.8	33	
1.3.1	Ease of starting a business*	88.4	58	○
1.3.2	Ease of resolving insolvency*	62.6	42	
1.3.3	Ease of paying taxes*	88.5	17	
2	**Human capital & research**	**63.3**	**7**	
2.1	Education	58.6	28	
2.1.1	Expenditure on education, % GDP	5.1	46	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ◷	26.1	23	
2.1.3	School life expectancy, years	16.0	30	
2.1.4	PISA scales in reading, maths, & science	506.3	13	
2.1.5	Pupil-teacher ratio, secondary ◷	9.3	17	
2.2	Tertiary education	55.9	12	
2.2.1	Tertiary enrolment, % gross ◷	57.2	45	
2.2.2	Graduates in science & engineering, %	22.1	45	○
2.2.3	Tertiary inbound mobility, % ◷	17.1	9	
2.3	Research & development (R&D)	75.4	6	
2.3.1	Researchers, FTE/mn pop. ◷	4,481.1	17	
2.3.2	Gross expenditure on R&D, % GDP ◷	3.0	7	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	94.3	3	●
2.3.4	QS university ranking, average score top 3*	84.4	3	●
3	**Infrastructure**	**65.1**	**6**	
3.1	Information & communication technologies (ICTs)	73.5	30	
3.1.1	ICT access*	89.5	9	
3.1.2	ICT use*	86.7	2	●
3.1.3	Government's online service*	60.1	64	○
3.1.4	E-participation*	57.6	70	○
3.2	General infrastructure	51.7	18	
3.2.1	Electricity output, kWh/cap	7,975.4	19	
3.2.2	Logistics performance*	89.0	11	
3.2.3	Gross capital formation, % GDP	23.1	55	○
3.3	Ecological sustainability	70.1	2	●
3.3.1	GDP/unit of energy use	17.5	4	
3.3.2	Environmental performance*	86.9	16	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.7	15	
4	**Market sophistication**	**67.5**	**7**	
4.1	Credit	64.7	9	
4.1.1	Ease of getting credit*	60.0	55	○
4.1.2	Domestic credit to private sector, % GDP	172.6	6	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	

		Score/Value	Rank	
4.2	Investment	63.5	14	
4.2.1	Ease of protecting minority investors*	50.0	89	○
4.2.2	Market capitalization, % GDP	226.5	3	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	10	
4.3	Trade, competition, & market scale	74.4	23	
4.3.1	Applied tariff rate, weighted mean, %	0.0	1	●
4.3.2	Intensity of local competition†	73.2	38	
4.3.3	Domestic market scale, bn PPP$	494.3	37	
5	**Business sophistication**	**62.6**	**3**	●
5.1	Knowledge workers	74.6	3	●
5.1.1	Knowledge-intensive employment, %	53.0	3	●
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP ◷	2.1	6	
5.1.4	GERD financed by business, % ◷	60.8	12	
5.1.5	Females employed w/advanced degrees, % total	17.8	28	
5.2	Innovation linkages	57.0	4	
5.2.1	University/industry research collaboration†	80.0	1	●
5.2.2	State of cluster development†	68.9	13	
5.2.3	GERD financed by abroad, % ◷	12.1	43	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	10	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	10.6	1	●
5.3	Knowledge absorption	56.3	5	
5.3.1	Intellectual property payments, % total trade	3.3	4	
5.3.2	High-tech imports less re-imports, % total trade	8.2	63	○
5.3.3	ICT services imports, % total trade	3.7	4	
5.3.4	FDI net inflows, % GDP	5.6	25	
5.3.5	Research talent, % in business enterprise ◷	46.2	30	
6	**Knowledge & technology outputs**	**69.1**	**1**	●
6.1	Knowledge creation	85.8	1	●
6.1.1	Patents by origin/bn PPP$ GDP	17.7	5	
6.1.2	PCT patent applications/bn PPP$ GDP	8.8	1	●
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	58.1	3	●
6.1.5	Citable documents H index	66.8	9	
6.2	Knowledge impact	49.1	13	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.6)	94	○
6.2.2	New businesses/th pop. 15–64 ◷	2.5	40	
6.2.3	Computer software spending, % GDP	0.7	5	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	25.3	13	
6.2.5	High- & medium-high-tech manufactures, %	0.6	1	●
6.3	Knowledge diffusion	72.3	3	●
6.3.1	Intellectual property receipts, % total trade	3.8	4	
6.3.2	High-tech exports less re-exports, % total trade	14.4	12	
6.3.3	ICT services exports, % total trade	3.7	21	
6.3.4	FDI net outflows, % GDP	7.0	8	
7	**Creative outputs**	**62.5**	**3**	●
7.1	Intangible assets	65.0	5	
7.1.1	Trademarks by origin/bn PPP$ GDP	79.8	21	
7.1.2	Industrial designs by origin/bn PPP$ GDP	10.1	13	
7.1.3	ICTs & business model creation†	83.3	2	●
7.1.4	ICTs & organizational model creation†	76.2	10	
7.2	Creative goods & services	51.5	3	●
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	16.9	7	
7.2.3	Global ent. & media market/th pop. 15–69	98.7	2	●
7.2.4	Printing & publishing manufactures, %	1.1	58	○
7.2.5	Creative goods exports, % total trade	3.8	14	
7.3	Online creativity	68.6	5	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	60.5	12	
7.3.2	Country-code TLDs/th pop. 15–69	100.0	1	●
7.3.3	Wikipedia edits/mn pop. 15–69	6.7	21	
7.3.4	Video uploads on YouTube/pop. 15–69	49.2	16	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Tajikistan

Key indicators

Population (millions)	8.7
GDP (US$ billions)	6.6
GDP per capita, PPP$	2,749.4
Income group	Lower-middle income
Region	Central and Southern Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**28.2**	**94**
Innovation Output Sub-Index	20.8	88
Innovation Input Sub-Index	35.5	100
Innovation Efficiency Ratio	0.6	83
Global Innovation Index 2016 (out of 128)	29.6	86

		Score	Rank	
1	**Institutions**	**46.4**	**108**	
1.1	Political environment	32.0	112	
1.1.1	Political stability & safety*	42.8	101	
1.1.2	Government effectiveness*	21.1	116	
1.2	Regulatory environment	49.1	102	
1.2.1	Regulatory quality*	16.4	122	
1.2.2	Rule of law*	9.9	120	
1.2.3	Cost of redundancy dismissal, salary weeks	15.5	63	●
1.3	Business environment	58.0	105	
1.3.1	Ease of starting a business*	86.6	69	
1.3.2	Ease of resolving insolvency*	28.7	117	
1.3.3	Ease of paying taxes*	58.8	98	
2	**Human capital & research**	**28.5**	**80**	
2.1	Education	50.0	54	●
2.1.1	Expenditure on education, % GDP	5.2	43	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⓓ	11.3	91	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	15.4	65	
2.2	Tertiary education	34.6	67	
2.2.1	Tertiary enrolment, % gross	28.9	80	
2.2.2	Graduates in science & engineering, %	28.1	14	●
2.2.3	Tertiary inbound mobility, %	0.6	87	
2.3	Research & development (R&D)	0.8	107	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.1	101	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**24.8**	**120**	
3.1	Information & communication technologies (ICTs)	16.3	122	
3.1.1	ICT access*	n/a	n/a	
3.1.2	ICT use*	n/a	n/a	
3.1.3	Government's online service*	12.3	121	
3.1.4	E-participation*	20.3	113	
3.2	General infrastructure	18.2	122	
3.2.1	Electricity output, kWh/cap	1,984.6	77	
3.2.2	Logistics performance*	0.0	127	○
3.2.3	Gross capital formation, % GDP	17.9	99	
3.3	Ecological sustainability	39.9	82	
3.3.1	GDP/unit of energy use	7.5	79	
3.3.2	Environmental performance*	73.1	66	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.1	117	
4	**Market sophistication**	**53.6**	**29**	●
4.1	Credit	49.4	29	●
4.1.1	Ease of getting credit*	40.0	98	
4.1.2	Domestic credit to private sector, % GDP	22.7	108	
4.1.3	Microfinance gross loans, % GDP	5.6	1	●
4.2	Investment	66.7	[11]	
4.2.1	Ease of protecting minority investors*	66.7	26	●
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	44.9	115	
4.3.1	Applied tariff rate, weighted mean, %	7.2	105	
4.3.2	Intensity of local competition†	62.2	92	
4.3.3	Domestic market scale, bn PPP$	25.8	114	
5	**Business sophistication**	**24.2**	**107**	
5.1	Knowledge workers	26.8	[94]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms	33.1	41	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⓓ	1.6	84	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	20.6	102	
5.2.1	University/industry research collaboration†	55.2	30	●
5.2.2	State of cluster development†	33.6	108	
5.2.3	GERD financed by abroad, % ⓓ	0.2	95	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.1	78	
5.3	Knowledge absorption	25.3	96	
5.3.1	Intellectual property payments, % total trade ⓓ	0.0	116	○
5.3.2	High-tech imports less re-imports, % total trade	n/a	n/a	
5.3.3	ICT services imports, % total trade	0.5	101	
5.3.4	FDI net inflows, % GDP	3.4	49	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**22.4**	**58**	●
6.1	Knowledge creation	34.1	26	●
6.1.1	Patents by origin/bn PPP$ GDP	0.1	109	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	3.7	7	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.6	116	
6.1.5	Citable documents H index	0.0	127	○
6.2	Knowledge impact	25.8	86	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.8	17	●
6.2.2	New businesses/th pop. 15–64 ⓓ	0.3	93	
6.2.3	Computer software spending, % GDP	0.1	95	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.2	124	○
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.0	100	○
6.3	Knowledge diffusion	7.3	126	○
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	89	
6.3.2	High-tech exports less re-exports, % total trade	n/a	n/a	
6.3.3	ICT services exports, % total trade	0.6	98	
6.3.4	FDI net outflows, % GDP	(1.9)	123	○
7	**Creative outputs**	**19.2**	**106**	
7.1	Intangible assets	26.8	115	
7.1.1	Trademarks by origin/bn PPP$ GDP	9.2	105	
7.1.2	Industrial designs by origin/bn PPP$ GDP ⓓ	0.0	110	○
7.1.3	ICTs & business model creation†	47.3	111	
7.1.4	ICTs & organizational model creation†	42.1	102	
7.2	Creative goods & services	12.7	[79]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69 ⓓ	1.8	64	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	1.2	53	
7.2.5	Creative goods exports, % total trade	n/a	n/a	
7.3	Online creativity	10.7	98	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.0	123	○
7.3.2	Country-code TLDs/th pop. 15–69	0.4	95	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	3.3	97	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Tanzania, United Republic of

Key indicators

Population (millions)	55.2
GDP (US$ billions)	46.7
GDP per capita, PPP$	2,904.0
Income group	Low income
Region	Sub-Saharan Africa

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**28.0**	**96**	
	Innovation Output Sub-Index	23.6	76	
	Innovation Input Sub-Index	32.3	109	
	Innovation Efficiency Ratio	0.7	29	●
	Global Innovation Index 2016 (out of 128)	26.4	105	
1	**Institutions**	**53.9**	**83**	
1.1	Political environment	39.9	97	
1.1.1	Political stability & safety*	53.0	85	
1.1.2	Government effectiveness*	26.8	100	
1.2	Regulatory environment	63.6	66	●
1.2.1	Regulatory quality*	32.8	92	
1.2.2	Rule of law*	27.0	87	
1.2.3	Cost of redundancy dismissal, salary weeks	9.3	27	●
1.3	Business environment	58.1	104	
1.3.1	Ease of starting a business*	79.1	102	
1.3.2	Ease of resolving insolvency*	41.0	89	
1.3.3	Ease of paying taxes*	54.1	107	
2	**Human capital & research**	**9.5**	**125**	○
2.1	Education	22.9	121	
2.1.1	Expenditure on education, % GDP	3.5	92	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	12.3	90	
2.1.3	School life expectancy, years ⓓ	8.4	111	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	26.4	97	
2.2	Tertiary education	2.5	[123]	
2.2.1	Tertiary enrolment, % gross ⓓ	3.6	119	○
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	3.0	87	
2.3.1	Researchers, FTE/mn pop. ⓓ	18.5	100	○
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.5	62	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**36.1**	**100**	
3.1	Information & communication technologies (ICTs)	36.5	97	
3.1.1	ICT access*	26.5	117	
3.1.2	ICT use*	3.0	125	○
3.1.3	Government's online service*	57.2	72	
3.1.4	E-participation*	59.3	65	
3.2	General infrastructure	41.7	47	●
3.2.1	Electricity output, kWh/cap	120.0	115	
3.2.2	Logistics performance*	42.9	60	●
3.2.3	Gross capital formation, % GDP	30.7	16	●
3.3	Ecological sustainability	30.0	116	
3.3.1	GDP/unit of energy use	4.8	105	
3.3.2	Environmental performance*	58.3	103	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	105	
4	**Market sophistication**	**36.0**	**110**	
4.1	Credit	24.7	100	
4.1.1	Ease of getting credit*	65.0	40	●
4.1.2	Domestic credit to private sector, % GDP	15.2	116	
4.1.3	Microfinance gross loans, % GDP	0.2	48	
4.2	Investment	27.3	120	
4.2.1	Ease of protecting minority investors*	40.0	111	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	79	
4.3	Trade, competition, & market scale	55.9	88	
4.3.1	Applied tariff rate, weighted mean, %	6.5	102	
4.3.2	Intensity of local competition†	62.0	94	
4.3.3	Domestic market scale, bn PPP$	150.6	68	●
5	**Business sophistication**	**26.1**	**97**	
5.1	Knowledge workers	14.2	119	
5.1.1	Knowledge-intensive employment, % ⓓ	3.4	107	○
5.1.2	Firms offering formal training, % firms	30.7	51	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, % ⓓ	0.1	94	○
5.1.5	Females employed w/advanced degrees, % total ⓓ	1.3	85	
5.2	Innovation linkages	39.7	31	●
5.2.1	University/industry research collaboration†	42.3	53	●
5.2.2	State of cluster development†	44.8	67	
5.2.3	GERD financed by abroad, % ⓓ	42.0	8	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	73	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	113	
5.3	Knowledge absorption	24.4	99	
5.3.1	Intellectual property payments, % total trade ⓓ	0.0	113	
5.3.2	High-tech imports less re-imports, % total trade	7.2	76	
5.3.3	ICT services imports, % total trade ⓓ	0.4	109	
5.3.4	FDI net inflows, % GDP	4.4	32	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**16.6**	**94**	
6.1	Knowledge creation	4.2	97	
6.1.1	Patents by origin/bn PPP$ GDP	0.0	124	○
6.1.2	PCT patent applications/bn PPP$ GDP ⓓ	0.0	102	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.2	87	
6.1.5	Citable documents H index	8.7	72	
6.2	Knowledge impact	33.1	57	●
6.2.1	Growth rate of PPP$ GDP/worker, %	4.1	14	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.0	123	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.8	113	
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	82	
6.3	Knowledge diffusion	12.6	123	
6.3.1	Intellectual property receipts, % total trade ⓓ	0.0	108	○
6.3.2	High-tech exports less re-exports, % total trade	0.1	112	
6.3.3	ICT services exports, % total trade ⓓ	0.4	104	
6.3.4	FDI net outflows, % GDP	0.0	109	
7	**Creative outputs**	**30.6**	**64**	●
7.1	Intangible assets	48.3	45	●
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	51.8	94	
7.1.4	ICTs & organizational model creation†	44.7	93	
7.2	Creative goods & services	22.5	[51]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	2.8	10	●
7.2.5	Creative goods exports, % total trade ⓓ	0.1	101	
7.3	Online creativity	3.5	114	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	117	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	106	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	1.0	115	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Thailand

Key indicators

Population (millions)	68.1
GDP (US$ billions)	390.6
GDP per capita, PPP$	16,097.4
Income group	Upper-middle income
Region	South East Asia, East Asia, and Oceania

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**37.6**	**51**
Innovation Output Sub-Index	32.2	43
Innovation Input Sub-Index	42.9	65
Innovation Efficiency Ratio	0.8	24
Global Innovation Index 2016 (out of 128)	36.5	52

1	**Institutions**	**55.8**	**75**	
1.1	Political environment	46.0	79	
1.1.1	Political stability & safety*	40.7	108	○
1.1.2	Government effectiveness*	51.3	50	
1.2	Regulatory environment	43.8	110	○
1.2.1	Regulatory quality*	49.8	60	
1.2.2	Rule of law*	36.3	65	
1.2.3	Cost of redundancy dismissal, salary weeks	36.0	121	○
1.3	Business environment	77.6	37	
1.3.1	Ease of starting a business*	87.0	64	
1.3.2	Ease of resolving insolvency*	77.1	21	●
1.3.3	Ease of paying taxes*	68.7	80	
2	**Human capital & research**	**30.8**	**72**	
2.1	Education	40.6	85	
2.1.1	Expenditure on education, % GDP	4.1	77	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	17.8	63	
2.1.3	School life expectancy, years	16.0	32	
2.1.4	PISA scales in reading, maths, & science	415.3	56	
2.1.5	Pupil-teacher ratio, secondary	28.2	101	○
2.2	Tertiary education	26.7	90	
2.2.1	Tertiary enrolment, % gross	48.9	54	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	2.1	66	
2.3	Research & development (R&D)	25.2	40	
2.3.1	Researchers, FTE/mn pop.	874.3	51	
2.3.2	Gross expenditure on R&D, % GDP	0.6	52	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	42.7	36	
2.3.4	QS university ranking, average score top 3*	33.4	37	
3	**Infrastructure**	**45.0**	**71**	
3.1	Information & communication technologies (ICTs)	53.2	71	
3.1.1	ICT access*	55.0	75	
3.1.2	ICT use*	43.3	63	
3.1.3	Government's online service*	55.1	77	
3.1.4	E-participation*	59.3	65	
3.2	General infrastructure	39.8	51	
3.2.1	Electricity output, kWh/cap	2,563.6	69	
3.2.2	Logistics performance*	55.1	44	
3.2.3	Gross capital formation, % GDP	24.4	48	
3.3	Ecological sustainability	42.0	77	
3.3.1	GDP/unit of energy use	7.4	80	
3.3.2	Environmental performance*	69.5	81	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.7	41	
4	**Market sophistication**	**51.2**	**42**	
4.1	Credit	36.9	58	
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	151.3	8	●
4.1.3	Microfinance gross loans, % GDP ◷	0.0	81	○
4.2	Investment	43.3	50	
4.2.1	Ease of protecting minority investors*	66.7	26	
4.2.2	Market capitalization, % GDP	88.3	14	●
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	77	○
4.3	Trade, competition, & market scale	73.3	26	
4.3.1	Applied tariff rate, weighted mean, %	3.5	77	
4.3.2	Intensity of local competition†	71.9	43	
4.3.3	Domestic market scale, bn PPP$	1,161.3	20	●
5	**Business sophistication**	**31.8**	**68**	
5.1	Knowledge workers	29.2	85	
5.1.1	Knowledge-intensive employment, % ◷	13.8	91	○
5.1.2	Firms offering formal training, % firms	18.0	81	○
5.1.3	GERD performed by business, % of GDP	0.4	36	
5.1.4	GERD financed by business, %	66.2	6	●
5.1.5	Females employed w/advanced degrees, % total ◷	7.5	71	
5.2	Innovation linkages	22.1	85	
5.2.1	University/industry research collaboration†	46.2	40	
5.2.2	State of cluster development†	46.2	58	
5.2.3	GERD financed by abroad, %	1.5	81	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	47	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	77	
5.3	Knowledge absorption	44.1	22	
5.3.1	Intellectual property payments, % total trade	1.6	18	●
5.3.2	High-tech imports less re-imports, % total trade	15.6	12	●
5.3.3	ICT services imports, % total trade	0.2	117	○
5.3.4	FDI net inflows, % GDP	2.4	73	
5.3.5	Research talent, % in business enterprise	50.9	21	
6	**Knowledge & technology outputs**	**29.8**	**40**	
6.1	Knowledge creation	19.6	47	
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.9	66	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	60	
6.1.3	Utility models by origin/bn PPP$ GDP	1.9	16	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.5	84	
6.1.5	Citable documents H index	19.3	38	
6.2	Knowledge impact	39.7	35	
6.2.1	Growth rate of PPP$ GDP/worker, %	3.0	19	●
6.2.2	New businesses/th pop. 15–64	0.9	75	
6.2.3	Computer software spending, % GDP	0.3	47	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.8	44	
6.2.5	High- & medium-high-tech manufactures, % ◷	0.4	19	
6.3	Knowledge diffusion	30.1	39	
6.3.1	Intellectual property receipts, % total trade	0.1	60	
6.3.2	High-tech exports less re-exports, % total trade	15.2	9	●
6.3.3	ICT services exports, % total trade	0.2	117	○
6.3.4	FDI net outflows, % GDP	1.9	35	
7	**Creative outputs**	**34.6**	**53**	
7.1	Intangible assets	42.6	62	
7.1.1	Trademarks by origin/bn PPP$ GDP	30.0	72	
7.1.2	Industrial designs by origin/bn PPP$ GDP	3.0	37	
7.1.3	ICTs & business model creation†	67.1	39	
7.1.4	ICTs & organizational model creation†	58.9	43	
7.2	Creative goods & services	34.4	20	●
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69 ◷	1.0	78	
7.2.3	Global ent. & media market/th pop. 15–69	5.5	43	
7.2.4	Printing & publishing manufactures, % ◷	0.8	76	
7.2.5	Creative goods exports, % total trade	9.5	5	●
7.3	Online creativity	18.8	67	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	5.4	54	
7.3.2	Country-code TLDs/th pop. 15–69	0.4	94	
7.3.3	Wikipedia edits/mn pop. 15–69	4.3	75	
7.3.4	Video uploads on YouTube/pop. 15–69	28.2	46	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

The Former Yugoslav Republic of Macedonia

Key indicators

Population (millions)	2.1
GDP (US$ billions)	10.5
GDP per capita, PPP$	14,009.1
Income group	Upper-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**35.4**	**61**
Innovation Output Sub-Index	26.3	63
Innovation Input Sub-Index	44.5	53
Innovation Efficiency Ratio	0.6	80
Global Innovation Index 2016 (out of 128)	35.4	58

1	**Institutions**	**68.9**	**45**	
1.1	Political environment	52.2	63	
1.1.1	Political stability & safety*	59.0	75	
1.1.2	Government effectiveness*	45.4	63	
1.2	Regulatory environment	67.0	52	
1.2.1	Regulatory quality*	53.5	53	
1.2.2	Rule of law*	34.3	70	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	47	
1.3	Business environment	87.4	12	●
1.3.1	Ease of starting a business*	98.1	4	●
1.3.2	Ease of resolving insolvency*	72.4	30	●
1.3.3	Ease of paying taxes*	91.7	9	●
2	**Human capital & research**	**29.7**	**77**	
2.1	Education	51.5	51	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	12.8	76	
2.1.4	PISA scales in reading, maths, & science	368.9	68	○
2.1.5	Pupil-teacher ratio, secondary ◷	9.6	21	●
2.2	Tertiary education	32.4	75	
2.2.1	Tertiary enrolment, % gross ◷	39.6	66	
2.2.2	Graduates in science & engineering, %	21.2	48	
2.2.3	Tertiary inbound mobility, % ◷	2.8	59	
2.3	Research & development (R&D)	5.1	75	
2.3.1	Researchers, FTE/mn pop.	858.8	52	
2.3.2	Gross expenditure on R&D, % GDP	0.4	69	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**42.2**	**80**	
3.1	Information & communication technologies (ICTs)	60.1	61	
3.1.1	ICT access*	66.8	60	
3.1.2	ICT use*	51.7	56	
3.1.3	Government's online service*	60.9	62	
3.1.4	E-participation*	61.0	63	
3.2	General infrastructure	15.0	124	○
3.2.1	Electricity output, kWh/cap	2,583.7	66	
3.2.2	Logistics performance*	20.7	100	○
3.2.3	Gross capital formation, % GDP	n/a	n/a	
3.3	Ecological sustainability	51.5	43	
3.3.1	GDP/unit of energy use	10.0	48	
3.3.2	Environmental performance*	78.0	49	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	4.3	22	●
4	**Market sophistication**	**47.4**	**59**	
4.1	Credit	35.2	64	
4.1.1	Ease of getting credit*	80.0	15	●
4.1.2	Domestic credit to private sector, % GDP	50.9	68	
4.1.3	Microfinance gross loans, % GDP	0.3	40	
4.2	Investment	49.7	30	●
4.2.1	Ease of protecting minority investors*	73.3	13	●
4.2.2	Market capitalization, % GDP ◷	5.7	81	○
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	57.4	81	
4.3.1	Applied tariff rate, weighted mean, %	1.1	16	●
4.3.2	Intensity of local competition†	73.0	40	
4.3.3	Domestic market scale, bn PPP$	30.1	108	○
5	**Business sophistication**	**34.5**	**56**	
5.1	Knowledge workers	41.4	54	
5.1.1	Knowledge-intensive employment, %	27.3	51	
5.1.2	Firms offering formal training, % firms	46.9	25	
5.1.3	GERD performed by business, % of GDP ◷	0.0	75	○
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	12.9	49	
5.2	Innovation linkages	33.9	48	
5.2.1	University/industry research collaboration†	40.7	67	
5.2.2	State of cluster development†	47.3	52	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	86	
5.3	Knowledge absorption	28.1	86	
5.3.1	Intellectual property payments, % total trade	1.0	31	
5.3.2	High-tech imports less re-imports, % total trade	6.4	89	
5.3.3	ICT services imports, % total trade	1.6	37	
5.3.4	FDI net inflows, % GDP	2.4	75	
5.3.5	Research talent, % in business enterprise ◷	11.7	63	
6	**Knowledge & technology outputs**	**18.9**	**83**	
6.1	Knowledge creation	6.4	79	
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.0	119	○
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	64	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	14.2	53	
6.1.5	Citable documents H index	4.9	95	○
6.2	Knowledge impact	31.2	63	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.3	45	
6.2.2	New businesses/th pop. 15–64	3.7	32	
6.2.3	Computer software spending, % GDP	0.1	80	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	12.5	29	●
6.2.5	High- & medium-high-tech manufactures, % ◷	0.2	59	
6.3	Knowledge diffusion	19.2	86	
6.3.1	Intellectual property receipts, % total trade	0.2	44	
6.3.2	High-tech exports less re-exports, % total trade	2.2	54	
6.3.3	ICT services exports, % total trade	2.5	43	
6.3.4	FDI net outflows, % GDP	(0.1)	115	○
7	**Creative outputs**	**33.7**	**56**	
7.1	Intangible assets	45.4	56	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.6	49	
7.1.3	ICTs & business model creation†	57.9	73	
7.1.4	ICTs & organizational model creation†	51.2	70	
7.2	Creative goods & services	20.9	55	
7.2.1	Cultural & creative services exports, % of total trade	0.2	43	
7.2.2	National feature films/mn pop. 15–69	6.4	29	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ◷	2.6	12	●
7.2.5	Creative goods exports, % total trade	0.2	81	
7.3	Online creativity	23.1	56	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	6.6	50	
7.3.2	Country-code TLDs/th pop. 15–69	1.4	71	
7.3.3	Wikipedia edits/mn pop. 15–69 ◷	6.2	36	
7.3.4	Video uploads on YouTube/pop. 15–69	25.1	50	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Togo

Key indicators

Population (millions)	7.5
GDP (US$ billions)	4.5
GDP per capita, PPP$	1,483.4
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**18.4**	**125**	○
Innovation Output Sub-Index	8.0	127	○
Innovation Input Sub-Index	28.8	119	
Innovation Efficiency Ratio	0.3	126	○
Global Innovation Index 2016 (out of 128)	18.4	126	

	Indicator	Score	Rank	
1	**Institutions**	**49.4**	**96**	
1.1	Political environment	35.7	106	
1.1.1	Political stability & safety*	59.6	73	●
1.1.2	Government effectiveness*	11.9	125	○
1.2	Regulatory environment	54.2	88	
1.2.1	Regulatory quality*	21.1	113	
1.2.2	Rule of law*	16.1	109	
1.2.3	Cost of redundancy dismissal, salary weeks	13.1	51	●
1.3	Business environment	58.2	103	
1.3.1	Ease of starting a business*	81.7	94	
1.3.2	Ease of resolving insolvency*	44.7	79	
1.3.3	Ease of paying taxes*	48.2	116	
2	**Human capital & research**	**15.7**	**111**	
2.1	Education	37.4	96	
2.1.1	Expenditure on education, % GDP	5.3	37	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ◷	15.6	77	
2.1.3	School life expectancy, years ◷	12.0	88	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ◷	26.2	96	
2.2	Tertiary education	8.0	116	
2.2.1	Tertiary enrolment, % gross	10.6	102	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % ◷	1.4	78	
2.3	Research & development (R&D)	1.6	97	
2.3.1	Researchers, FTE/mn pop. ◷	38.2	96	
2.3.2	Gross expenditure on R&D, % GDP ◷	0.3	82	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**26.5**	**115**	
3.1	Information & communication technologies (ICTs)	25.4	112	
3.1.1	ICT access*	25.9	119	
3.1.2	ICT use*	4.9	121	
3.1.3	Government's online service*	31.9	107	
3.1.4	E-participation*	39.0	98	
3.2	General infrastructure	32.0	87	
3.2.1	Electricity output, kWh/cap	19.9	118	○
3.2.2	Logistics performance*	25.7	90	
3.2.3	Gross capital formation, % GDP	26.0	37	●
3.3	Ecological sustainability	22.0	123	○
3.3.1	GDP/unit of energy use	2.9	113	
3.3.2	Environmental performance*	46.1	114	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.2	109	
4	**Market sophistication**	**30.7**	**119**	
4.1	Credit	30.3	77	
4.1.1	Ease of getting credit*	30.0	108	
4.1.2	Domestic credit to private sector, % GDP	37.1	88	
4.1.3	Microfinance gross loans, % GDP	2.7	14	●
4.2	Investment	40.0	[64]	
4.2.1	Ease of protecting minority investors*	40.0	111	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	21.6	127	○
4.3.1	Applied tariff rate, weighted mean, %	11.4	117	
4.3.2	Intensity of local competition†	n/a	n/a	
4.3.3	Domestic market scale, bn PPP$	11.6	125	○
5	**Business sophistication**	**21.9**	**[117]**	
5.1	Knowledge workers	36.4	[69]	
5.1.1	Knowledge-intensive employment, %	n/a	n/a	
5.1.2	Firms offering formal training, % firms ◷	31.0	50	●
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	9.3	[126]	
5.2.1	University/industry research collaboration†	n/a	n/a	
5.2.2	State of cluster development†	n/a	n/a	
5.2.3	GERD financed by abroad, % ◷	5.5	63	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	n/a	n/a	
5.3	Knowledge absorption	19.9	122	
5.3.1	Intellectual property payments, % total trade ◷	0.1	96	
5.3.2	High-tech imports less re-imports, % total trade ◷	2.7	123	○
5.3.3	ICT services imports, % total trade ◷	0.8	77	
5.3.4	FDI net inflows, % GDP	2.5	71	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**12.5**	**116**	
6.1	Knowledge creation	3.7	102	
6.1.1	Patents by origin/bn PPP$ GDP ◷	0.3	88	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	6.7	80	
6.1.5	Citable documents H index	0.9	124	○
6.2	Knowledge impact	4.0	121	
6.2.1	Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2	New businesses/th pop. 15–64	0.3	93	
6.2.3	Computer software spending, % GDP	0.1	93	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.0	92	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	29.8	41	●
6.3.1	Intellectual property receipts, % total trade ◷	0.0	103	
6.3.2	High-tech exports less re-exports, % total trade ◷	0.0	121	○
6.3.3	ICT services exports, % total trade ◷	1.3	73	●
6.3.4	FDI net outflows, % GDP	4.1	11	●
7	**Creative outputs**	**3.5**	**125**	○
7.1	Intangible assets	3.3	125	○
7.1.1	Trademarks by origin/bn PPP$ GDP	8.7	107	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.4	86	
7.1.3	ICTs & business model creation†	n/a	n/a	
7.1.4	ICTs & organizational model creation†	n/a	n/a	
7.2	Creative goods & services	4.4	111	
7.2.1	Cultural & creative services exports, % of total trade ◷	0.0	85	
7.2.2	National feature films/mn pop. 15–69	4.6	42	●
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade ◷	0.0	123	○
7.3	Online creativity	3.3	118	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.6	101	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	127	○
7.3.3	Wikipedia edits/mn pop. 15–69 ◷	0.9	118	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Trinidad and Tobago

Key indicators

Population (millions)	1.4
GDP (US$ billions)	22.8
GDP per capita, PPP$	32,635.5
Income group	High income
Region	Latin America and the Caribbean

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**29.7**	**91**	
	Innovation Output Sub-Index	21.3	86	
	Innovation Input Sub-Index	38.2	85	
	Innovation Efficiency Ratio	0.6	90	
	Global Innovation Index 2016 (out of 128)	n/a	n/a	
1	**Institutions**	**60.7**	**65**	
1.1	Political environment	59.3	49	●
1.1.1	Political stability & safety*	70.4	49	●
1.1.2	Government effectiveness*	48.2	56	●
1.2	Regulatory environment	57.9	76	
1.2.1	Regulatory quality*	45.8	66	
1.2.2	Rule of law*	35.2	68	
1.2.3	Cost of redundancy dismissal, salary weeks	20.5	84	
1.3	Business environment	64.9	77	
1.3.1	Ease of starting a business*	88.6	57	●
1.3.2	Ease of resolving insolvency*	48.7	65	
1.3.3	Ease of paying taxes*	57.3	101	
2	**Human capital & research**	**20.4**	**[99]**	
2.1	Education	40.4	[87]	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	423.0	50	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	n/a	n/a	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	0.5	109	
2.3.1	Researchers, FTE/mn pop.	n/a	n/a	
2.3.2	Gross expenditure on R&D, % GDP◷	0.1	107	○
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**35.9**	**101**	
3.1	Information & communication technologies (ICTs)	53.1	72	
3.1.1	ICT access*	70.3	50	●
3.1.2	ICT use*	45.3	62	
3.1.3	Government's online service*	52.9	79	
3.1.4	E-participation*	44.1	96	
3.2	General infrastructure	21.9	116	
3.2.1	Electricity output, kWh/cap	7,326.7	26	●
3.2.2	Logistics performance*	15.5	113	
3.2.3	Gross capital formation, % GDP	13.4	118	○
3.3	Ecological sustainability	32.5	111	
3.3.1	GDP/unit of energy use	2.1	118	○
3.3.2	Environmental performance*	74.3	58	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	81	
4	**Market sophistication**	**45.0**	**71**	
4.1	Credit	26.3	95	
4.1.1	Ease of getting credit*	65.0	40	●
4.1.2	Domestic credit to private sector, % GDP	37.1	87	
4.1.3	Microfinance gross loans, % GDP◷	0.0	77	
4.2	Investment	60.0	[18]	
4.2.1	Ease of protecting minority investors*	60.0	52	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a	
4.3	Trade, competition, & market scale	48.6	105	
4.3.1	Applied tariff rate, weighted mean, %◷	8.3	108	
4.3.2	Intensity of local competition†	70.3	57	
4.3.3	Domestic market scale, bn PPP$	43.6	94	

		Score/Value	Rank	
5	**Business sophistication**	**29.1**	**77**	
5.1	Knowledge workers	32.7	80	
5.1.1	Knowledge-intensive employment, %	28.4	49	
5.1.2	Firms offering formal training, % firms◷	28.0	57	
5.1.3	GERD performed by business, % of GDP◷	0.0	87	○
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	28.8	59	
5.2.1	University/industry research collaboration†	31.7	102	
5.2.2	State of cluster development†	41.5	78	
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	85	
5.3	Knowledge absorption	25.9	93	
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade◷	4.9	110	
5.3.3	ICT services imports, % total trade◷	0.1	122	○
5.3.4	FDI net inflows, % GDP	8.0	17	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**22.5**	**56**	●
6.1	Knowledge creation	3.4	107	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	111	
6.1.2	PCT patent applications/bn PPP$ GDP	0.9	29	●
6.1.3	Utility models by origin/bn PPP$ GDP◷	0.0	62	○
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.3	107	
6.1.5	Citable documents H index	4.4	98	
6.2	Knowledge impact	23.0	[97]	
6.2.1	Growth rate of PPP$ GDP/worker, %	(1.0)	98	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	n/a	n/a	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	2.6	84	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	41.2	20	●
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade◷	0.0	120	○
6.3.3	ICT services exports, % total trade◷	0.1	123	○
6.3.4	FDI net outflows, % GDP	5.6	9	●
7	**Creative outputs**	**20.0**	**101**	
7.1	Intangible assets	30.9	101	
7.1.1	Trademarks by origin/bn PPP$ GDP	17.3	87	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.4	83	
7.1.3	ICTs & business model creation†	53.2	90	
7.1.4	ICTs & organizational model creation†	45.6	89	
7.2	Creative goods & services	2.0	[121]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade◷	0.1	103	
7.3	Online creativity	16.1	77	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	4.5	56	●
7.3.2	Country-code TLDs/th pop. 15–69	1.5	69	
7.3.3	Wikipedia edits/mn pop. 15–69◷	4.4	71	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Tunisia

Key indicators

Population (millions)	11.4
GDP (US$ billions)	42.4
GDP per capita, PPP$	11,428.2
Income group	Lower-middle income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**32.3**	**74**
Innovation Output Sub-Index	24.6	71
Innovation Input Sub-Index	40.0	81
Innovation Efficiency Ratio	0.6	65
Global Innovation Index 2016 (out of 128)	30.6	77

		Score	Rank	
1	**Institutions**	**54.9**	**77**	
1.1	Political environment	41.1	91	
1.1.1	Political stability & safety*	42.8	102	
1.1.2	Government effectiveness*	39.5	78	
1.2	Regulatory environment	54.0	90	
1.2.1	Regulatory quality*	32.0	94	
1.2.2	Rule of law*	37.9	60	
1.2.3	Cost of redundancy dismissal, salary weeks	21.6	89	
1.3	Business environment	69.5	69	
1.3.1	Ease of starting a business*	85.0	78	
1.3.2	Ease of resolving insolvency*	54.5	55	
1.3.3	Ease of paying taxes*	69.0	79	
2	**Human capital & research**	**38.0**	**44**	
2.1	Education	49.9	55	
2.1.1	Expenditure on education, % GDP◷	6.3	19	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap◷	24.4	34	●
2.1.3	School life expectancy, years	14.8	55	
2.1.4	PISA scales in reading, maths, & science	371.4	67	○
2.1.5	Pupil-teacher ratio, secondary◷	13.6	54	
2.2	Tertiary education	55.0	14	●
2.2.1	Tertiary enrolment, % gross	34.6	75	
2.2.2	Graduates in science & engineering, %	44.1	3	●
2.2.3	Tertiary inbound mobility, %	2.0	69	
2.3	Research & development (R&D)	9.1	61	
2.3.1	Researchers, FTE/mn pop.	1,787.3	42	
2.3.2	Gross expenditure on R&D, % GDP◷	0.7	51	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**45.2**	**70**	
3.1	Information & communication technologies (ICTs)	58.4	64	
3.1.1	ICT access*	52.9	79	
3.1.2	ICT use*	39.5	70	
3.1.3	Government's online service*	71.7	40	
3.1.4	E-participation*	69.5	43	
3.2	General infrastructure	27.3	101	
3.2.1	Electricity output, kWh/cap	1,729.5	81	
3.2.2	Logistics performance*	20.1	104	○
3.2.3	Gross capital formation, % GDP	21.7	67	
3.3	Ecological sustainability	49.8	48	
3.3.1	GDP/unit of energy use	11.2	32	●
3.3.2	Environmental performance*	77.3	52	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.8	50	
4	**Market sophistication**	**38.7**	**98**	
4.1	Credit	27.4	88	
4.1.1	Ease of getting credit*	45.0	84	
4.1.2	Domestic credit to private sector, % GDP	79.6	37	●
4.1.3	Microfinance gross loans, % GDP	0.3	41	
4.2	Investment	29.2	117	○
4.2.1	Ease of protecting minority investors*	46.7	95	
4.2.2	Market capitalization, % GDP◷	21.1	61	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	32	
4.3	Trade, competition, & market scale	59.5	73	
4.3.1	Applied tariff rate, weighted mean, %	3.9	78	
4.3.2	Intensity of local competition†	64.2	81	
4.3.3	Domestic market scale, bn PPP$	130.8	71	
5	**Business sophistication**	**23.2**	**112**	○
5.1	Knowledge workers	27.7	91	
5.1.1	Knowledge-intensive employment, %◷	21.0	70	
5.1.2	Firms offering formal training, % firms	28.9	53	
5.1.3	GERD performed by business, % of GDP◷	0.1	61	
5.1.4	GERD financed by business, %◷	18.5	64	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	19.5	112	○
5.2.1	University/industry research collaboration†	32.8	98	
5.2.2	State of cluster development†	36.3	97	
5.2.3	GERD financed by abroad, %◷	4.0	67	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	30	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	69	
5.3	Knowledge absorption	22.3	113	○
5.3.1	Intellectual property payments, % total trade◷	0.1	103	○
5.3.2	High-tech imports less re-imports, % total trade	10.5	38	●
5.3.3	ICT services imports, % total trade◷	0.4	106	○
5.3.4	FDI net inflows, % GDP	2.2	77	
5.3.5	Research talent, % in business enterprise	4.0	75	○
6	**Knowledge & technology outputs**	**21.0**	**69**	
6.1	Knowledge creation	15.3	53	
6.1.1	Patents by origin/bn PPP$ GDP	1.4	57	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	84	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	31.8	24	●
6.1.5	Citable documents H index	8.8	71	
6.2	Knowledge impact	28.6	74	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.4)	92	○
6.2.2	New businesses/th pop. 15–64◷	1.5	55	
6.2.3	Computer software spending, % GDP	0.3	40	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.8	43	
6.2.5	High- & medium-high-tech manufactures, %◷	0.3	34	
6.3	Knowledge diffusion	19.0	89	
6.3.1	Intellectual property receipts, % total trade◷	0.1	48	
6.3.2	High-tech exports less re-exports, % total trade	4.3	37	●
6.3.3	ICT services exports, % total trade◷	1.6	64	
6.3.4	FDI net outflows, % GDP	0.1	99	
7	**Creative outputs**	**28.3**	**76**	
7.1	Intangible assets	42.1	63	
7.1.1	Trademarks by origin/bn PPP$ GDP	n/a	n/a	
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.0	62	
7.1.3	ICTs & business model creation†	58.9	69	
7.1.4	ICTs & organizational model creation†	43.7	99	
7.2	Creative goods & services	17.7	66	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	1.4	72	
7.2.3	Global ent. & media market/th pop. 15–69	0.9	58	○
7.2.4	Printing & publishing manufactures, %◷	0.7	80	
7.2.5	Creative goods exports, % total trade	2.1	24	●
7.3	Online creativity	11.2	96	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.7	69	
7.3.2	Country-code TLDs/th pop. 15–69	0.2	101	
7.3.3	Wikipedia edits/mn pop. 15–69◷	3.4	96	
7.3.4	Video uploads on YouTube/pop. 15–69	9.2	63	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Turkey

Key indicators

Population (millions)	79.6
GDP (US$ billions)	735.7
GDP per capita, PPP$	20,437.8
Income group	Upper-middle income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**38.9**	**43**	
Innovation Output Sub-Index	35.5	36	
Innovation Input Sub-Index	42.3	68	
Innovation Efficiency Ratio	0.8	9	●
Global Innovation Index 2016 (out of 128)	39.0	42	

		Score/Value	Rank	
1	**Institutions**	**50.6**	**95**	
1.1	Political environment	40.5	95	
1.1.1	Political stability & safety*	32.9	117	○
1.1.2	Government effectiveness*	48.1	57	
1.2	Regulatory environment	50.5	97	
1.2.1	Regulatory quality*	50.6	58	
1.2.2	Rule of law*	37.7	62	
1.2.3	Cost of redundancy dismissal, salary weeks	29.8	116	○
1.3	Business environment	60.9	95	
1.3.1	Ease of starting a business*	87.0	65	
1.3.2	Ease of resolving insolvency*	35.0	106	○
1.3.3	Ease of paying taxes*	60.8	92	
2	**Human capital & research**	**38.1**	**43**	
2.1	Education	45.5	72	
2.1.1	Expenditure on education, % GDP	4.8	59	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	14.8	84	
2.1.3	School life expectancy, years ⓐ	16.4	24	
2.1.4	PISA scales in reading, maths, & science	424.8	49	
2.1.5	Pupil-teacher ratio, secondary ⓐ	20.1	81	
2.2	Tertiary education	39.8	48	
2.2.1	Tertiary enrolment, % gross ⓐ	86.3	8	●
2.2.2	Graduates in science & engineering, % ⓐ	20.9	50	
2.2.3	Tertiary inbound mobility, % ⓐ	0.9	84	
2.3	Research & development (R&D)	29.0	38	
2.3.1	Researchers, FTE/mn pop. ⓐ	1,156.5	46	
2.3.2	Gross expenditure on R&D, % GDP ⓐ	1.0	37	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	51.2	29	
2.3.4	QS university ranking, average score top 3*	28.0	41	
3	**Infrastructure**	**45.7**	**68**	
3.1	Information & communication technologies (ICTs)	56.7	67	
3.1.1	ICT access*	62.0	69	
3.1.2	ICT use*	41.8	67	
3.1.3	Government's online service*	60.1	64	
3.1.4	E-participation*	62.7	59	
3.2	General infrastructure	34.6	76	
3.2.1	Electricity output, kWh/cap	3,351.7	58	
3.2.2	Logistics performance*	62.9	33	
3.2.3	Gross capital formation, % GDP	17.4	101	○
3.3	Ecological sustainability	45.7	59	
3.3.1	GDP/unit of energy use	11.1	37	
3.3.2	Environmental performance*	67.7	87	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.8	51	
4	**Market sophistication**	**47.8**	**57**	
4.1	Credit	27.2	89	
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	80.0	36	
4.1.3	Microfinance gross loans, % GDP	0.0	76	○
4.2	Investment	38.5	72	
4.2.1	Ease of protecting minority investors*	70.0	22	●
4.2.2	Market capitalization, % GDP	26.3	55	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	73	
4.3	Trade, competition, & market scale	77.9	14	●
4.3.1	Applied tariff rate, weighted mean, %	3.2	70	
4.3.2	Intensity of local competition†	81.3	11	●
4.3.3	Domestic market scale, bn PPP$	1,669.9	17	●
5	**Business sophistication**	**29.3**	**75**	
5.1	Knowledge workers	34.1	77	
5.1.1	Knowledge-intensive employment, %	20.5	72	
5.1.2	Firms offering formal training, % firms	28.4	54	
5.1.3	GERD performed by business, % of GDP ⓐ	0.5	34	
5.1.4	GERD financed by business, % ⓐ	50.9	19	●
5.1.5	Females employed w/advanced degrees, % total	8.0	70	○
5.2	Innovation linkages	21.2	96	
5.2.1	University/industry research collaboration†	41.2	60	
5.2.2	State of cluster development†	47.0	54	
5.2.3	GERD financed by abroad, % ⓐ	1.1	85	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	79	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.5	35	
5.3	Knowledge absorption	32.7	65	
5.3.1	Intellectual property payments, % total trade	0.3	72	
5.3.2	High-tech imports less re-imports, % total trade	10.3	39	
5.3.3	ICT services imports, % total trade	0.1	121	○
5.3.4	FDI net inflows, % GDP	1.8	85	
5.3.5	Research talent, % in business enterprise ⓐ	46.7	28	
6	**Knowledge & technology outputs**	**27.6**	**46**	
6.1	Knowledge creation	28.8	33	
6.1.1	Patents by origin/bn PPP$ GDP	3.6	29	
6.1.2	PCT patent applications/bn PPP$ GDP	0.6	32	
6.1.3	Utility models by origin/bn PPP$ GDP	2.2	12	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	17.5	43	
6.1.5	Citable documents H index	25.0	36	
6.2	Knowledge impact	34.6	47	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.4	43	
6.2.2	New businesses/th pop. 15–64	1.1	64	
6.2.3	Computer software spending, % GDP	0.5	18	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	5.4	61	
6.2.5	High- & medium-high-tech manufactures, %	0.3	48	
6.3	Knowledge diffusion	19.2	85	
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	1.3	66	
6.3.3	ICT services exports, % total trade	0.1	121	○
6.3.4	FDI net outflows, % GDP	0.7	64	
7	**Creative outputs**	**43.4**	**31**	
7.1	Intangible assets	64.7	6	●
7.1.1	Trademarks by origin/bn PPP$ GDP	122.0	7	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	24.3	1	●
7.1.3	ICTs & business model creation†	63.2	51	
7.1.4	ICTs & organizational model creation†	50.8	73	
7.2	Creative goods & services	20.7	56	
7.2.1	Cultural & creative services exports, % of total trade	0.0	79	○
7.2.2	National feature films/mn pop. 15–69	2.5	58	
7.2.3	Global ent. & media market/th pop. 15–69	7.0	41	
7.2.4	Printing & publishing manufactures, %	0.9	67	
7.2.5	Creative goods exports, % total trade	3.1	17	●
7.3	Online creativity	23.5	53	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	12.2	36	
7.3.2	Country-code TLDs/th pop. 15–69	2.1	64	
7.3.3	Wikipedia edits/mn pop. 15–69	5.2	54	
7.3.4	Video uploads on YouTube/pop. 15–69	29.5	44	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Uganda

Key indicators

Population (millions)	40.3
GDP (US$ billions)	25.6
GDP per capita, PPP$	2,002.6
Income group	Low income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)	**27.0**	**102**
Innovation Output Sub-Index	17.2	106
Innovation Input Sub-Index	36.7	93
Innovation Efficiency Ratio	0.5	113
Global Innovation Index 2016 (out of 128)	27.1	99

		Score	Rank	
1	**Institutions**	**54.6**	**79**	
1.1	Political environment	36.3	103	
1.1.1	Political stability & safety*	42.9	100	
1.1.2	Government effectiveness*	29.7	94	
1.2	Regulatory environment	65.7	60	
1.2.1	Regulatory quality*	35.9	84	
1.2.2	Rule of law*	29.5	79	
1.2.3	Cost of redundancy dismissal, salary weeks	8.7	22	●
1.3	Business environment	61.8	89	
1.3.1	Ease of starting a business*	71.3	117	
1.3.2	Ease of resolving insolvency*	39.4	98	
1.3.3	Ease of paying taxes*	74.7	61	
2	**Human capital & research**	**18.2**	**106**	
2.1	Education	21.4	123	○
2.1.1	Expenditure on education, % GDP	1.7	116	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	10.7	94	
2.1.3	School life expectancy, years ⓓ	10.0	102	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓓ	21.8	86	
2.2	Tertiary education	29.6	82	
2.2.1	Tertiary enrolment, % gross ⓓ	4.5	116	○
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, % ⓓ	10.7	15	●
2.3	Research & development (R&D)	3.5	84	
2.3.1	Researchers, FTE/mn pop. ⓓ	38.1	97	○
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.5	65	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	3.1	74	
3	**Infrastructure**	**40.5**	**84**	
3.1	Information & communication technologies (ICTs)	33.9	102	
3.1.1	ICT access*	23.7	122	○
3.1.2	ICT use*	12.7	108	
3.1.3	Government's online service*	50.0	85	
3.1.4	E-participation*	49.2	89	
3.2	General infrastructure	48.6	31	●
3.2.1	Electricity output, kWh/cap	n/a	n/a	
3.2.2	Logistics performance*	45.3	57	
3.2.3	Gross capital formation, % GDP	25.6	40	●
3.3	Ecological sustainability	39.0	85	
3.3.1	GDP/unit of energy use	n/a	n/a	
3.3.2	Environmental performance*	57.6	105	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	96	
4	**Market sophistication**	**36.7**	**108**	
4.1	Credit	24.6	101	
4.1.1	Ease of getting credit*	65.0	40	
4.1.2	Domestic credit to private sector, % GDP	14.6	118	○
4.1.3	Microfinance gross loans, % GDP	0.2	49	
4.2	Investment	29.3	116	
4.2.1	Ease of protecting minority investors*	50.0	89	
4.2.2	Market capitalization, % GDP ⓓ	31.0	45	
4.2.3	Venture capital deals/bn PPP$ GDP ⓓ	0.0	63	
4.3	Trade, competition, & market scale	56.2	87	
4.3.1	Applied tariff rate, weighted mean, %	5.9	97	
4.3.2	Intensity of local competition†	71.8	44	●
4.3.3	Domestic market scale, bn PPP$	84.9	79	
5	**Business sophistication**	**33.6**	**60**	
5.1	Knowledge workers	17.8	113	
5.1.1	Knowledge-intensive employment, % ⓓ	4.1	103	○
5.1.2	Firms offering formal training, % firms	34.7	39	●
5.1.3	GERD performed by business, % of GDP ⓓ	0.2	55	
5.1.4	GERD financed by business, % ⓓ	13.7	68	
5.1.5	Females employed w/advanced degrees, % total ⓓ	2.7	82	
5.2	Innovation linkages	46.7	14	●
5.2.1	University/industry research collaboration†	46.5	39	●
5.2.2	State of cluster development†	41.3	81	
5.2.3	GERD financed by abroad, % ⓓ	57.3	2	●
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	71	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	118	○
5.3	Knowledge absorption	36.3	49	●
5.3.1	Intellectual property payments, % total trade	0.2	80	
5.3.2	High-tech imports less re-imports, % total trade	6.9	78	
5.3.3	ICT services imports, % total trade	1.3	57	
5.3.4	FDI net inflows, % GDP	4.0	36	●
5.3.5	Research talent, % in business enterprise ⓓ	50.6	22	●
6	**Knowledge & technology outputs**	**15.6**	**103**	
6.1	Knowledge creation	6.7	77	
6.1.1	Patents by origin/bn PPP$ GDP	0.1	106	
6.1.2	PCT patent applications/bn PPP$ GDP ⓓ	0.1	74	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	12.0	60	
6.1.5	Citable documents H index	9.3	69	
6.2	Knowledge impact	25.7	88	
6.2.1	Growth rate of PPP$ GDP/worker, %	2.2	36	●
6.2.2	New businesses/th pop. 15–64 ⓓ	1.2	63	
6.2.3	Computer software spending, % GDP	0.0	122	○
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.1	105	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	14.3	114	
6.3.1	Intellectual property receipts, % total trade	0.1	64	
6.3.2	High-tech exports less re-exports, % total trade	0.2	105	
6.3.3	ICT services exports, % total trade	1.0	83	
6.3.4	FDI net outflows, % GDP	(0.0)	113	
7	**Creative outputs**	**18.9**	**107**	
7.1	Intangible assets	34.8	94	
7.1.1	Trademarks by origin/bn PPP$ GDP	13.1	96	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	54.7	84	
7.1.4	ICTs & organizational model creation†	43.4	101	
7.2	Creative goods & services	1.4	[124]	
7.2.1	Cultural & creative services exports, % of total trade	0.0	80	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.1	105	
7.3	Online creativity	4.6	112	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.2	113	
7.3.2	Country-code TLDs/th pop. 15–69	0.0	116	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	1.9	107	
7.3.4	Video uploads on YouTube/pop. 15–69	0.0	73	○

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Ukraine

Key indicators

Population (millions)	44.6
GDP (US$ billions)	87.2
GDP per capita, PPP$	7,518.8
Income group	Lower-middle income
Region	Europe

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**37.6**	**50**	
Innovation Output Sub-Index	34.2	40	
Innovation Input Sub-Index	41.0	77	
Innovation Efficiency Ratio	0.8	11	●
Global Innovation Index 2016 (out of 128)	35.7	56	

		Score/Value	Rank	
1	**Institutions**	**47.9**	**101**	
1.1	Political environment	23.0	122	○
1.1.1	Political stability & safety*	17.0	124	○
1.1.2	Government effectiveness*	29.0	96	
1.2	Regulatory environment	55.9	82	
1.2.1	Regulatory quality*	27.3	105	
1.2.2	Rule of law*	16.0	110	
1.2.3	Cost of redundancy dismissal, salary weeks	13.0	47	
1.3	Business environment	64.9	78	
1.3.1	Ease of starting a business*	94.4	18	●
1.3.2	Ease of resolving insolvency*	27.5	120	○
1.3.3	Ease of paying taxes*	72.7	66	
2	**Human capital & research**	**39.6**	**41**	
2.1	Education	58.3	30	
2.1.1	Expenditure on education, % GDP	6.0	22	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	26.2	22	
2.1.3	School life expectancy, years	15.3	40	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	7.0	2	●
2.2	Tertiary education	47.1	26	
2.2.1	Tertiary enrolment, % gross◷	82.3	12	●
2.2.2	Graduates in science & engineering, %	25.5	28	
2.2.3	Tertiary inbound mobility, %	3.2	55	
2.3	Research & development (R&D)	13.4	51	
2.3.1	Researchers, FTE/mn pop.	1,006.0	49	
2.3.2	Gross expenditure on R&D, % GDP	0.6	54	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	27.4	43	
3	**Infrastructure**	**39.3**	**90**	
3.1	Information & communication technologies (ICTs)	55.9	68	
3.1.1	ICT access*	64.8	64	
3.1.2	ICT use*	25.7	93	
3.1.3	Government's online service*	58.7	70	
3.1.4	E-participation*	74.6	32	
3.2	General infrastructure	25.5	108	
3.2.1	Electricity output, kWh/cap	4,011.7	53	
3.2.2	Logistics performance*	31.2	79	
3.2.3	Gross capital formation, % GDP	15.8	108	○
3.3	Ecological sustainability	36.5	95	
3.3.1	GDP/unit of energy use	3.3	112	○
3.3.2	Environmental performance*	79.7	44	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.5	85	
4	**Market sophistication**	**43.2**	**81**	
4.1	Credit	32.4	71	
4.1.1	Ease of getting credit*	75.0	19	
4.1.2	Domestic credit to private sector, % GDP	57.0	54	
4.1.3	Microfinance gross loans, % GDP	0.0	80	○
4.2	Investment	30.6	107	
4.2.1	Ease of protecting minority investors*	56.7	67	
4.2.2	Market capitalization, % GDP◷	15.7	66	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	75	
4.3	Trade, competition, & market scale	66.5	48	
4.3.1	Applied tariff rate, weighted mean, %	1.9	55	
4.3.2	Intensity of local competition†	60.2	99	
4.3.3	Domestic market scale, bn PPP$	349.8	47	
5	**Business sophistication**	**35.3**	**51**	
5.1	Knowledge workers	47.4	41	
5.1.1	Knowledge-intensive employment, %	37.6	30	
5.1.2	Firms offering formal training, % firms	22.6	68	
5.1.3	GERD performed by business, % of GDP	0.4	40	
5.1.4	GERD financed by business, %	40.3	35	
5.1.5	Females employed w/advanced degrees, % total	29.7	3	●
5.2	Innovation linkages	25.5	72	
5.2.1	University/industry research collaboration†	41.8	55	
5.2.2	State of cluster development†	32.5	114	○
5.2.3	GERD financed by abroad, %	18.2	23	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	76	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.6	34	
5.3	Knowledge absorption	33.0	63	
5.3.1	Intellectual property payments, % total trade	0.7	46	
5.3.2	High-tech imports less re-imports, % total trade	8.0	65	
5.3.3	ICT services imports, % total trade	1.3	56	
5.3.4	FDI net inflows, % GDP	2.2	78	
5.3.5	Research talent, % in business enterprise	32.5	42	
6	**Knowledge & technology outputs**	**32.8**	**32**	
6.1	Knowledge creation	45.5	16	●
6.1.1	Patents by origin/bn PPP$ GDP	6.7	18	●
6.1.2	PCT patent applications/bn PPP$ GDP	0.5	37	
6.1.3	Utility models by origin/bn PPP$ GDP	24.9	1	●
6.1.4	Scientific & technical articles/bn PPP$ GDP	12.2	59	
6.1.5	Citable documents H index	14.9	46	
6.2	Knowledge impact	28.1	77	
6.2.1	Growth rate of PPP$ GDP/worker, %	(0.9)	97	○
6.2.2	New businesses/th pop. 15–64◷	0.9	74	
6.2.3	Computer software spending, % GDP	0.7	6	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	3.1	78	
6.2.5	High- & medium-high-tech manufactures, %	0.2	56	
6.3	Knowledge diffusion	24.6	54	
6.3.1	Intellectual property receipts, % total trade	0.2	43	
6.3.2	High-tech exports less re-exports, % total trade	3.1	46	
6.3.3	ICT services exports, % total trade	4.4	15	●
6.3.4	FDI net outflows, % GDP	0.2	81	
7	**Creative outputs**	**35.6**	**49**	
7.1	Intangible assets	53.7	26	
7.1.1	Trademarks by origin/bn PPP$ GDP	106.8	12	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	12.6	11	●
7.1.3	ICTs & business model creation†	47.0	112	○
7.1.4	ICTs & organizational model creation†	52.2	66	
7.2	Creative goods & services	9.3	92	
7.2.1	Cultural & creative services exports, % of total trade	0.1	53	
7.2.2	National feature films/mn pop. 15–69	0.1	102	○
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	1.0	66	
7.2.5	Creative goods exports, % total trade	0.4	63	
7.3	Online creativity	25.8	47	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	4.4	59	
7.3.2	Country-code TLDs/th pop. 15–69	5.1	50	
7.3.3	Wikipedia edits/mn pop. 15–69	6.1	39	
7.3.4	Video uploads on YouTube/pop. 15–69	34.9	41	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

United Arab Emirates

Key indicators

Population (millions)	9.3
GDP (US$ billions)	375.0
GDP per capita, PPP$	67,616.9
Income group	High income
Region	Northern Africa and Western Asia

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**43.2**	**35**	
Innovation Output Sub-Index	28.5	56	
Innovation Input Sub-Index	58.0	23	
Innovation Efficiency Ratio	0.5	104	○
Global Innovation Index 2016 (out of 128)	39.4	41	

		Score	Rank	
1	**Institutions**	**80.6**	**25**	
1.1	Political environment	81.9	19	
1.1.1	Political stability & safety*	82.2	28	
1.1.2	Government effectiveness*	81.6	16	
1.2	Regulatory environment	82.8	22	
1.2.1	Regulatory quality*	71.1	28	
1.2.2	Rule of law*	60.1	37	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	77.1	38	
1.3.1	Ease of starting a business*	91.2	45	
1.3.2	Ease of resolving insolvency*	40.6	92	○
1.3.3	Ease of paying taxes*	99.4	1	●
2	**Human capital & research**	**51.0**	**22**	
2.1	Education	75.6	[3]	
2.1.1	Expenditure on education, % GDP	n/a	n/a	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	474.3	37	
2.1.5	Pupil-teacher ratio, secondary	11.2	33	
2.2	Tertiary education	59.1	8	●
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	20.4	52	
2.2.3	Tertiary inbound mobility, %	46.9	1	●
2.3	Research & development (R&D)	18.2	47	
2.3.1	Researchers, FTE/mn pop.	2,003.4	38	
2.3.2	Gross expenditure on R&D, % GDP	0.9	41	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	28.9	40	
3	**Infrastructure**	**57.5**	**29**	
3.1	Information & communication technologies (ICTs)	78.3	23	
3.1.1	ICT access*	81.4	23	
3.1.2	ICT use*	68.2	25	
3.1.3	Government's online service*	89.1	13	
3.1.4	E-participation*	74.6	32	
3.2	General infrastructure	51.0	21	
3.2.1	Electricity output, kWh/cap	12,098.9	10	●
3.2.2	Logistics performance*	86.9	13	●
3.2.3	Gross capital formation, % GDP	19.7	84	○
3.3	Ecological sustainability	43.3	71	
3.3.1	GDP/unit of energy use	8.1	68	
3.3.2	Environmental performance*	69.4	82	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.9	36	
4	**Market sophistication**	**52.9**	**33**	
4.1	Credit	37.5	56	
4.1.1	Ease of getting credit*	45.0	84	○
4.1.2	Domestic credit to private sector, % GDP	76.5	39	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	47.3	33	
4.2.1	Ease of protecting minority investors*	75.0	9	●
4.2.2	Market capitalization, % GDP	52.9	30	
4.2.3	Venture capital deals/bn PPP$ GDP	0.1	28	
4.3	Trade, competition, & market scale	73.9	25	
4.3.1	Applied tariff rate, weighted mean, %	2.8	67	
4.3.2	Intensity of local competition†	81.7	8	●
4.3.3	Domestic market scale, bn PPP$	667.2	31	
5	**Business sophistication**	**47.8**	**25**	
5.1	Knowledge workers	58.1	26	
5.1.1	Knowledge-intensive employment, %ⓓ	36.1	33	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	0.4	39	
5.1.4	GERD financed by business, %ⓓ	74.3	4	●
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	47.4	12	●
5.2.1	University/industry research collaboration†	58.5	24	
5.2.2	State of cluster development†	73.7	2	●
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	16	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	68	
5.3	Knowledge absorption	37.8	42	
5.3.1	Intellectual property payments, % total trade	0.6	51	
5.3.2	High-tech imports less re-imports, % total trade	8.0	66	
5.3.3	ICT services imports, % total trade	0.6	92	○
5.3.4	FDI net inflows, % GDP	2.7	67	
5.3.5	Research talent, % in business enterprise	60.9	10	
6	**Knowledge & technology outputs**	**20.9**	**71**	
6.1	Knowledge creation	3.9	99	○
6.1.1	Patents by origin/bn PPP$ GDP	0.1	114	○
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	62	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	3.5	106	○
6.1.5	Citable documents H index	9.4	67	
6.2	Knowledge impact	30.7	65	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.3	47	
6.2.2	New businesses/th pop. 15–64ⓓ	1.4	58	
6.2.3	Computer software spending, % GDP	0.3	37	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.7	45	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	28.1	45	
6.3.1	Intellectual property receipts, % total trade	0.5	23	
6.3.2	High-tech exports less re-exports, % total trade	0.3	95	○
6.3.3	ICT services exports, % total trade	1.7	61	
6.3.4	FDI net outflows, % GDP	2.3	26	
7	**Creative outputs**	**36.1**	**47**	
7.1	Intangible assets	45.7	55	
7.1.1	Trademarks by origin/bn PPP$ GDPⓓ	11.4	101	○
7.1.2	Industrial designs by origin/bn PPP$ GDPⓓ	0.1	102	○
7.1.3	ICTs & business model creation†	79.9	10	●
7.1.4	ICTs & organizational model creation†	74.4	13	●
7.2	Creative goods & services	28.0	34	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	1.4	71	
7.2.3	Global ent. & media market/th pop. 15–69	16.5	28	
7.2.4	Printing & publishing manufactures, %ⓓ	2.5	14	
7.2.5	Creative goods exports, % total trade	1.6	33	
7.3	Online creativity	25.1	49	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	11.2	38	
7.3.2	Country-code TLDs/th pop. 15–69	5.6	47	
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	4.6	68	
7.3.4	Video uploads on YouTube/pop. 15–69	39.1	32	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

United Kingdom

Key indicators

Population (millions)	65.1
GDP (US$ billions)	2,649.9
GDP per capita, PPP$	41,158.9
Income group	High income
Region	Europe

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**60.9**	**5**	
	Innovation Output Sub-Index	53.5	6	
	Innovation Input Sub-Index	68.3	7	
	Innovation Efficiency Ratio	0.8	20	
	Global Innovation Index 2016 (out of 128)	61.9	3	
1	**Institutions**	**88.4**	**9**	
1.1	Political environment	82.1	18	
1.1.1	Political stability & safety*	77.3	40	
1.1.2	Government effectiveness*	86.8	13	
1.2	Regulatory environment	94.1	7	
1.2.1	Regulatory quality*	89.6	4	●
1.2.2	Rule of law*	92.2	14	
1.2.3	Cost of redundancy dismissal, salary weeks	9.3	27	
1.3	Business environment	89.1	8	
1.3.1	Ease of starting a business*	94.6	15	
1.3.2	Ease of resolving insolvency*	82.0	12	
1.3.3	Ease of paying taxes*	90.7	10	
2	**Human capital & research**	**63.3**	**6**	
2.1	Education	59.9	22	
2.1.1	Expenditure on education, % GDP	5.8	25	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	23.1	39	○
2.1.3	School life expectancy, years	17.9	10	
2.1.4	PISA scales in reading, maths, & science	499.9	21	
2.1.5	Pupil-teacher ratio, secondary ◷	15.8	69	○
2.2	Tertiary education	60.5	5	
2.2.1	Tertiary enrolment, % gross ◷	56.5	46	○
2.2.2	Graduates in science & engineering, %	25.2	30	
2.2.3	Tertiary inbound mobility, % ◷	18.2	7	
2.3	Research & development (R&D)	69.5	10	
2.3.1	Researchers, FTE/mn pop.	4,470.8	18	
2.3.2	Gross expenditure on R&D, % GDP	1.7	21	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	88.0	7	
2.3.4	QS university ranking, average score top 3*	96.5	2	●
3	**Infrastructure**	**67.1**	**5**	
3.1	Information & communication technologies (ICTs)	93.3	1	●
3.1.1	ICT access*	92.4	3	●
3.1.2	ICT use*	80.9	9	
3.1.3	Government's online service*	100.0	1	●
3.1.4	E-participation*	100.0	1	●
3.2	General infrastructure	43.6	43	
3.2.1	Electricity output, kWh/cap	5,155.5	38	
3.2.2	Logistics performance*	92.8	8	
3.2.3	Gross capital formation, % GDP	17.3	102	○
3.3	Ecological sustainability	64.5	7	
3.3.1	GDP/unit of energy use	13.9	14	
3.3.2	Environmental performance*	87.4	12	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	6.6	16	
4	**Market sophistication**	**70.2**	**5**	
4.1	Credit	64.3	10	
4.1.1	Ease of getting credit*	75.0	19	
4.1.2	Domestic credit to private sector, % GDP	134.1	14	
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	63.0	16	
4.2.1	Ease of protecting minority investors*	78.3	6	
4.2.2	Market capitalization, % GDP ◷	65.0	26	
4.2.3	Venture capital deals/bn PPP$ GDP	0.2	7	
4.3	Trade, competition, & market scale	83.3	5	
4.3.1	Applied tariff rate, weighted mean, %	1.6	23	○
4.3.2	Intensity of local competition†	83.2	3	●
4.3.3	Domestic market scale, bn PPP$	2,787.7	9	
5	**Business sophistication**	**52.2**	**13**	
5.1	Knowledge workers	65.0	14	
5.1.1	Knowledge-intensive employment, %	47.6	8	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	1.1	18	
5.1.4	GERD financed by business, %	48.4	22	
5.1.5	Females employed w/advanced degrees, % total	22.2	17	
5.2	Innovation linkages	48.6	10	
5.2.1	University/industry research collaboration†	74.5	6	
5.2.2	State of cluster development†	72.3	5	
5.2.3	GERD financed by abroad, %	17.6	24	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	13	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	2.5	21	
5.3	Knowledge absorption	42.9	28	
5.3.1	Intellectual property payments, % total trade	1.3	21	
5.3.2	High-tech imports less re-imports, % total trade	12.7	21	
5.3.3	ICT services imports, % total trade	1.8	27	
5.3.4	FDI net inflows, % GDP	2.0	83	○
5.3.5	Research talent, % in business enterprise	38.2	36	○
6	**Knowledge & technology outputs**	**46.5**	**13**	
6.1	Knowledge creation	56.0	10	
6.1.1	Patents by origin/bn PPP$ GDP	7.4	16	
6.1.2	PCT patent applications/bn PPP$ GDP	2.0	18	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	41.6	14	
6.1.5	Citable documents H index	100.0	1	●
6.2	Knowledge impact	53.2	6	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.8	65	○
6.2.2	New businesses/th pop. 15–64 ◷	12.9	9	
6.2.3	Computer software spending, % GDP	0.8	4	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	14.9	24	
6.2.5	High- & medium-high-tech manufactures, %	0.4	25	
6.3	Knowledge diffusion	30.3	38	
6.3.1	Intellectual property receipts, % total trade	2.0	10	
6.3.2	High-tech exports less re-exports, % total trade	9.2	21	
6.3.3	ICT services exports, % total trade	3.3	24	
6.3.4	FDI net outflows, % GDP	(1.5)	122	○
7	**Creative outputs**	**60.5**	**4**	●
7.1	Intangible assets	63.9	8	
7.1.1	Trademarks by origin/bn PPP$ GDP	52.7	43	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	83.8	1	●
7.1.4	ICTs & organizational model creation†	81.3	2	●
7.2	Creative goods & services	45.6	6	
7.2.1	Cultural & creative services exports, % of total trade	1.0	15	
7.2.2	National feature films/mn pop. 15–69	6.6	27	
7.2.3	Global ent. & media market/th pop. 15–69	71.6	5	
7.2.4	Printing & publishing manufactures, %	1.9	23	
7.2.5	Creative goods exports, % total trade	3.6	15	
7.3	Online creativity	68.7	4	●
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	61.9	10	
7.3.2	Country-code TLDs/th pop. 15–69	69.5	7	
7.3.3	Wikipedia edits/mn pop. 15–69	6.9	12	
7.3.4	Video uploads on YouTube/pop. 15–69	76.4	3	●

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
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United States of America

Key indicators

Population (millions)	324.1
GDP (US$ billions)	18,561.9
GDP per capita, PPP$	55,805.2
Income group	High income
Region	Northern America

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**61.4**	**4**	
Innovation Output Sub-Index	53.9	5	
Innovation Input Sub-Index	68.9	5	
Innovation Efficiency Ratio	0.8	21	
Global Innovation Index 2016 (out of 128)	61.4	4	

		Score/Value	Rank	
1	**Institutions**	**86.2**	**17**	
1.1	Political environment	80.3	21	
1.1.1	Political stability & safety*	80.8	31	
1.1.2	Government effectiveness*	79.7	20	
1.2	Regulatory environment	90.4	13	
1.2.1	Regulatory quality*	75.3	19	
1.2.2	Rule of law*	86.3	18	
1.2.3	Cost of redundancy dismissal, salary weeks	8.0	1	●
1.3	Business environment	88.1	10	
1.3.1	Ease of starting a business*	91.2	44	
1.3.2	Ease of resolving insolvency*	89.2	5	
1.3.3	Ease of paying taxes*	83.9	32	
2	**Human capital & research**	**57.2**	**13**	
2.1	Education	54.7	41	
2.1.1	Expenditure on education, % GDP	4.9	54	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	22.7	41	
2.1.3	School life expectancy, years	16.5	20	
2.1.4	PISA scales in reading, maths, & science	487.6	29	
2.1.5	Pupil-teacher ratio, secondary ⓓ	14.8	63	○
2.2	Tertiary education	38.1	54	
2.2.1	Tertiary enrolment, % gross	85.8	9	
2.2.2	Graduates in science & engineering, %	14.9	85	○
2.2.3	Tertiary inbound mobility, %	4.6	40	
2.3	Research & development (R&D)	78.8	4	
2.3.1	Researchers, FTE/mn pop. ⓓ	4,232.0	20	
2.3.2	Gross expenditure on R&D, % GDP	2.8	10	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	100.0	1	●
2.3.4	QS university ranking, average score top 3*	99.0	1	●
3	**Infrastructure**	**61.0**	**21**	
3.1	Information & communication technologies (ICTs)	85.2	11	
3.1.1	ICT access*	82.7	19	
3.1.2	ICT use*	75.7	17	
3.1.3	Government's online service*	92.8	9	
3.1.4	E-participation*	89.8	12	
3.2	General infrastructure	52.8	16	
3.2.1	Electricity output, kWh/cap	13,342.4	8	
3.2.2	Logistics performance*	89.2	10	
3.2.3	Gross capital formation, % GDP	19.8	82	○
3.3	Ecological sustainability	45.0	61	
3.3.1	GDP/unit of energy use	7.6	76	○
3.3.2	Environmental performance*	84.7	26	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.3	91	○
4	**Market sophistication**	**83.4**	**1**	●
4.1	Credit	85.5	1	●
4.1.1	Ease of getting credit*	95.0	2	●
4.1.2	Domestic credit to private sector, % GDP	188.8	3	●
4.1.3	Microfinance gross loans, % GDP	n/a	n/a	
4.2	Investment	72.2	3	●
4.2.1	Ease of protecting minority investors*	64.7	40	
4.2.2	Market capitalization, % GDP	139.0	5	
4.2.3	Venture capital deals/bn PPP$ GDP	0.4	1	●
4.3	Trade, competition, & market scale	92.7	1	●
4.3.1	Applied tariff rate, weighted mean, %	1.6	50	
4.3.2	Intensity of local competition†	83.0	5	
4.3.3	Domestic market scale, bn PPP$	18,561.9	2	●
5	**Business sophistication**	**56.4**	**8**	
5.1	Knowledge workers	67.4	11	
5.1.1	Knowledge-intensive employment, % ⓓ	38.0	28	
5.1.2	Firms offering formal training, % firms	n/a	n/a	
5.1.3	GERD performed by business, % of GDP	2.0	7	
5.1.4	GERD financed by business, %	64.2	8	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	46.6	15	
5.2.1	University/industry research collaboration†	76.2	4	
5.2.2	State of cluster development†	76.0	1	●
5.2.3	GERD financed by abroad, %	4.7	66	○
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	17	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	5.0	13	
5.3	Knowledge absorption	55.2	6	
5.3.1	Intellectual property payments, % total trade	1.6	19	
5.3.2	High-tech imports less re-imports, % total trade	17.7	11	
5.3.3	ICT services imports, % total trade	1.3	52	
5.3.4	FDI net inflows, % GDP	1.7	90	○
5.3.5	Research talent, % in business enterprise ⓓ	71.0	4	
6	**Knowledge & technology outputs**	**54.4**	**7**	
6.1	Knowledge creation	63.4	7	
6.1.1	Patents by origin/bn PPP$ GDP	16.0	6	
6.1.2	PCT patent applications/bn PPP$ GDP	3.0	14	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	19.8	38	
6.1.5	Citable documents H index	100.0	1	●
6.2	Knowledge impact	52.5	7	
6.2.1	Growth rate of PPP$ GDP/worker, %	0.7	67	○
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	1.1	1	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	1.8	94	○
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.4	13	
6.3	Knowledge diffusion	47.3	12	
6.3.1	Intellectual property receipts, % total trade	5.1	1	●
6.3.2	High-tech exports less re-exports, % total trade	7.1	26	
6.3.3	ICT services exports, % total trade	1.5	68	
6.3.4	FDI net outflows, % GDP	2.1	29	
7	**Creative outputs**	**53.5**	**10**	
7.1	Intangible assets	50.1	38	
7.1.1	Trademarks by origin/bn PPP$ GDP	21.5	81	○
7.1.2	Industrial designs by origin/bn PPP$ GDP	1.3	54	
7.1.3	ICTs & business model creation†	79.2	12	
7.1.4	ICTs & organizational model creation†	82.3	1	●
7.2	Creative goods & services	48.2	5	
7.2.1	Cultural & creative services exports, % of total trade ⓓ	2.0	1	●
7.2.2	National feature films/mn pop. 15–69	3.5	53	
7.2.3	Global ent. & media market/th pop. 15–69	97.1	3	●
7.2.4	Printing & publishing manufactures, % ⓓ	1.9	24	
7.2.5	Creative goods exports, % total trade	1.7	31	
7.3	Online creativity	65.4	7	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	100.0	1	●
7.3.2	Country-code TLDs/th pop. 15–69	2.9	58	
7.3.3	Wikipedia edits/mn pop. 15–69	6.1	41	
7.3.4	Video uploads on YouTube/pop. 15–69	100.0	1	●

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Uruguay

Key indicators

Population (millions)	3.4
GDP (US$ billions)	54.4
GDP per capita, PPP$	21,506.5
Income group	High income
Region	Latin America and the Caribbean

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**34.5**	**67**	
Innovation Output Sub-Index	25.6	64	
Innovation Input Sub-Index	43.5	61	
Innovation Efficiency Ratio	0.6	82	
Global Innovation Index 2016 (out of 128)	34.3	62	

		Score/Value	Rank	
1	**Institutions**	**69.0**	**44**	
1.1	Political environment	71.9	37	●
1.1.1	Political stability & safety*	87.9	14	●
1.1.2	Government effectiveness*	56.0	42	
1.2	Regulatory environment	65.5	62	
1.2.1	Regulatory quality*	53.7	51	
1.2.2	Rule of law*	59.1	38	●
1.2.3	Cost of redundancy dismissal, salary weeks	20.8	86	
1.3	Business environment	69.4	70	
1.3.1	Ease of starting a business*	89.8	51	
1.3.2	Ease of resolving insolvency*	52.3	57	
1.3.3	Ease of paying taxes*	66.1	82	
2	**Human capital & research**	**33.5**	**57**	
2.1	Education	56.9	37	●
2.1.1	Expenditure on education, % GDP ⓓ	4.4	69	
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years ⓓ	15.5	36	
2.1.4	PISA scales in reading, maths, & science	430.0	48	
2.1.5	Pupil-teacher ratio, secondary ⓓ	11.3	35	
2.2	Tertiary education	37.1	59	
2.2.1	Tertiary enrolment, % gross ⓓ	63.1	38	
2.2.2	Graduates in science & engineering, % ⓓ	15.6	83	○
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	6.6	69	
2.3.1	Researchers, FTE/mn pop.	524.3	63	
2.3.2	Gross expenditure on R&D, % GDP ⓓ	0.3	77	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	12.6	60	
3	**Infrastructure**	**52.7**	**43**	
3.1	Information & communication technologies (ICTs)	70.8	34	●
3.1.1	ICT access*	72.5	43	
3.1.2	ICT use*	62.0	35	●
3.1.3	Government's online service*	77.5	28	●
3.1.4	E-participation*	71.2	39	
3.2	General infrastructure	32.8	85	
3.2.1	Electricity output, kWh/cap	3,804.4	55	
3.2.2	Logistics performance*	42.2	64	
3.2.3	Gross capital formation, % GDP	20.0	81	
3.3	Ecological sustainability	54.7	31	●
3.3.1	GDP/unit of energy use	14.1	13	●
3.3.2	Environmental performance*	74.0	61	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	3.1	32	●
4	**Market sophistication**	**36.5**	**109**	○
4.1	Credit	23.8	104	○
4.1.1	Ease of getting credit*	60.0	55	
4.1.2	Domestic credit to private sector, % GDP	30.0	98	
4.1.3	Microfinance gross loans, % GDP	0.0	71	○
4.2	Investment	31.4	104	○
4.2.1	Ease of protecting minority investors*	45.0	98	○
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	59	
4.3	Trade, competition, & market scale	54.3	96	
4.3.1	Applied tariff rate, weighted mean, %	4.8	89	
4.3.2	Intensity of local competition†	60.6	96	
4.3.3	Domestic market scale, bn PPP$	73.9	83	
5	**Business sophistication**	**25.6**	**100**	○
5.1	Knowledge workers	34.0	78	
5.1.1	Knowledge-intensive employment, % ⓓ	21.0	69	
5.1.2	Firms offering formal training, % firms ⓓ	48.6	24	●
5.1.3	GERD performed by business, % of GDP ⓓ	0.0	80	○
5.1.4	GERD financed by business, % ⓓ	4.6	78	○
5.1.5	Females employed w/advanced degrees, % total ⓓ	13.7	44	
5.2	Innovation linkages	21.3	94	
5.2.1	University/industry research collaboration†	40.7	66	
5.2.2	State of cluster development†	37.9	91	
5.2.3	GERD financed by abroad, % ⓓ	7.4	53	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	66	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.1	60	
5.3	Knowledge absorption	21.6	117	○
5.3.1	Intellectual property payments, % total trade	0.4	68	
5.3.2	High-tech imports less re-imports, % total trade	8.4	60	
5.3.3	ICT services imports, % total trade	0.4	105	○
5.3.4	FDI net inflows, % GDP	4.0	37	●
5.3.5	Research talent, % in business enterprise	0.9	78	○
6	**Knowledge & technology outputs**	**20.3**	**76**	
6.1	Knowledge creation	10.8	63	
6.1.1	Patents by origin/bn PPP$ GDP	0.4	83	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	0.6	34	
6.1.4	Scientific & technical articles/bn PPP$ GDP	13.2	56	
6.1.5	Citable documents H index	9.6	65	
6.2	Knowledge impact	31.3	61	
6.2.1	Growth rate of PPP$ GDP/worker, %	1.2	50	
6.2.2	New businesses/th pop. 15–64 ⓓ	2.5	41	
6.2.3	Computer software spending, % GDP	0.2	65	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	18.0	22	●
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.1	68	
6.3	Knowledge diffusion	18.9	90	
6.3.1	Intellectual property receipts, % total trade	0.0	97	○
6.3.2	High-tech exports less re-exports, % total trade	2.3	50	
6.3.3	ICT services exports, % total trade	2.6	42	
6.3.4	FDI net outflows, % GDP	0.2	87	
7	**Creative outputs**	**30.9**	**63**	
7.1	Intangible assets	42.9	61	
7.1.1	Trademarks by origin/bn PPP$ GDP	50.1	49	
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.1	105	○
7.1.3	ICTs & business model creation†	67.6	38	
7.1.4	ICTs & organizational model creation†	57.0	48	
7.2	Creative goods & services	11.2	84	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	4.7	41	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, % ⓓ	1.2	44	
7.2.5	Creative goods exports, % total trade	0.1	97	
7.3	Online creativity	26.5	44	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	6.4	51	
7.3.2	Country-code TLDs/th pop. 15–69	10.0	39	
7.3.3	Wikipedia edits/mn pop. 15–69	6.5	28	●
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Viet Nam

Key indicators

Population (millions)	94.4
GDP (US$ billions)	200.5
GDP per capita, PPP$	6,024.4
Income group	Lower-middle income
Region	South East Asia, East Asia, and Oceania

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**38.3**	**47**	
	Innovation Output Sub-Index	34.9	38	
	Innovation Input Sub-Index	41.7	71	
	Innovation Efficiency Ratio	0.8	10	●
	Global Innovation Index 2016 (out of 128)	35.4	59	
1	**Institutions**	**52.8**	**87**	
1.1	Political environment	54.1	59	
1.1.1	Political stability & safety*	64.1	59	
1.1.2	Government effectiveness*	44.1	68	
1.2	Regulatory environment	48.9	103	
1.2.1	Regulatory quality*	29.4	100	
1.2.2	Rule of law*	31.6	74	
1.2.3	Cost of redundancy dismissal, salary weeks	24.6	101	
1.3	Business environment	55.4	113	○
1.3.1	Ease of starting a business*	81.8	92	
1.3.2	Ease of resolving insolvency*	35.1	105	
1.3.3	Ease of paying taxes*	49.4	115	○
2	**Human capital & research**	**31.0**	**70**	
2.1	Education	61.2	[17]	
2.1.1	Expenditure on education, % GDP	5.7	26	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	502.0	20	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	27.8	86	
2.2.1	Tertiary enrolment, % gross	28.8	82	
2.2.2	Graduates in science & engineering, %	22.4	40	
2.2.3	Tertiary inbound mobility, %	0.1	103	○
2.3	Research & development (R&D)	4.1	80	
2.3.1	Researchers, FTE/mn pop.◷	674.8	58	
2.3.2	Gross expenditure on R&D, % GDP◷	0.4	73	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**42.7**	**77**	
3.1	Information & communication technologies (ICTs)	52.0	75	
3.1.1	ICT access*	46.0	90	
3.1.2	ICT use*	35.1	77	
3.1.3	Government's online service*	57.2	72	
3.1.4	E-participation*	69.5	43	
3.2	General infrastructure	39.8	52	
3.2.1	Electricity output, kWh/cap	1,553.1	84	
3.2.2	Logistics performance*	42.2	63	
3.2.3	Gross capital formation, % GDP	28.0	29	●
3.3	Ecological sustainability	36.4	97	
3.3.1	GDP/unit of energy use	7.1	84	
3.3.2	Environmental performance*	58.5	102	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	2.2	47	
4	**Market sophistication**	**52.8**	**34**	
4.1	Credit	59.0	17	●
4.1.1	Ease of getting credit*	70.0	29	
4.1.2	Domestic credit to private sector, % GDP	111.9	22	●
4.1.3	Microfinance gross loans, % GDP	3.5	12	●
4.2	Investment	30.5	109	
4.2.1	Ease of protecting minority investors*	53.3	80	
4.2.2	Market capitalization, % GDP	26.8	54	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	60	
4.3	Trade, competition, & market scale	68.9	41	
4.3.1	Applied tariff rate, weighted mean, %	3.1	69	
4.3.2	Intensity of local competition†	65.9	77	
4.3.3	Domestic market scale, bn PPP$	594.9	34	
5	**Business sophistication**	**29.4**	**73**	
5.1	Knowledge workers	23.3	102	
5.1.1	Knowledge-intensive employment, %	10.8	94	○
5.1.2	Firms offering formal training, % firms	22.2	69	
5.1.3	GERD performed by business, % of GDP◷	0.2	52	
5.1.4	GERD financed by business, %◷	40.0	36	
5.1.5	Females employed w/advanced degrees, % total	7.4	72	
5.2	Innovation linkages	20.8	100	
5.2.1	University/industry research collaboration†	38.9	76	
5.2.2	State of cluster development†	47.5	50	
5.2.3	GERD financed by abroad, %◷	1.5	82	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.0	65	
5.2.5	Patent families 2+ offices/bn PPP$ GDP	0.0	96	
5.3	Knowledge absorption	44.1	23	●
5.3.1	Intellectual property payments, % total trade	n/a	n/a	
5.3.2	High-tech imports less re-imports, % total trade	22.6	3	●
5.3.3	ICT services imports, % total trade◷	0.1	123	○
5.3.4	FDI net inflows, % GDP	5.4	26	●
5.3.5	Research talent, % in business enterprise◷	21.1	54	
6	**Knowledge & technology outputs**	**35.0**	**28**	●
6.1	Knowledge creation	8.0	73	
6.1.1	Patents by origin/bn PPP$ GDP	1.1	61	
6.1.2	PCT patent applications/bn PPP$ GDP	0.0	100	○
6.1.3	Utility models by origin/bn PPP$ GDP	0.6	35	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.6	94	
6.1.5	Citable documents H index	10.6	58	
6.2	Knowledge impact	55.8	5	●
6.2.1	Growth rate of PPP$ GDP/worker, %	6.9	1	●
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.3	39	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	7.5	48	
6.2.5	High- & medium-high-tech manufactures, %◷	0.3	46	
6.3	Knowledge diffusion	41.4	19	●
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	26.8	4	●
6.3.3	ICT services exports, % total trade◷	0.1	122	○
6.3.4	FDI net outflows, % GDP	0.8	59	
7	**Creative outputs**	**34.8**	**52**	
7.1	Intangible assets	46.2	52	
7.1.1	Trademarks by origin/bn PPP$ GDP	81.7	20	●
7.1.2	Industrial designs by origin/bn PPP$ GDP	3.3	33	
7.1.3	ICTs & business model creation†	57.1	78	
7.1.4	ICTs & organizational model creation†	54.2	61	
7.2	Creative goods & services	27.4	36	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69◷	0.2	98	○
7.2.3	Global ent. & media market/th pop. 15–69	0.9	57	○
7.2.4	Printing & publishing manufactures, %◷	0.7	81	
7.2.5	Creative goods exports, % total trade	6.0	7	●
7.3	Online creativity	19.3	64	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	2.6	70	
7.3.2	Country-code TLDs/th pop. 15–69	2.6	60	
7.3.3	Wikipedia edits/mn pop. 15–69	4.9	64	
7.3.4	Video uploads on YouTube/pop. 15–69	24.3	52	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
◷ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Yemen

Key indicators

Population (millions)	27.5
GDP (US$ billions)	31.3
GDP per capita, PPP$	2,670.6
Income group	Lower-middle income
Region	Northern Africa and Western Asia

		Score 0–100 or value (hard data)	Rank
Global Innovation Index (out of 127)		**15.6**	**127**
Innovation Output Sub-Index		8.9	125
Innovation Input Sub-Index		22.4	127
Innovation Efficiency Ratio		0.4	119
Global Innovation Index 2016 (out of 128)		14.6	128
1	**Institutions**	**30.6**	**126**
1.1	Political environment	0.0	127
1.1.1	Political stability & safety*	0.0	127
1.1.2	Government effectiveness*	0.0	127
1.2	Regulatory environment	35.1	119
1.2.1	Regulatory quality*	14.0	123
1.2.2	Rule of law*	3.2	126
1.2.3	Cost of redundancy dismissal, salary weeks	27.4	110
1.3	Business environment	56.6	110
1.3.1	Ease of starting a business*	71.6	116
1.3.2	Ease of resolving insolvency*	26.7	122
1.3.3	Ease of paying taxes*	71.6	70
2	**Human capital & research**	**13.5**	**120**
2.1	Education	25.4	117
2.1.1	Expenditure on education, % GDP ⓓ	4.6	66
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap ⓓ	12.6	89
2.1.3	School life expectancy, years ⓓ	9.0	106
2.1.4	PISA scales in reading, maths, & science	n/a	n/a
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a
2.2	Tertiary education	15.1	109
2.2.1	Tertiary enrolment, % gross ⓓ	10.0	105
2.2.2	Graduates in science & engineering, %	n/a	n/a
2.2.3	Tertiary inbound mobility, % ⓓ	4.3	43
2.3	Research & development (R&D)	0.0	115
2.3.1	Researchers, FTE/mn pop.	n/a	n/a
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43
2.3.4	QS university ranking, average score top 3*	0.0	75
3	**Infrastructure**	**16.3**	**126**
3.1	Information & communication technologies (ICTs)	16.5	121
3.1.1	ICT access*	26.6	116
3.1.2	ICT use*	11.2	111
3.1.3	Government's online service*	14.5	119
3.1.4	E-participation*	13.6	121
3.2	General infrastructure	1.6	127
3.2.1	Electricity output, kWh/cap	292.1	109
3.2.2	Logistics performance* ⓓ	5.6	122
3.2.3	Gross capital formation, % GDP	3.2	124
3.3	Ecological sustainability	30.7	115
3.3.1	GDP/unit of energy use	12.5	23
3.3.2	Environmental performance*	n/a	n/a
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.0	125
4	**Market sophistication**	**32.1**	**117**
4.1	Credit	0.6	127
4.1.1	Ease of getting credit*	0.0	126
4.1.2	Domestic credit to private sector, % GDP ⓓ	5.6	125
4.1.3	Microfinance gross loans, % GDP	0.0	64
4.2	Investment	43.3	[47]
4.2.1	Ease of protecting minority investors*	43.3	101
4.2.2	Market capitalization, % GDP	n/a	n/a
4.2.3	Venture capital deals/bn PPP$ GDP	n/a	n/a
4.3	Trade, competition, & market scale	52.2	100
4.3.1	Applied tariff rate, weighted mean, %	5.1	91
4.3.2	Intensity of local competition†	54.6	115
4.3.3	Domestic market scale, bn PPP$	73.4	84
5	**Business sophistication**	**19.5**	**123**
5.1	Knowledge workers	16.9	114
5.1.1	Knowledge-intensive employment, % ⓓ	15.0	87
5.1.2	Firms offering formal training, % firms	14.3	86
5.1.3	GERD performed by business, % of GDP	n/a	n/a
5.1.4	GERD financed by business, %	n/a	n/a
5.1.5	Females employed w/advanced degrees, % total ⓓ	1.6	84
5.2	Innovation linkages	19.9	108
5.2.1	University/industry research collaboration†	14.8	123
5.2.2	State of cluster development†	32.4	115
5.2.3	GERD financed by abroad, %	n/a	n/a
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	n/a	n/a
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓓ	0.0	110
5.3	Knowledge absorption	21.8	114
5.3.1	Intellectual property payments, % total trade ⓓ	0.0	109
5.3.2	High-tech imports less re-imports, % total trade ⓓ	4.5	112
5.3.3	ICT services imports, % total trade ⓓ	1.4	48
5.3.4	FDI net inflows, % GDP	(0.3)	126
5.3.5	Research talent, % in business enterprise	n/a	n/a
6	**Knowledge & technology outputs**	**6.8**	**126**
6.1	Knowledge creation	1.1	124
6.1.1	Patents by origin/bn PPP$ GDP	0.1	112
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a
6.1.3	Utility models by origin/bn PPP$ GDP ⓓ	0.0	63
6.1.4	Scientific & technical articles/bn PPP$ GDP	2.8	112
6.1.5	Citable documents H index	2.0	119
6.2	Knowledge impact	0.4	127
6.2.1	Growth rate of PPP$ GDP/worker, %	(31.1)	110
6.2.2	New businesses/th pop. 15–64	n/a	n/a
6.2.3	Computer software spending, % GDP	0.0	118
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.3	121
6.2.5	High- & medium-high-tech manufactures, % ⓓ	0.0	102
6.3	Knowledge diffusion	18.9	91
6.3.1	Intellectual property receipts, % total trade ⓓ	0.4	27
6.3.2	High-tech exports less re-exports, % total trade ⓓ	0.0	123
6.3.3	ICT services exports, % total trade ⓓ	2.0	53
6.3.4	FDI net outflows, % GDP	0.0	102
7	**Creative outputs**	**11.0**	**124**
7.1	Intangible assets	18.3	123
7.1.1	Trademarks by origin/bn PPP$ GDP	17.5	86
7.1.2	Industrial designs by origin/bn PPP$ GDP	0.1	109
7.1.3	ICTs & business model creation†	29.9	123
7.1.4	ICTs & organizational model creation†	25.7	123
7.2	Creative goods & services	1.0	126
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a
7.2.2	National feature films/mn pop. 15–69	n/a	n/a
7.2.3	Global ent. & media market/th pop. 15–69	0.0	63
7.2.4	Printing & publishing manufactures, % ⓓ	0.4	95
7.2.5	Creative goods exports, % total trade ⓓ	0.0	124
7.3	Online creativity	6.3	107
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.4	110
7.3.2	Country-code TLDs/th pop. 15–69	0.0	122
7.3.3	Wikipedia edits/mn pop. 15–69 ⓓ	2.5	104
7.3.4	Video uploads on YouTube/pop. 15–69	0.8	71

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Zambia

Key indicators

Population (millions)	16.7
GDP (US$ billions)	20.6
GDP per capita, PPP$	3,868.1
Income group	Lower-middle income
Region	Sub-Saharan Africa

	Score 0–100 or value (hard data)	Rank	
Global Innovation Index (out of 127)	**20.8**	**124**	○
Innovation Output Sub-Index	15.5	118	
Innovation Input Sub-Index	26.1	125	○
Innovation Efficiency Ratio	0.6	79	
Global Innovation Index 2016 (out of 128)	19.9	125	

		Score/Value	Rank	
1	**Institutions**	**46.9**	**104**	
1.1	Political environment	46.9	76	
1.1.1	Political stability & safety*	65.9	57	●
1.1.2	Government effectiveness*	27.9	98	
1.2	Regulatory environment	23.7	124	○
1.2.1	Regulatory quality*	31.3	96	
1.2.2	Rule of law*	32.0	73	
1.2.3	Cost of redundancy dismissal, salary weeks	50.6	124	○
1.3	Business environment	70.2	65	●
1.3.1	Ease of starting a business*	85.0	80	
1.3.2	Ease of resolving insolvency*	45.4	75	
1.3.3	Ease of paying taxes*	80.2	49	●
2	**Human capital & research**	**0.8**	**[127]**	
2.1	Education	0.0	[127]	
2.1.1	Expenditure on education, % GDPⓓ	1.1	117	○
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	n/a	n/a	
2.1.3	School life expectancy, years	n/a	n/a	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary	n/a	n/a	
2.2	Tertiary education	n/a	n/a	
2.2.1	Tertiary enrolment, % gross	n/a	n/a	
2.2.2	Graduates in science & engineering, %	n/a	n/a	
2.2.3	Tertiary inbound mobility, %	n/a	n/a	
2.3	Research & development (R&D)	1.6	96	
2.3.1	Researchers, FTE/mn pop.ⓓ	40.9	93	
2.3.2	Gross expenditure on R&D, % GDPⓓ	0.3	81	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**26.3**	**116**	
3.1	Information & communication technologies (ICTs)	28.2	110	
3.1.1	ICT access*	28.4	114	
3.1.2	ICT use*	11.7	110	
3.1.3	Government's online service*	37.0	101	
3.1.4	E-participation*	35.6	105	
3.2	General infrastructure	36.8	66	●
3.2.1	Electricity output, kWh/cap	919.3	95	
3.2.2	Logistics performance*	17.0	108	
3.2.3	Gross capital formation, % GDP	31.5	14	●
3.3	Ecological sustainability	13.9	126	○
3.3.1	GDP/unit of energy use	5.7	96	
3.3.2	Environmental performance*	n/a	n/a	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	0.4	88	
4	**Market sophistication**	**38.4**	**100**	
4.1	Credit	27.9	87	
4.1.1	Ease of getting credit*	75.0	19	●
4.1.2	Domestic credit to private sector, % GDP	19.8	112	
4.1.3	Microfinance gross loans, % GDP	0.1	58	
4.2	Investment	29.3	115	
4.2.1	Ease of protecting minority investors*	53.3	80	
4.2.2	Market capitalization, % GDPⓓ	13.6	72	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	56	
4.3	Trade, competition, & market scale	58.0	79	
4.3.1	Applied tariff rate, weighted mean, %ⓓ	3.4	72	
4.3.2	Intensity of local competition†	69.9	62	●
4.3.3	Domestic market scale, bn PPP$	65.2	88	
5	**Business sophistication**	**18.3**	**125**	○
5.1	Knowledge workers	15.5	116	
5.1.1	Knowledge-intensive employment, %ⓓ	7.3	98	
5.1.2	Firms offering formal training, % firms	28.2	56	
5.1.3	GERD performed by business, % of GDPⓓ	0.0	84	
5.1.4	GERD financed by business, %ⓓ	3.2	82	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	19.8	109	
5.2.1	University/industry research collaboration†	41.4	58	●
5.2.2	State of cluster development†	45.3	64	●
5.2.3	GERD financed by abroad, %ⓓ	1.6	79	
5.2.4	JV–strategic alliance deals/bn PPP$ GDPⓓ	0.0	105	○
5.2.5	Patent families 2+ offices/bn PPP$ GDPⓓ	0.0	98	
5.3	Knowledge absorption	19.6	123	○
5.3.1	Intellectual property payments, % total tradeⓓ	0.0	112	○
5.3.2	High-tech imports less re-imports, % total trade	5.2	106	
5.3.3	ICT services imports, % total tradeⓓ	0.4	108	
5.3.4	FDI net inflows, % GDP	6.8	18	●
5.3.5	Research talent, % in business enterpriseⓓ	4.9	74	
6	**Knowledge & technology outputs**	**16.1**	**95**	
6.1	Knowledge creation	4.7	90	
6.1.1	Patents by origin/bn PPP$ GDPⓓ	0.2	92	
6.1.2	PCT patent applications/bn PPP$ GDP	n/a	n/a	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	5.4	96	
6.1.5	Citable documents H index	5.9	88	
6.2	Knowledge impact	33.4	54	●
6.2.1	Growth rate of PPP$ GDP/worker, %	4.3	12	●
6.2.2	New businesses/th pop. 15–64	1.3	59	●
6.2.3	Computer software spending, % GDP	0.0	114	
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	0.8	112	
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	10.4	125	○
6.3.1	Intellectual property receipts, % total trade	n/a	n/a	
6.3.2	High-tech exports less re-exports, % total trade	0.6	75	
6.3.3	ICT services exports, % total tradeⓓ	0.3	110	
6.3.4	FDI net outflows, % GDP	(1.2)	121	○
7	**Creative outputs**	**14.9**	**120**	○
7.1	Intangible assets	28.0	113	
7.1.1	Trademarks by origin/bn PPP$ GDPⓓ	8.8	106	
7.1.2	Industrial designs by origin/bn PPP$ GDPⓓ	0.5	80	
7.1.3	ICTs & business model creation†	48.6	108	
7.1.4	ICTs & organizational model creation†	44.0	97	
7.2	Creative goods & services	1.5	[122]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade	0.0	106	
7.3	Online creativity	2.2	121	○
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.1	121	○
7.3.2	Country-code TLDs/th pop. 15–69	0.0	126	○
7.3.3	Wikipedia edits/mn pop. 15–69ⓓ	0.7	120	○
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓓ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Zimbabwe

Key indicators

Population (millions)	16.0
GDP (US$ billions)	14.2
GDP per capita, PPP$	2,096.2
Income group	Low income
Region	Sub-Saharan Africa

		Score 0–100 or value (hard data)	Rank	
	Global Innovation Index (out of 127)	**21.8**	**121**	
	Innovation Output Sub-Index	15.6	116	
	Innovation Input Sub-Index	28.0	124	○
	Innovation Efficiency Ratio	0.6	89	
	Global Innovation Index 2016 (out of 128)	n/a	n/a	
1	**Institutions**	**35.7**	**125**	○
1.1	Political environment	31.3	114	
1.1.1	Political stability & safety*	49.8	93	
1.1.2	Government effectiveness*	12.7	124	○
1.2	Regulatory environment	32.9	121	
1.2.1	Regulatory quality*	0.0	127	○
1.2.2	Rule of law*	0.0	127	○
1.2.3	Cost of redundancy dismissal, salary weeks	25.3	102	
1.3	Business environment	42.9	126	○
1.3.1	Ease of starting a business*	49.1	127	○
1.3.2	Ease of resolving insolvency*	28.5	118	
1.3.3	Ease of paying taxes*	51.2	112	
2	**Human capital & research**	**28.7**	**79**	
2.1	Education	54.5	42	●
2.1.1	Expenditure on education, % GDP	8.4	3	●
2.1.2	Gov't expenditure/pupil, secondary, % GDP/cap	35.1	10	●
2.1.3	School life expectancy, years ⓐ	10.3	101	
2.1.4	PISA scales in reading, maths, & science	n/a	n/a	
2.1.5	Pupil-teacher ratio, secondary ⓐ	22.5	89	
2.2	Tertiary education	31.3	77	
2.2.1	Tertiary enrolment, % gross	8.4	109	
2.2.2	Graduates in science & engineering, %	29.4	9	●
2.2.3	Tertiary inbound mobility, %	0.5	91	
2.3	Research & development (R&D)	0.3	111	
2.3.1	Researchers, FTE/mn pop. ⓐ	89.6	86	
2.3.2	Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3	Global R&D companies, avg. expend. top 3, mn $US	0.0	43	○
2.3.4	QS university ranking, average score top 3*	0.0	75	○
3	**Infrastructure**	**15.5**	**127**	○
3.1	Information & communication technologies (ICTs)	26.9	111	
3.1.1	ICT access*	33.5	105	
3.1.2	ICT use*	19.1	100	
3.1.3	Government's online service*	26.1	111	
3.1.4	E-participation*	28.8	107	
3.2	General infrastructure	13.1	125	○
3.2.1	Electricity output, kWh/cap	657.2	101	
3.2.2	Logistics performance*	0.9	126	○
3.2.3	Gross capital formation, % GDP	14.2	115	
3.3	Ecological sustainability	6.4	127	○
3.3.1	GDP/unit of energy use	2.3	117	○
3.3.2	Environmental performance*	n/a	n/a	
3.3.3	ISO 14001 environmental certificates/bn PPP$ GDP	1.0	63	
4	**Market sophistication**	**37.2**	**105**	
4.1	Credit	25.1	98	
4.1.1	Ease of getting credit*	50.0	72	
4.1.2	Domestic credit to private sector, % GDP	n/a	n/a	
4.1.3	Microfinance gross loans, % GDP	0.0	69	
4.2	Investment	38.1	75	
4.2.1	Ease of protecting minority investors*	51.7	86	
4.2.2	Market capitalization, % GDP	n/a	n/a	
4.2.3	Venture capital deals/bn PPP$ GDP	0.0	36	●
4.3	Trade, competition, & market scale	48.4	108	
4.3.1	Applied tariff rate, weighted mean, %	5.4	95	
4.3.2	Intensity of local competition†	63.6	85	
4.3.3	Domestic market scale, bn PPP$	28.3	110	
5	**Business sophistication**	**22.8**	**114**	
5.1	Knowledge workers	23.1	[104]	
5.1.1	Knowledge-intensive employment, % ⓐ	6.1	100	
5.1.2	Firms offering formal training, % firms ⓐ	31.2	49	
5.1.3	GERD performed by business, % of GDP	n/a	n/a	
5.1.4	GERD financed by business, %	n/a	n/a	
5.1.5	Females employed w/advanced degrees, % total	n/a	n/a	
5.2	Innovation linkages	20.2	106	
5.2.1	University/industry research collaboration†	25.0	118	
5.2.2	State of cluster development†	28.4	122	○
5.2.3	GERD financed by abroad, %	n/a	n/a	
5.2.4	JV–strategic alliance deals/bn PPP$ GDP	0.1	28	●
5.2.5	Patent families 2+ offices/bn PPP$ GDP ⓐ	0.1	71	
5.3	Knowledge absorption	25.2	97	
5.3.1	Intellectual property payments, % total trade ⓐ	0.3	71	
5.3.2	High-tech imports less re-imports, % total trade ⓐ	8.4	61	●
5.3.3	ICT services imports, % total trade ⓐ	0.2	118	
5.3.4	FDI net inflows, % GDP	3.0	58	●
5.3.5	Research talent, % in business enterprise	n/a	n/a	
6	**Knowledge & technology outputs**	**14.0**	**110**	
6.1	Knowledge creation	7.6	76	
6.1.1	Patents by origin/bn PPP$ GDP	0.3	84	
6.1.2	PCT patent applications/bn PPP$ GDP	0.1	69	
6.1.3	Utility models by origin/bn PPP$ GDP	n/a	n/a	
6.1.4	Scientific & technical articles/bn PPP$ GDP	15.6	49	●
6.1.5	Citable documents H index	6.5	84	
6.2	Knowledge impact	21.1	104	
6.2.1	Growth rate of PPP$ GDP/worker, %	(2.4)	103	
6.2.2	New businesses/th pop. 15–64	n/a	n/a	
6.2.3	Computer software spending, % GDP	0.4	24	●
6.2.4	ISO 9001 quality certificates/bn PPP$ GDP	4.6	63	●
6.2.5	High- & medium-high-tech manufactures, %	n/a	n/a	
6.3	Knowledge diffusion	13.3	120	
6.3.1	Intellectual property receipts, % total trade ⓐ	0.0	78	
6.3.2	High-tech exports less re-exports, % total trade ⓐ	0.2	98	
6.3.3	ICT services exports, % total trade ⓐ	0.0	125	○
6.3.4	FDI net outflows, % GDP	0.3	77	
7	**Creative outputs**	**17.2**	**113**	
7.1	Intangible assets	28.2	112	
7.1.1	Trademarks by origin/bn PPP$ GDP	10.2	103	
7.1.2	Industrial designs by origin/bn PPP$ GDP	n/a	n/a	
7.1.3	ICTs & business model creation†	46.6	113	
7.1.4	ICTs & organizational model creation†	33.2	117	
7.2	Creative goods & services	8.4	[95]	
7.2.1	Cultural & creative services exports, % of total trade	n/a	n/a	
7.2.2	National feature films/mn pop. 15–69	n/a	n/a	
7.2.3	Global ent. & media market/th pop. 15–69	n/a	n/a	
7.2.4	Printing & publishing manufactures, %	n/a	n/a	
7.2.5	Creative goods exports, % total trade ⓐ	0.3	70	
7.3	Online creativity	4.1	113	
7.3.1	Generic top-level domains (TLDs)/th pop. 15–69	0.4	109	
7.3.2	Country-code TLDs/th pop. 15–69	0.1	114	
7.3.3	Wikipedia edits/mn pop. 15–69 ⓐ	1.2	113	
7.3.4	Video uploads on YouTube/pop. 15–69	n/a	n/a	

NOTES: ● indicates a strength; ○ a weakness; * an index; † a survey question.
ⓐ indicates that the country's data are older than the base year; see Appendix II for details, including the year of the data, at http://globalinnovationindex.org.
Square brackets indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; see page 181 of this appendix for details.

Appendix II

Data Tables

Data Tables

This appendix provides tables for each of the 81 indicators that make up the Global Innovation Index 2017.

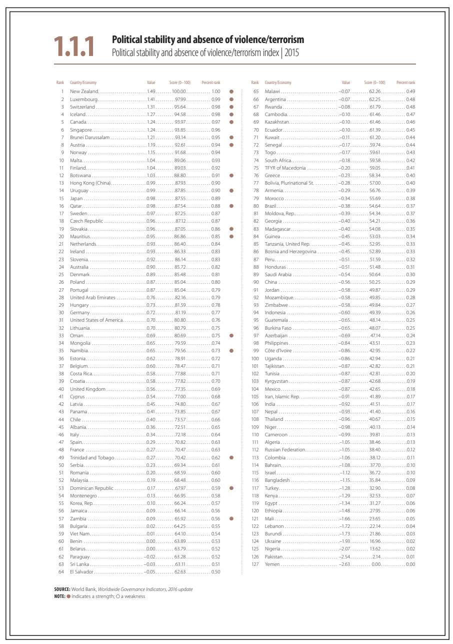
Structure

Each table is identified by indicator number, with the first digit representing the pillar, the second representing the sub-pillar, and the final digit representing the indicator within that particular sub-pillar. For example, Table 5.1.4 shows results for indicator 5.1.4, GERD financed by business enterprise, which is the fourth indicator of sub-pillar 5.1, knowledge workers, within pillar 5, Business sophistication.

The sub-heading text provides a detailed description of each indicator and includes information on the units of each variable, the scaling factor (if any), the question asked (for survey questions), and the most frequent year for which data were available.

For each indicator for each economy, the most recent value within the period 2007–16 was used (with the exceptions of four indicators, which are further explained in Appendix III). In instances where this base year does not correspond to the most frequent year reported in the sub-heading, the year of the value appears in parentheses after the economy name. These instances are noted in the Country/Economy Profiles after the indicator name with a clock symbol.

A total of 57 variables are hard data. A total of 19 variables are composite indicators and 5 are survey questions from the World Economic Forum's Executive Opinion Survey.



1.1.1 Political stability and absence of violence/terrorism
Political stability and absence of violence/terrorism index | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	New Zealand	1.49	100.00	1.00	●
2	Luxembourg	1.41	97.99	0.99	●
3	Switzerland	1.31	95.64	0.98	●
4	Iceland	1.27	94.58	0.98	●
5	Canada	1.24	93.97	0.97	●
6	Singapore	1.24	93.85	0.96	
7	Brunei Darussalam	1.21	93.14	0.95	●
8	Austria	1.19	92.61	0.94	●
9	Norway	1.15	91.68	0.94	
10	Malta	1.04	89.06	0.93	
11	Finland	1.04	89.03	0.92	
12	Botswana	1.03	88.80	0.91	●
13	Hong Kong (China)	0.99	87.93	0.90	
14	Uruguay	0.99	87.85	0.90	●
15	Japan	0.98	87.55	0.89	
16	Qatar	0.98	87.54	0.88	●
17	Sweden	0.97	87.25	0.87	
18	Czech Republic	0.96	87.12	0.87	
19	Slovakia	0.96	87.05	0.86	●
20	Mauritius	0.95	86.86	0.85	●
21	Netherlands	0.93	86.40	0.84	
22	Ireland	0.93	86.33	0.83	
23	Slovenia	0.92	86.14	0.83	
24	Australia	0.90	85.72	0.82	
25	Denmark	0.89	85.48	0.81	
26	Poland	0.87	85.04	0.80	
27	Portugal	0.87	85.04	0.79	
28	United Arab Emirates	0.76	82.16	0.79	
29	Hungary	0.73	81.59	0.78	
30	Germany	0.72	81.19	0.77	
31	United States of America	0.70	80.80	0.76	
32	Lithuania	0.70	80.79	0.75	
33	Oman	0.69	80.69	0.75	●
34	Mongolia	0.65	79.59	0.74	
35	Namibia	0.65	79.56	0.73	●
36	Estonia	0.62	78.91	0.72	
37	Belgium	0.60	78.47	0.71	
38	Costa Rica	0.58	77.88	0.71	
39	Croatia	0.58	77.82	0.70	
40	United Kingdom	0.56	77.35	0.69	
41	Cyprus	0.54	77.00	0.68	
42	Latvia	0.45	74.80	0.67	
43	Panama	0.41	73.85	0.67	
44	Chile	0.40	73.57	0.66	
45	Albania	0.36	72.51	0.65	
46	Italy	0.34	72.18	0.64	
47	Spain	0.29	70.82	0.63	
48	France	0.27	70.47	0.63	
49	Trinidad and Tobago	0.27	70.42	0.62	●
50	Serbia	0.23	69.34	0.61	
51	Romania	0.20	68.59	0.60	
52	Malaysia	0.19	68.48	0.60	
53	Dominican Republic	0.17	67.97	0.59	●
54	Montenegro	0.13	66.95	0.58	
55	Korea, Rep.	0.10	66.24	0.57	
56	Jamaica	0.09	66.14	0.56	
57	Zambia	0.09	65.92	0.56	●
58	Bulgaria	0.02	64.25	0.55	
59	Viet Nam	0.01	64.10	0.54	
60	Benin	0.00	63.89	0.53	
61	Belarus	0.00	63.79	0.52	
62	Paraguay	–0.02	63.28	0.52	
63	Sri Lanka	–0.03	63.11	0.51	
64	El Salvador	–0.05	62.63	0.50	
65	Malawi	–0.07	62.26	0.49	
66	Argentina	–0.07	62.25	0.48	
67	Rwanda	–0.08	61.79	0.48	
68	Cambodia	–0.10	61.46	0.47	
69	Kazakhstan	–0.10	61.46	0.46	
70	Ecuador	–0.10	61.39	0.45	
71	Kuwait	–0.11	61.20	0.44	
72	Senegal	–0.17	59.74	0.44	
73	Togo	–0.17	59.61	0.43	
74	South Africa	–0.18	59.58	0.42	
75	TFYR of Macedonia	–0.20	59.05	0.41	
76	Greece	–0.23	58.34	0.40	
77	Bolivia, Plurinational St.	–0.28	57.00	0.40	
78	Armenia	–0.29	56.76	0.39	
79	Morocco	–0.34	55.69	0.38	
80	Brazil	–0.38	54.64	0.37	
81	Moldova, Rep.	–0.39	54.34	0.37	
82	Georgia	–0.40	54.21	0.36	
83	Madagascar	–0.40	54.08	0.35	
84	Guinea	–0.45	53.03	0.34	
85	Tanzania, United Rep.	–0.45	52.95	0.33	
86	Bosnia and Herzegovina	–0.45	52.89	0.33	
87	Peru	–0.51	51.59	0.32	
88	Honduras	–0.51	51.48	0.31	
89	Saudi Arabia	–0.54	50.64	0.30	
90	China	–0.56	50.25	0.29	
91	Jordan	–0.58	49.87	0.29	
92	Mozambique	–0.58	49.85	0.28	
93	Zimbabwe	–0.58	49.84	0.27	
94	Indonesia	–0.60	49.39	0.26	
95	Guatemala	–0.65	48.14	0.25	
96	Burkina Faso	–0.65	48.07	0.25	
97	Azerbaijan	–0.69	47.14	0.24	
98	Philippines	–0.84	43.51	0.23	
99	Côte d'Ivoire	–0.86	42.95	0.22	
100	Uganda	–0.86	42.94	0.21	
101	Tajikistan	–0.87	42.82	0.21	
102	Tunisia	–0.87	42.81	0.20	
103	Kyrgyzstan	–0.87	42.68	0.19	
104	Mexico	–0.87	42.65	0.18	
105	Iran, Islamic Rep.	–0.91	41.89	0.17	
106	India	–0.92	41.51	0.17	
107	Nepal	–0.93	41.40	0.16	
108	Thailand	–0.96	40.67	0.15	
109	Niger	–0.98	40.13	0.14	
110	Cameroon	–0.99	39.81	0.13	
111	Algeria	–1.05	38.46	0.13	
112	Russian Federation	–1.05	38.40	0.12	
113	Colombia	–1.06	38.12	0.11	
114	Bahrain	–1.08	37.70	0.10	
115	Israel	–1.12	36.72	0.10	
116	Bangladesh	–1.15	35.84	0.09	
117	Turkey	–1.28	32.90	0.08	
118	Kenya	–1.29	32.53	0.07	
119	Egypt	–1.34	31.27	0.06	
120	Ethiopia	–1.48	27.95	0.06	
121	Mali	–1.66	23.65	0.05	
122	Lebanon	–1.72	22.14	0.04	
123	Burundi	–1.73	21.86	0.03	
124	Ukraine	–1.93	16.96	0.02	
125	Nigeria	–2.07	13.62	0.02	
126	Pakistan	–2.54	2.14	0.01	
127	Yemen	–2.63	0.00	0.00	

SOURCE: World Bank, *Worldwide Governance Indicators, 2016 update*
NOTE: ● indicates a strength; ○ a weakness

The source of each indicator is indicated at the bottom of the page; details for each can be found in Appendix III, Sources and Definitions.

Explanation of scores

The tables list the economies by their rank order, with the best performers at the top. After the rank comes the country/economy name, the original value of the specific indicator for that country (in the units specified in the sub-heading), the normalized score in the 0–100 range, and the percentage of economies with scores that fall below the normalized score (i.e., percent ranks). To the far right of each column, a solid circle indicates that an indicator is a strength for the country/economy in question, and a hollow circle indicates that it is a weakness (refer to Appendix I, Country/Economy Profiles, for details).

- Strengths (●) are all ranks of 1, 2, and 3, as well as all scores with percent ranks greater than the 10th highest percent rank among the 81 indicators in a specific economy.
- Weaknesses (○) are all scores with percent ranks lower than the 10th smallest percent rank among the 81 indicators in a specific economy.

For four hard data series (7.3.1, 7.3.2, 7.3.3, and 7.3.4), the raw data were provided under the condition that only the normalized scores be published and therefore the original value equals the normalized score. For indicators 1.3.1, 1.3.2, 1.3.3, 2.3.4, 3.3.2, 4.1.1, and 4.2.1, the range for both measures is the same—(0–100)—and therefore both measures are also identical.

Details on the computation methodology can be found in Appendix IV, Technical Notes.

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5.2 Innovation linkages

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6 Knowledge & technology outputs

6.1 Knowledge creation

6.2 Knowledge impact

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7 Creative outputs

7.1 Intangible assets

7.2 Creative goods & services

7.3 Online creativity

1.1.1 Political stability and absence of violence/terrorism

Political stability and absence of violence/terrorism index | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	New Zealand	1.49	100.00	1.00	●
2	Luxembourg	1.41	97.99	0.99	●
3	Switzerland	1.31	95.64	0.98	●
4	Iceland	1.27	94.58	0.98	●
5	Canada	1.24	93.97	0.97	●
6	Singapore	1.24	93.85	0.96	
7	Brunei Darussalam	1.21	93.14	0.95	●
8	Austria	1.19	92.61	0.94	●
9	Norway	1.15	91.68	0.94	
10	Malta	1.04	89.06	0.93	
11	Finland	1.04	89.03	0.92	
12	Botswana	1.03	88.80	0.91	●
13	Hong Kong (China)	0.99	87.93	0.90	
14	Uruguay	0.99	87.85	0.90	●
15	Japan	0.98	87.55	0.89	
16	Qatar	0.98	87.54	0.88	●
17	Sweden	0.97	87.25	0.87	
18	Czech Republic	0.96	87.12	0.87	
19	Slovakia	0.96	87.05	0.86	●
20	Mauritius	0.95	86.86	0.85	●
21	Netherlands	0.93	86.40	0.84	
22	Ireland	0.93	86.33	0.83	
23	Slovenia	0.92	86.14	0.83	
24	Australia	0.90	85.72	0.82	
25	Denmark	0.89	85.48	0.81	
26	Poland	0.87	85.04	0.80	
27	Portugal	0.87	85.04	0.79	
28	United Arab Emirates	0.76	82.16	0.79	
29	Hungary	0.73	81.59	0.78	
30	Germany	0.72	81.19	0.77	
31	United States of America	0.70	80.80	0.76	
32	Lithuania	0.70	80.79	0.75	
33	Oman	0.69	80.69	0.75	●
34	Mongolia	0.65	79.59	0.74	
35	Namibia	0.65	79.56	0.73	●
36	Estonia	0.62	78.91	0.72	
37	Belgium	0.60	78.47	0.71	
38	Costa Rica	0.58	77.88	0.71	
39	Croatia	0.58	77.82	0.70	
40	United Kingdom	0.56	77.35	0.69	
41	Cyprus	0.54	77.00	0.68	
42	Latvia	0.45	74.80	0.67	
43	Panama	0.41	73.85	0.67	
44	Chile	0.40	73.57	0.66	
45	Albania	0.36	72.51	0.65	
46	Italy	0.34	72.18	0.64	
47	Spain	0.29	70.82	0.63	
48	France	0.27	70.47	0.63	
49	Trinidad and Tobago	0.27	70.42	0.62	●
50	Serbia	0.23	69.34	0.61	
51	Romania	0.20	68.59	0.60	
52	Malaysia	0.19	68.48	0.60	
53	Dominican Republic	0.17	67.97	0.59	●
54	Montenegro	0.13	66.95	0.58	
55	Korea, Rep.	0.10	66.24	0.57	
56	Jamaica	0.09	66.14	0.56	
57	Zambia	0.09	65.92	0.56	●
58	Bulgaria	0.02	64.25	0.55	
59	Viet Nam	0.01	64.10	0.54	
60	Benin	0.00	63.89	0.53	
61	Belarus	0.00	63.79	0.52	
62	Paraguay	–0.02	63.28	0.52	
63	Sri Lanka	–0.03	63.11	0.51	
64	El Salvador	–0.05	62.63	0.50	
65	Malawi	–0.07	62.26	0.49	●
66	Argentina	–0.07	62.25	0.48	
67	Rwanda	–0.08	61.79	0.48	
68	Cambodia	–0.10	61.46	0.47	
69	Kazakhstan	–0.10	61.46	0.46	
70	Ecuador	–0.10	61.39	0.45	
71	Kuwait	–0.11	61.20	0.44	
72	Senegal	–0.17	59.74	0.44	
73	Togo	–0.17	59.61	0.43	●
74	South Africa	–0.18	59.58	0.42	
75	TFYR of Macedonia	–0.20	59.05	0.41	
76	Greece	–0.23	58.34	0.40	
77	Bolivia, Plurinational St.	–0.28	57.00	0.40	
78	Armenia	–0.29	56.76	0.39	
79	Morocco	–0.34	55.69	0.38	
80	Brazil	–0.38	54.64	0.37	
81	Moldova, Rep.	–0.39	54.34	0.37	
82	Georgia	–0.40	54.21	0.36	
83	Madagascar	–0.40	54.08	0.35	
84	Guinea	–0.45	53.03	0.34	●
85	Tanzania, United Rep.	–0.45	52.95	0.33	
86	Bosnia and Herzegovina	–0.45	52.89	0.33	
87	Peru	–0.51	51.59	0.32	
88	Honduras	–0.51	51.48	0.31	
89	Saudi Arabia	–0.54	50.64	0.30	
90	China	–0.56	50.25	0.29	
91	Jordan	–0.58	49.87	0.29	
92	Mozambique	–0.58	49.85	0.28	
93	Zimbabwe	–0.58	49.84	0.27	
94	Indonesia	–0.60	49.39	0.26	
95	Guatemala	–0.65	48.14	0.25	
96	Burkina Faso	–0.65	48.07	0.25	
97	Azerbaijan	–0.69	47.14	0.24	
98	Philippines	–0.84	43.51	0.23	
99	Côte d'Ivoire	–0.86	42.95	0.22	
100	Uganda	–0.86	42.94	0.21	
101	Tajikistan	–0.87	42.82	0.21	
102	Tunisia	–0.87	42.81	0.20	
103	Kyrgyzstan	–0.87	42.68	0.19	
104	Mexico	–0.87	42.65	0.18	○
105	Iran, Islamic Rep.	–0.91	41.89	0.17	
106	India	–0.92	41.51	0.17	
107	Nepal	–0.93	41.40	0.16	
108	Thailand	–0.96	40.67	0.15	○
109	Niger	–0.98	40.13	0.14	
110	Cameroon	–0.99	39.81	0.13	
111	Algeria	–1.05	38.46	0.13	
112	Russian Federation	–1.05	38.40	0.12	○
113	Colombia	–1.06	38.12	0.11	○
114	Bahrain	–1.08	37.70	0.10	
115	Israel	–1.12	36.72	0.10	○
116	Bangladesh	–1.15	35.84	0.09	
117	Turkey	–1.28	32.90	0.08	○
118	Kenya	–1.29	32.53	0.07	○
119	Egypt	–1.34	31.27	0.06	
120	Ethiopia	–1.48	27.95	0.06	
121	Mali	–1.66	23.65	0.05	
122	Lebanon	–1.72	22.14	0.04	○
123	Burundi	–1.73	21.86	0.03	
124	Ukraine	–1.93	16.96	0.02	○
125	Nigeria	–2.07	13.62	0.02	○
126	Pakistan	–2.54	2.14	0.01	○
127	Yemen	–2.63	0.00	0.00	○

SOURCE: World Bank, *Worldwide Governance Indicators, 2016 update*
NOTE: ● indicates a strength; ○ a weakness

1.1.2 Government effectiveness

Government effectiveness index | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Singapore	2.25	100.00	1.00	●
2	Switzerland	2.01	93.78	0.99	●
3	Hong Kong (China)	1.93	91.68	0.98	●
4	New Zealand	1.89	90.70	0.98	●
5	Norway	1.86	89.98	0.97	●
6	Denmark	1.85	89.65	0.96	●
7	Netherlands	1.84	89.46	0.95	
8	Finland	1.82	88.96	0.94	
9	Sweden	1.81	88.68	0.94	
10	Japan	1.79	88.16	0.93	
11	Canada	1.77	87.49	0.92	
12	Germany	1.74	86.84	0.91	
13	United Kingdom	1.74	86.81	0.90	
14	Luxembourg	1.72	86.45	0.90	
15	Australia	1.56	82.18	0.89	
16	United Arab Emirates	1.54	81.63	0.88	
17	Ireland	1.54	81.62	0.87	
18	Iceland	1.50	80.70	0.87	
19	Austria	1.47	80.00	0.86	
20	United States of America	1.46	79.70	0.85	
21	France	1.44	79.22	0.84	
22	Belgium	1.44	79.17	0.83	
23	Israel	1.38	77.47	0.83	
24	Portugal	1.23	73.81	0.82	
25	Lithuania	1.20	73.00	0.81	
26	Spain	1.18	72.39	0.80	
27	Latvia	1.10	70.35	0.79	
28	Estonia	1.09	70.18	0.79	
29	Chile	1.08	69.94	0.78	
30	Brunei Darussalam	1.05	69.19	0.77	●
31	Czech Republic	1.05	69.16	0.76	
32	Cyprus	1.04	68.77	0.75	
33	Mauritius	1.04	68.76	0.75	●
34	Korea, Rep.	1.03	68.51	0.74	
35	Qatar	1.00	67.72	0.73	
36	Slovenia	0.97	67.17	0.72	
37	Malaysia	0.96	66.92	0.71	
38	Malta	0.85	64.01	0.71	
39	Slovakia	0.84	63.73	0.70	
40	Poland	0.80	62.69	0.69	
41	Bahrain	0.57	56.89	0.68	
42	Uruguay	0.54	56.02	0.67	
43	Botswana	0.51	55.33	0.67	
44	Croatia	0.51	55.23	0.66	
45	Hungary	0.49	54.78	0.65	
46	Italy	0.45	53.81	0.64	
47	China	0.42	53.05	0.63	
48	Georgia	0.40	52.46	0.63	
49	Costa Rica	0.38	51.88	0.62	
50	Thailand	0.36	51.31	0.61	
51	Panama	0.30	49.79	0.60	
52	South Africa	0.27	48.96	0.60	
53	Namibia	0.26	48.77	0.59	
54	Greece	0.25	48.55	0.58	
55	Jamaica	0.25	48.47	0.57	
56	Trinidad and Tobago	0.24	48.24	0.56	●
57	Turkey	0.23	48.13	0.56	
58	Bulgaria	0.22	47.70	0.55	
59	Mexico	0.21	47.57	0.54	
60	Saudi Arabia	0.21	47.55	0.53	
61	Montenegro	0.16	46.29	0.52	
62	Jordan	0.14	45.64	0.52	
63	TFYR of Macedonia	0.13	45.39	0.51	
64	Serbia	0.11	45.08	0.50	
65	Philippines	0.11	44.90	0.49	
66	India	0.10	44.73	0.48	
67	Oman	0.09	44.55	0.48	
68	Viet Nam	0.08	44.13	0.47	
69	Albania	0.03	42.86	0.46	
70	Sri Lanka	0.01	42.37	0.45	
71	Kuwait	–0.02	41.52	0.44	
72	Colombia	–0.03	41.25	0.44	
73	Romania	–0.04	41.17	0.43	
74	Rwanda	–0.04	41.14	0.42	
75	Kazakhstan	–0.05	40.79	0.41	
76	Morocco	–0.06	40.60	0.40	
77	Argentina	–0.09	39.91	0.40	
78	Tunisia	–0.10	39.48	0.39	
79	Armenia	–0.14	38.67	0.38	
80	Russian Federation	–0.18	37.46	0.37	
81	Brazil	–0.19	37.29	0.37	
82	Iran, Islamic Rep.	–0.20	36.97	0.36	
83	Indonesia	–0.22	36.38	0.35	
84	Azerbaijan	–0.23	36.16	0.34	
85	El Salvador	–0.24	35.92	0.33	
86	Peru	–0.28	35.02	0.33	
87	Kenya	–0.29	34.83	0.32	
88	Dominican Republic	–0.34	33.31	0.31	
89	Mongolia	–0.40	31.78	0.30	
90	Senegal	–0.44	30.97	0.29	
91	Ecuador	–0.44	30.95	0.29	
92	Lebanon	–0.47	30.06	0.28	
93	Belarus	–0.48	29.92	0.27	
94	Uganda	–0.48	29.74	0.26	
95	Algeria	–0.51	29.15	0.25	
96	Ukraine	–0.51	28.95	0.25	
97	Bosnia and Herzegovina	–0.54	28.17	0.24	
98	Zambia	–0.55	27.91	0.23	
99	Burkina Faso	–0.59	27.09	0.22	
100	Tanzania, United Rep.	–0.60	26.77	0.21	
101	Niger	–0.61	26.55	0.21	
102	Benin	–0.62	26.28	0.20	
103	Moldova, Rep.	–0.63	25.94	0.19	
104	Ethiopia	–0.64	25.69	0.18	
105	Côte d'Ivoire	–0.65	25.43	0.17	
106	Bolivia, Plurinational St.	–0.66	25.26	0.17	
107	Pakistan	–0.66	25.16	0.16	
108	Malawi	–0.67	24.81	0.15	
109	Cambodia	–0.69	24.43	0.14	
110	Guatemala	–0.71	23.82	0.13	
111	Bangladesh	–0.73	23.45	0.13	
112	Mozambique	–0.74	23.10	0.12	
113	Egypt	–0.76	22.58	0.11	
114	Cameroon	–0.76	22.54	0.10	
115	Honduras	–0.82	21.12	0.10	○
116	Tajikistan	–0.82	21.10	0.09	
117	Kyrgyzstan	–0.90	18.99	0.08	
118	Mali	–0.91	18.74	0.07	
119	Paraguay	–0.95	17.87	0.06	○
120	Nigeria	–0.95	17.70	0.06	
121	Nepal	–1.04	15.35	0.05	○
122	Guinea	–1.14	12.98	0.04	
123	Burundi	–1.15	12.74	0.03	
124	Zimbabwe	–1.15	12.66	0.02	○
125	Togo	–1.18	11.86	0.02	○
126	Madagascar	–1.29	8.96	0.01	○
127	Yemen	–1.64	0.00	0.00	○

SOURCE: World Bank, *Worldwide Governance Indicators, 2016 update*
NOTE: ● indicates a strength; ○ a weakness

1.2.1 Regulatory quality

Regulatory quality index | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Singapore	2.26	100.00	1.00	●
2	Hong Kong (China)	2.18	97.79	0.99	●
3	New Zealand	1.95	91.94	0.98	●
4	United Kingdom	1.86	89.58	0.98	●
5	Finland	1.83	88.89	0.97	●
6	Ireland	1.81	88.51	0.96	●
7	Sweden	1.81	88.37	0.95	
8	Australia	1.80	88.05	0.94	
9	Netherlands	1.77	87.36	0.94	
10	Switzerland	1.76	87.03	0.93	
11	Denmark	1.73	86.47	0.92	
12	Canada	1.71	85.75	0.91	
13	Luxembourg	1.67	84.93	0.90	
14	Germany	1.67	84.71	0.90	
15	Estonia	1.66	84.48	0.89	
16	Norway	1.63	83.90	0.88	
17	Austria	1.43	78.70	0.87	
18	Chile	1.35	76.72	0.87	●
19	United States of America	1.30	75.31	0.86	
20	Lithuania	1.28	74.87	0.85	●
21	Belgium	1.28	74.79	0.84	
22	Israel	1.27	74.61	0.83	
23	Iceland	1.27	74.57	0.83	
24	Japan	1.18	72.23	0.82	
25	Malta	1.17	72.17	0.81	
26	Korea, Rep.	1.16	71.69	0.80	
27	France	1.15	71.65	0.79	
28	United Arab Emirates	1.13	71.11	0.79	
29	Mauritius	1.09	69.97	0.78	●
30	Latvia	1.09	69.89	0.77	
31	Czech Republic	1.08	69.87	0.76	
32	Cyprus	1.06	69.25	0.75	
33	Poland	1.00	67.63	0.75	
34	Portugal	0.94	66.17	0.74	
35	Georgia	0.92	65.76	0.73	
36	Brunei Darussalam	0.84	63.67	0.72	
37	Bahrain	0.83	63.30	0.71	
38	Slovakia	0.79	62.27	0.71	
39	Spain	0.79	62.21	0.70	
40	Malaysia	0.77	61.87	0.69	
41	Hungary	0.77	61.78	0.68	
42	Italy	0.73	60.79	0.67	
43	Qatar	0.69	59.82	0.67	
44	Slovenia	0.62	58.00	0.66	
45	Romania	0.59	57.23	0.65	
46	Oman	0.58	57.01	0.64	
47	Bulgaria	0.55	56.26	0.63	
48	Peru	0.49	54.75	0.63	
49	Costa Rica	0.49	54.73	0.62	
50	Botswana	0.49	54.53	0.61	
51	Uruguay	0.45	53.69	0.60	
52	Colombia	0.45	53.67	0.60	
53	TFYR of Macedonia	0.45	53.55	0.59	
54	Mexico	0.40	52.35	0.58	
55	Greece	0.40	52.28	0.57	
56	Panama	0.37	51.71	0.56	
57	Croatia	0.36	51.43	0.56	
58	Turkey	0.33	50.57	0.55	
59	South Africa	0.30	49.89	0.54	
60	Thailand	0.30	49.77	0.53	
61	Armenia	0.25	48.49	0.52	
62	Rwanda	0.25	48.48	0.52	
63	Montenegro	0.23	47.88	0.51	
64	El Salvador	0.20	47.23	0.50	
65	Albania	0.20	47.20	0.49	
66	Trinidad and Tobago	0.15	45.84	0.48	
67	Serbia	0.14	45.60	0.48	
68	Jamaica	0.11	44.93	0.47	
69	Jordan	0.05	43.34	0.46	
70	Saudi Arabia	0.03	42.90	0.45	
71	Kazakhstan	–0.03	41.48	0.44	
72	Philippines	–0.04	41.18	0.44	
73	Dominican Republic	–0.04	41.17	0.43	
74	Sri Lanka	–0.05	40.79	0.42	
75	Moldova, Rep.	–0.05	40.76	0.41	
76	Namibia	–0.08	40.02	0.40	
77	Kuwait	–0.16	38.13	0.40	
78	Morocco	–0.17	37.71	0.39	
79	Senegal	–0.18	37.55	0.38	
80	Bosnia and Herzegovina	–0.18	37.50	0.37	
81	Guatemala	–0.20	36.90	0.37	
82	Indonesia	–0.21	36.74	0.36	
83	Brazil	–0.21	36.69	0.35	
84	Uganda	–0.24	35.93	0.34	
85	Azerbaijan	–0.25	35.61	0.33	
86	Paraguay	–0.27	35.29	0.33	
87	China	–0.27	35.25	0.32	
88	Lebanon	–0.28	35.03	0.31	
89	Kenya	–0.29	34.60	0.30	
90	Mongolia	–0.33	33.61	0.29	
91	Burkina Faso	–0.36	32.90	0.29	
92	Tanzania, United Rep.	–0.36	32.85	0.28	
93	India	–0.39	32.11	0.27	
94	Tunisia	–0.39	32.03	0.26	
95	Honduras	–0.40	31.96	0.25	
96	Zambia	–0.42	31.32	0.25	
97	Kyrgyzstan	–0.47	30.20	0.24	
98	Cambodia	–0.48	29.84	0.23	
99	Mozambique	–0.49	29.47	0.22	
100	Viet Nam	–0.50	29.43	0.21	
101	Côte d'Ivoire	–0.52	28.94	0.21	
102	Russian Federation	–0.52	28.76	0.20	○
103	Benin	–0.56	27.92	0.19	
104	Mali	–0.57	27.56	0.18	
105	Ukraine	–0.58	27.29	0.17	
106	Pakistan	–0.62	26.17	0.17	
107	Burundi	–0.71	23.98	0.16	
108	Niger	–0.73	23.56	0.15	
109	Madagascar	–0.76	22.75	0.14	
110	Nepal	–0.79	22.04	0.13	
111	Egypt	–0.80	21.75	0.13	
112	Malawi	–0.82	21.18	0.12	
113	Togo	–0.82	21.14	0.11	
114	Nigeria	–0.84	20.62	0.10	
115	Guinea	–0.86	20.03	0.10	
116	Cameroon	–0.91	18.96	0.09	
117	Bolivia, Plurinational St.	–0.91	18.94	0.08	
118	Bangladesh	–0.93	18.37	0.07	
119	Argentina	–0.96	17.66	0.06	○
120	Belarus	–1.00	16.49	0.06	○
121	Ethiopia	–1.00	16.42	0.05	
122	Tajikistan	–1.01	16.39	0.04	
123	Yemen	–1.10	13.96	0.03	
124	Ecuador	–1.14	12.92	0.02	○
125	Algeria	–1.17	12.20	0.02	○
126	Iran, Islamic Rep.	–1.28	9.37	0.01	○
127	Zimbabwe	–1.65	0.00	0.00	○

SOURCE: World Bank, *Worldwide Governance Indicators, 2016 update*

NOTE: ● indicates a strength; ○ a weakness

1.2.2 Rule of law

Rule of law index | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Finland	2.07	100.00	1.00	●
2	Sweden	2.04	99.15	0.99	●
3	Denmark	2.04	99.05	0.98	●
4	Norway	2.02	98.51	0.98	●
5	New Zealand	2.02	98.46	0.97	●
6	Switzerland	1.97	96.87	0.96	
7	Netherlands	1.93	95.94	0.95	
8	Singapore	1.88	94.39	0.94	
9	Luxembourg	1.86	93.89	0.94	
10	Austria	1.85	93.47	0.93	●
11	Canada	1.84	93.05	0.92	
12	Hong Kong (China)	1.83	92.95	0.91	
13	Australia	1.82	92.71	0.90	
14	United Kingdom	1.81	92.16	0.90	
15	Ireland	1.79	91.65	0.89	
16	Germany	1.78	91.49	0.88	
17	Iceland	1.67	88.35	0.87	
18	United States of America	1.60	86.27	0.87	
19	Japan	1.51	83.58	0.86	
20	Belgium	1.42	80.94	0.85	
21	France	1.41	80.51	0.84	
22	Chile	1.33	78.36	0.83	●
23	Estonia	1.33	78.23	0.83	
24	Israel	1.17	73.55	0.82	
25	Malta	1.15	73.12	0.81	
26	Portugal	1.14	72.84	0.80	
27	Czech Republic	1.12	72.24	0.79	
28	Cyprus	1.01	68.98	0.79	
29	Lithuania	0.98	68.18	0.78	
30	Korea, Rep.	0.95	67.31	0.77	
31	Slovenia	0.95	67.28	0.76	
32	Spain	0.90	65.62	0.75	
33	Qatar	0.88	65.26	0.75	
34	Mauritius	0.85	64.37	0.74	
35	Poland	0.80	62.69	0.73	
36	Latvia	0.79	62.38	0.72	
37	United Arab Emirates	0.71	60.10	0.71	
38	Uruguay	0.68	59.15	0.71	●
39	Botswana	0.63	57.90	0.70	
40	Malaysia	0.57	56.20	0.69	
41	Slovakia	0.48	53.55	0.68	
42	Costa Rica	0.48	53.41	0.67	
43	Oman	0.46	52.93	0.67	
44	Jordan	0.46	52.92	0.66	
45	Bahrain	0.46	52.87	0.65	
46	Brunei Darussalam	0.44	52.38	0.64	
47	Hungary	0.40	51.22	0.63	
48	Georgia	0.30	48.08	0.63	
49	Saudi Arabia	0.25	46.84	0.62	
50	Italy	0.25	46.77	0.61	
51	Greece	0.24	46.50	0.60	
52	Croatia	0.20	45.33	0.60	
53	Namibia	0.19	44.95	0.59	
54	Romania	0.15	43.90	0.58	
55	Rwanda	0.07	41.51	0.57	
56	Sri Lanka	0.07	41.42	0.56	
57	South Africa	0.06	41.05	0.56	
58	Kuwait	0.03	40.44	0.55	
59	Montenegro	0.03	40.37	0.54	
60	Tunisia	–0.05	37.88	0.53	
61	India	–0.06	37.76	0.52	
62	Turkey	–0.06	37.66	0.52	
63	Morocco	–0.08	37.17	0.51	
64	Serbia	–0.09	36.64	0.50	
65	Thailand	–0.11	36.32	0.49	
66	Panama	–0.12	35.95	0.48	
67	Bulgaria	–0.12	35.80	0.48	
68	Trinidad and Tobago	–0.14	35.22	0.47	
69	Senegal	–0.15	34.97	0.46	
70	TFYR of Macedonia	–0.17	34.35	0.45	
71	Brazil	–0.19	33.78	0.44	
72	Jamaica	–0.23	32.55	0.44	
73	Zambia	–0.25	32.03	0.43	
74	Viet Nam	–0.27	31.57	0.42	
75	Bosnia and Herzegovina	–0.29	30.91	0.41	
76	Colombia	–0.31	30.44	0.40	
77	Malawi	–0.33	29.70	0.40	
78	China	–0.34	29.57	0.39	
79	Uganda	–0.34	29.46	0.38	
80	Armenia	–0.34	29.39	0.37	
81	Philippines	–0.35	29.33	0.37	
82	Albania	–0.36	28.92	0.36	
83	Kazakhstan	–0.37	28.67	0.35	
84	Mongolia	–0.39	28.01	0.34	
85	Moldova, Rep.	–0.40	27.67	0.33	
86	Indonesia	–0.41	27.36	0.33	
87	Tanzania, United Rep.	–0.43	26.99	0.32	
88	Ethiopia	–0.44	26.70	0.31	
89	Dominican Republic	–0.46	26.08	0.30	
90	Mexico	–0.47	25.69	0.29	
91	Kenya	–0.49	25.09	0.29	
92	Egypt	–0.50	24.72	0.28	
93	Peru	–0.53	23.90	0.27	
94	Burkina Faso	–0.53	23.86	0.26	
95	Benin	–0.58	22.43	0.25	
96	El Salvador	–0.59	22.12	0.25	
97	Azerbaijan	–0.60	21.80	0.24	
98	Niger	–0.61	21.70	0.23	
99	Côte d'Ivoire	–0.62	21.34	0.22	
100	Madagascar	–0.69	19.13	0.21	
101	Paraguay	–0.69	19.11	0.21	
102	Bangladesh	–0.70	18.96	0.20	
103	Nepal	–0.70	18.93	0.19	
104	Russian Federation	–0.72	18.39	0.18	○
105	Mali	–0.76	17.33	0.17	
106	Lebanon	–0.79	16.45	0.17	
107	Belarus	–0.79	16.43	0.16	○
108	Pakistan	–0.79	16.38	0.15	
109	Togo	–0.80	16.05	0.14	
110	Ukraine	–0.80	16.01	0.13	
111	Argentina	–0.80	15.93	0.13	
112	Algeria	–0.83	15.13	0.12	
113	Mozambique	–0.87	14.10	0.11	
114	Cambodia	–0.92	12.53	0.10	
115	Honduras	–0.95	11.63	0.10	○
116	Iran, Islamic Rep.	–0.95	11.54	0.09	
117	Cameroon	–0.96	11.34	0.08	
118	Guatemala	–0.99	10.59	0.07	
119	Kyrgyzstan	–1.00	10.26	0.06	○
120	Tajikistan	–1.01	9.92	0.06	
121	Ecuador	–1.03	9.36	0.05	○
122	Nigeria	–1.04	8.89	0.04	○
123	Burundi	–1.12	6.65	0.03	
124	Bolivia, Plurinational St.	–1.15	5.76	0.02	○
125	Guinea	–1.17	5.16	0.02	○
126	Yemen	–1.24	3.25	0.01	
127	Zimbabwe	–1.35	0.00	0.00	○

SOURCE: World Bank, *Worldwide Governance Indicators, 2016 update*

NOTE: ● indicates a strength; ○ a weakness

1.2.3 Cost of redundancy dismissal

Sum of notice period and severance pay for redundancy dismissal (in salary weeks, averages for workers with 1, 5, and 10 years of tenure, with a minimum threshold of 8 weeks) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Austria	8.00	100.00	0.86	●
1	Bahrain	8.00	100.00	0.86	●
1	Brunei Darussalam	8.00	100.00	0.86	●
1	Cyprus	8.00	100.00	0.86	●
1	Denmark	8.00	100.00	0.86	●
1	Hong Kong (China)	8.00	100.00	0.86	●
1	Italy	8.00	100.00	0.86	●
1	Japan	8.00	100.00	0.86	●
1	Jordan	8.00	100.00	0.86	●
1	Kenya	8.00	100.00	0.86	●
1	Malta	8.00	100.00	0.86	●
1	New Zealand	8.00	100.00	0.86	●
1	Nigeria	8.00	100.00	0.86	●
1	Oman (2015)	8.00	100.00	0.86	●
1	Romania	8.00	100.00	0.86	●
1	Serbia	8.00	100.00	0.86	●
1	Singapore	8.00	100.00	0.86	●
1	United Arab Emirates	8.00	100.00	0.86	●
1	United States of America	8.00	100.00	0.86	●
20	Bulgaria	8.62	98.77	0.84	●
20	Georgia	8.62	98.77	0.84	●
22	Kazakhstan	8.67	98.68	0.81	●
22	Mongolia	8.67	98.68	0.81	●
22	Norway	8.67	98.68	0.81	
22	Uganda	8.67	98.68	0.81	●
26	Bosnia and Herzegovina	9.22	97.58	0.80	●
27	South Africa	9.33	97.36	0.78	●
27	Tanzania, United Rep.	9.33	97.36	0.78	●
27	United Kingdom	9.33	97.36	0.78	
30	Namibia	9.67	96.70	0.77	●
31	Canada	10.00	96.04	0.76	
32	Guinea	10.06	95.91	0.75	●
33	Finland	10.11	95.82	0.74	
33	Switzerland	10.11	95.82	0.74	
35	Burkina Faso	10.47	95.10	0.73	●
36	Mauritius	10.62	94.81	0.72	
37	Slovenia	10.68	94.70	0.71	
38	Armenia	11.00	94.06	0.71	
39	Montenegro	11.22	93.63	0.70	
40	Peru	11.43	93.21	0.69	●
41	Benin	11.63	92.82	0.68	●
42	France	11.84	92.39	0.67	
43	Australia	12.00	92.08	0.67	
44	Estonia	12.90	90.29	0.66	
45	Rwanda	12.95	90.19	0.65	
46	Iceland	13.00	90.10	0.64	
47	Latvia	13.00	90.10	0.62	
47	TFYR of Macedonia	13.00	90.10	0.62	
47	Ukraine	13.00	90.10	0.62	
50	Côte d'Ivoire	13.07	89.96	0.61	●
51	Togo	13.14	89.81	0.60	●
52	Hungary	13.41	89.28	0.60	
53	Mali	13.65	88.81	0.59	●
54	Jamaica	14.00	88.12	0.58	
55	Niger	14.01	88.10	0.57	
56	Ireland	14.33	87.46	0.56	○
57	Sweden	14.44	87.24	0.56	○
58	Madagascar	14.67	86.80	0.55	●
59	Senegal	14.81	86.52	0.54	
60	Croatia	15.11	85.92	0.52	
60	Lebanon	15.11	85.92	0.52	
62	Brazil	15.45	85.26	0.52	
63	Tajikistan	15.53	85.09	0.51	●
64	India	15.76	84.63	0.50	
65	Netherlands	15.85	84.46	0.49	○
66	Greece	15.89	84.38	0.48	
67	Burundi	15.89	84.38	0.48	
68	Colombia	16.67	82.84	0.47	
69	Malawi	16.67	82.84	0.46	
70	Portugal	17.00	82.18	0.45	○
71	Algeria	17.33	81.52	0.44	
71	Kyrgyzstan	17.33	81.52	0.44	
73	Russian Federation	17.33	81.52	0.43	
74	Spain	17.38	81.42	0.42	○
75	Panama	18.13	79.93	0.41	
76	Costa Rica	18.70	78.81	0.40	
77	Slovakia	18.78	78.66	0.40	
78	Poland	18.78	78.66	0.39	
79	Ethiopia	19.14	77.93	0.38	
80	Cambodia	19.37	77.49	0.37	
81	Belgium	19.67	76.90	0.37	○
82	Cameroon	19.86	76.51	0.36	
83	Czech Republic	20.22	75.80	0.35	○
84	Trinidad and Tobago	20.51	75.22	0.34	
85	Morocco	20.69	74.87	0.33	
86	Uruguay	20.80	74.65	0.33	
87	Albania	20.83	74.60	0.32	
88	Germany	21.56	73.16	0.31	○
89	Tunisia	21.57	73.13	0.30	
90	Azerbaijan	21.67	72.94	0.29	
90	Belarus	21.67	72.94	0.29	
92	Luxembourg	21.67	72.94	0.28	○
93	Botswana	21.69	72.89	0.27	
94	Mexico	22.00	72.28	0.26	
95	Moldova, Rep.	22.60	71.09	0.25	
96	El Salvador	22.86	70.58	0.25	
97	Iran, Islamic Rep.	23.11	70.08	0.24	
98	Qatar	23.22	69.86	0.23	
99	Saudi Arabia	23.74	68.84	0.22	
100	Lithuania	24.56	67.22	0.21	○
101	Viet Nam	24.56	67.22	0.21	
102	Zimbabwe	25.28	65.79	0.20	
103	Dominican Republic	26.18	64.00	0.19	
104	Guatemala	26.96	62.45	0.18	
105	Nepal	27.19	62.00	0.17	
105	Pakistan	27.19	62.00	0.17	
107	Chile	27.40	61.59	0.14	○
107	China	27.40	61.59	0.14	○
107	Korea, Rep.	27.40	61.59	0.14	○
110	Yemen	27.40	61.59	0.13	
111	Israel	27.44	61.50	0.12	○
111	Philippines	27.44	61.50	0.12	○
113	Kuwait	28.12	60.16	0.11	○
114	Paraguay	29.40	57.61	0.10	
115	Malaysia	29.44	57.54	0.10	○
116	Turkey	29.78	56.88	0.09	○
117	Argentina	30.33	55.78	0.07	○
117	Honduras	30.33	55.78	0.07	○
119	Bangladesh	31.00	54.46	0.06	
120	Ecuador	31.78	52.92	0.06	
121	Thailand	36.00	44.55	0.05	○
122	Egypt	36.83	42.90	0.04	○
123	Mozambique	37.51	41.57	0.03	○
124	Zambia	50.56	15.73	0.02	○
125	Indonesia	57.78	1.43	0.02	○
126	Bolivia, Plurinational St. (2014)	82.33	0.00	0.00	○
126	Sri Lanka	58.50	0.00	0.00	○

SOURCE: World Bank, *Ease of Doing Business Index 2017: Equal Opportunity for All*
NOTE: ● indicates a strength; ○ a weakness

1.3.1 Ease of starting a business

Ease of starting a business (distance to frontier) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	New Zealand	99.96	99.96	1.00	●
2	Canada	98.23	98.23	0.99	●
3	Hong Kong (China)	98.20	98.20	0.98	●
4	TFYR of Macedonia	98.14	98.14	0.98	●
5	Azerbaijan	97.74	97.74	0.97	●
6	Singapore	96.49	96.49	0.96	
7	Australia	96.47	96.47	0.95	●
8	Georgia	96.13	96.13	0.94	●
9	Armenia	96.07	96.07	0.94	●
10	Ireland	95.91	95.91	0.93	
11	Korea, Rep.	95.83	95.83	0.92	
12	Jamaica	95.61	95.61	0.91	●
13	Estonia	95.13	95.13	0.90	
14	Sweden	94.64	94.64	0.90	
15	United Kingdom	94.58	94.58	0.89	
16	Belgium	94.49	94.49	0.88	
17	Burundi	94.45	94.45	0.87	●
18	Ukraine	94.40	94.40	0.87	●
19	Norway	94.30	94.30	0.86	
20	Latvia	94.15	94.15	0.84	
20	Netherlands	94.15	94.15	0.84	
22	Denmark	94.07	94.07	0.83	
23	Russian Federation	93.57	93.57	0.83	
24	France	93.27	93.27	0.82	
25	Finland	93.13	93.13	0.81	
26	Lithuania	92.99	92.99	0.80	
27	Kyrgyzstan	92.95	92.95	0.79	●
28	Belarus	92.91	92.91	0.79	●
29	Oman	92.85	92.85	0.77	●
29	Portugal	92.85	92.85	0.77	
31	Iceland	92.64	92.64	0.76	
32	Mongolia	92.55	92.55	0.75	
33	Egypt	92.43	92.43	0.75	●
34	Morocco	92.34	92.34	0.74	●
35	Israel	92.28	92.28	0.73	
36	Panama	92.01	92.01	0.72	
37	Moldova, Rep.	91.96	91.96	0.71	
38	Kazakhstan	91.94	91.94	0.71	
39	Albania	91.73	91.73	0.70	●
40	Serbia	91.67	91.67	0.69	
41	Mauritius	91.65	91.65	0.68	
42	Slovenia	91.42	91.42	0.67	
43	Côte d'Ivoire	91.38	91.38	0.67	●
44	United States of America	91.23	91.23	0.66	
45	Cyprus	91.21	91.21	0.64	
45	United Arab Emirates	91.21	91.21	0.64	
47	Greece	90.70	90.70	0.63	
48	Benin	90.56	90.56	0.63	●
49	Montenegro	90.07	90.07	0.62	
50	Chile	89.84	89.84	0.61	
51	Uruguay	89.79	89.79	0.60	
52	Colombia	89.57	89.57	0.60	
53	Romania	89.48	89.48	0.59	
54	Italy	89.40	89.40	0.58	
55	Luxembourg	88.66	88.66	0.57	
56	Slovakia	88.62	88.62	0.56	
57	Trinidad and Tobago	88.59	88.59	0.56	●
58	Switzerland	88.39	88.39	0.55	○
59	Burkina Faso	88.06	88.06	0.54	●
60	Bahrain	87.82	87.82	0.53	
61	Sri Lanka	87.52	87.52	0.52	
62	Hungary	87.28	87.28	0.52	
63	Rwanda	87.17	87.17	0.51	
64	Thailand	87.01	87.01	0.50	
65	Turkey	86.98	86.98	0.49	
66	Czech Republic	86.86	86.86	0.48	
67	Bulgaria	86.82	86.82	0.48	
68	Brunei Darussalam	86.72	86.72	0.47	
69	Spain	86.61	86.61	0.45	○
69	Tajikistan	86.61	86.61	0.45	
71	Niger	86.16	86.16	0.44	
72	Japan	86.09	86.09	0.44	
73	Senegal	86.07	86.07	0.43	
74	Qatar	86.06	86.06	0.42	
75	Mexico	85.74	85.74	0.41	
76	Croatia	85.56	85.56	0.40	
77	Iran, Islamic Rep.	85.06	85.06	0.40	
78	Peru	85.01	85.01	0.38	
78	Tunisia	85.01	85.01	0.38	
80	Zambia	84.95	84.95	0.37	
81	Jordan	84.62	84.62	0.37	
82	Poland	84.22	84.22	0.36	○
83	Mali	84.12	84.12	0.35	
84	Nepal	83.77	83.77	0.34	
85	Austria	83.72	83.72	0.33	○
86	Malaysia	83.67	83.67	0.33	
87	Madagascar	83.48	83.48	0.32	
88	Germany	83.42	83.42	0.31	○
89	Dominican Republic	83.34	83.34	0.30	
90	Kenya	83.13	83.13	0.29	
91	Guatemala	82.31	82.31	0.29	
92	Viet Nam	81.76	81.76	0.28	
93	Bangladesh	81.74	81.74	0.27	
94	Togo	81.71	81.71	0.26	
95	Costa Rica	81.57	81.57	0.25	
96	China	81.02	81.02	0.25	
97	El Salvador	80.70	80.70	0.24	
98	South Africa	80.47	80.47	0.23	○
99	Malta	80.21	80.21	0.22	○
100	Guinea	80.20	80.20	0.21	
101	Mozambique	79.86	79.86	0.21	
102	Tanzania, United Rep.	79.14	79.14	0.20	
103	Nigeria	78.62	78.62	0.19	
104	Lebanon	78.45	78.45	0.18	
105	Pakistan	77.88	77.88	0.17	
106	Algeria	77.54	77.54	0.17	
107	Paraguay	77.53	77.53	0.16	
108	Saudi Arabia	77.09	77.09	0.15	○
109	Honduras	77.02	77.02	0.14	
110	Cameroon	76.99	76.99	0.13	
111	Malawi	76.73	76.73	0.13	
112	Indonesia	76.43	76.43	0.12	
113	Botswana	76.21	76.21	0.11	○
114	India	74.31	74.31	0.10	○
115	Argentina	73.56	73.56	0.10	○
116	Yemen	71.59	71.59	0.09	
117	Uganda	71.30	71.30	0.08	
118	Ecuador	70.61	70.61	0.07	
119	Namibia	68.87	68.87	0.06	○
120	Philippines	68.86	68.86	0.06	○
121	Kuwait	66.77	66.77	0.05	○
122	Bosnia and Herzegovina	65.09	65.09	0.04	○
123	Brazil	65.04	65.04	0.03	○
124	Bolivia, Plurinational St.	62.94	62.94	0.02	○
125	Ethiopia	55.96	55.96	0.02	○
126	Cambodia	54.93	54.93	0.01	○
127	Zimbabwe	49.13	49.13	0.00	○

SOURCE: World Bank, *Ease of Doing Business Index 2017: Equal Opportunity for All*

NOTE: ● indicates a strength; ○ a weakness

1.3.2 Ease of resolving insolvency

Ease of resolving insolvency (distance to frontier) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Finland	93.89	93.89	1.00	●
2	Japan	93.34	93.34	0.99	●
3	Germany	92.28	92.28	0.98	●
4	Korea, Rep.	89.22	89.22	0.98	●
5	United States of America	89.19	89.19	0.97	
6	Norway	89.06	89.06	0.96	●
7	Portugal	85.24	85.24	0.95	●
8	Denmark	84.86	84.86	0.94	
9	Belgium	84.32	84.32	0.94	●
10	Netherlands	84.00	84.00	0.93	
11	Slovenia	83.97	83.97	0.92	●
12	United Kingdom	82.04	82.04	0.91	
13	Iceland	81.70	81.70	0.90	
14	Canada	81.43	81.43	0.90	
15	Cyprus	81.38	81.38	0.89	
16	Ireland	80.01	80.01	0.88	
17	Spain	79.62	79.62	0.87	
18	Sweden	79.44	79.44	0.87	
19	Austria	78.93	78.93	0.86	
20	Australia	78.73	78.73	0.85	
21	Thailand	77.08	77.08	0.84	●
22	France	76.62	76.62	0.83	
23	Italy	76.59	76.59	0.83	
24	Czech Republic	76.42	76.42	0.82	
25	Poland	76.37	76.37	0.81	●
26	Hong Kong (China)	75.06	75.06	0.80	
27	Singapore	74.31	74.31	0.79	
28	Mexico	73.11	73.11	0.79	
29	Israel	72.75	72.75	0.78	
30	TFYR of Macedonia	72.38	72.38	0.77	●
31	Colombia	71.74	71.74	0.76	
32	New Zealand	71.43	71.43	0.75	
33	Slovakia	70.53	70.53	0.75	
34	Kazakhstan	69.17	69.17	0.74	●
35	Jamaica	69.15	69.15	0.73	●
36	Mauritius	69.06	69.06	0.72	
37	Montenegro	68.37	68.37	0.71	
38	Bosnia and Herzegovina	66.93	66.93	0.71	●
39	Estonia	65.46	65.46	0.70	
40	Albania	64.96	64.96	0.69	●
41	Latvia	63.95	63.95	0.68	
42	Switzerland	62.61	62.61	0.67	
43	Malaysia	62.49	62.49	0.67	
44	Serbia	59.66	59.66	0.66	
45	Bulgaria	59.38	59.38	0.65	
46	Romania	59.16	59.16	0.64	
47	South Africa	57.94	57.94	0.63	
48	Russian Federation	56.69	56.69	0.63	
49	Greece	56.66	56.66	0.62	
50	China	55.82	55.82	0.61	
51	Croatia	55.62	55.62	0.60	
52	Chile	55.51	55.51	0.60	
53	Philippines	55.24	55.24	0.59	
54	Brunei Darussalam	55.11	55.11	0.58	
55	Tunisia	54.53	54.53	0.57	
56	Moldova, Rep.	52.61	52.61	0.56	
57	Uruguay	52.26	52.26	0.56	
58	Hungary	51.25	51.25	0.55	
59	Botswana	50.53	50.53	0.54	
60	Mozambique	49.61	49.61	0.53	●
61	Lithuania	49.23	49.23	0.52	
62	Brazil	49.15	49.15	0.52	
63	Côte d'Ivoire	49.13	49.13	0.51	●
64	Belarus	49.08	49.08	0.50	
65	Trinidad and Tobago	48.74	48.74	0.49	
66	Cambodia	48.10	48.10	0.48	
67	Rwanda	47.85	47.85	0.48	
68	Algeria	47.67	47.67	0.47	
69	Sri Lanka	46.73	46.73	0.46	
70	Indonesia	46.46	46.46	0.45	
71	Armenia	46.06	46.06	0.44	
72	Peru	45.85	45.85	0.44	
73	El Salvador	45.83	45.83	0.43	
74	Luxembourg	45.40	45.40	0.42	
75	Zambia	45.36	45.36	0.41	
76	Malta	45.35	45.35	0.40	
77	Pakistan	45.01	45.01	0.40	
78	Azerbaijan	44.77	44.77	0.39	
79	Togo	44.69	44.69	0.38	
80	Bahrain	44.66	44.66	0.37	
81	Nepal	44.64	44.64	0.37	
82	Mongolia	43.59	43.59	0.36	
83	Kenya	43.39	43.39	0.35	
84	Oman	42.65	42.65	0.34	
85	Bolivia, Plurinational St.	42.28	42.28	0.33	
86	Namibia	41.96	41.96	0.33	
87	Argentina	41.87	41.87	0.32	
88	Mali	41.46	41.46	0.31	
89	Tanzania, United Rep.	41.04	41.04	0.30	
90	Senegal	40.74	40.74	0.29	
91	Paraguay	40.70	40.70	0.29	
92	United Arab Emirates	40.61	40.61	0.28	○
93	Niger	40.36	40.36	0.27	
94	Georgia	40.02	40.02	0.26	
95	Costa Rica	39.62	39.62	0.25	
96	Kuwait	39.58	39.58	0.25	
97	Egypt	39.51	39.51	0.24	
98	Uganda	39.40	39.40	0.23	
99	Burkina Faso	39.25	39.25	0.22	
100	Guinea	38.84	38.84	0.21	
101	Benin	38.72	38.72	0.21	
102	Qatar	38.23	38.23	0.20	
103	Ethiopia	37.60	37.60	0.19	
104	Cameroon	36.63	36.63	0.18	
105	Viet Nam	35.08	35.08	0.17	
106	Turkey	34.98	34.98	0.17	○
107	Madagascar	34.24	34.24	0.16	
108	Kyrgyzstan	34.08	34.08	0.15	
109	Morocco	33.89	33.89	0.14	○
110	Panama	33.36	33.36	0.13	
111	India	32.75	32.75	0.13	○
112	Honduras	31.66	31.66	0.12	
113	Nigeria	30.60	30.60	0.11	
114	Burundi	30.52	30.52	0.10	
115	Jordan	30.38	30.38	0.10	○
116	Lebanon	30.03	30.03	0.09	○
117	Tajikistan	28.70	28.70	0.08	
118	Zimbabwe	28.46	28.46	0.07	
119	Guatemala	27.52	27.52	0.06	
120	Ukraine	27.50	27.50	0.06	○
121	Bangladesh	27.02	27.02	0.05	
122	Yemen	26.65	26.65	0.04	
123	Iran, Islamic Rep.	25.25	25.25	0.03	○
124	Ecuador	25.17	25.17	0.02	○
125	Dominican Republic	23.55	23.55	0.02	○
126	Malawi	22.25	22.25	0.01	○
127	Saudi Arabia	0.00	0.00	0.00	○

SOURCE: World Bank, *Ease of Doing Business Index 2017: Equal Opportunity for All*
NOTE: ● indicates a strength; ○ a weakness

1.3.3 Ease of paying taxes

Ease of paying taxes (distance to frontier) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Qatar	99.44	99.44	0.99	●
1	United Arab Emirates	99.44	99.44	0.99	●
3	Hong Kong (China)	98.69	98.69	0.98	●
4	Bahrain	94.44	94.44	0.98	●
5	Ireland	94.40	94.40	0.97	●
6	Kuwait	92.48	92.48	0.96	●
7	Denmark	92.11	92.11	0.95	
8	Singapore	91.85	91.85	0.94	
9	TFYR of Macedonia	91.67	91.67	0.94	●
10	United Kingdom	90.74	90.74	0.93	
11	New Zealand	90.71	90.71	0.92	
12	Oman	90.60	90.60	0.91	●
13	Finland	90.23	90.23	0.90	
14	Latvia	89.79	89.79	0.90	●
15	Luxembourg	88.92	88.92	0.89	
16	Canada	88.86	88.86	0.88	
17	Switzerland	88.49	88.49	0.87	
18	Netherlands	88.07	88.07	0.87	
19	Estonia	88.04	88.04	0.86	
20	Georgia	87.43	87.43	0.85	●
21	Korea, Rep.	86.56	86.56	0.84	
22	Slovenia	86.55	86.55	0.83	
23	Australia	85.60	85.60	0.83	
24	Norway	85.53	85.53	0.82	
25	Lithuania	85.44	85.44	0.81	
26	Sweden	85.28	85.28	0.80	
27	Iceland	84.88	84.88	0.79	
28	Moldova, Rep.	84.76	84.76	0.79	●
29	Malta	84.59	84.59	0.78	
30	Cyprus	84.45	84.45	0.77	
31	Mongolia	84.19	84.19	0.76	
32	United States of America	83.85	83.85	0.75	
33	Spain	83.80	83.80	0.75	
34	Portugal	83.75	83.75	0.74	
35	Azerbaijan	83.52	83.52	0.73	●
36	Morocco	83.51	83.51	0.72	●
37	Austria	83.39	83.39	0.71	
38	Mauritius	82.96	82.96	0.70	
38	Russian Federation	82.96	82.96	0.70	
40	Poland	82.73	82.73	0.69	
41	Germany	82.10	82.10	0.68	
42	Croatia	81.74	81.74	0.67	
43	Romania	81.64	81.64	0.67	
44	South Africa	81.09	81.09	0.66	
45	Czech Republic	80.69	80.69	0.65	
46	Botswana	80.58	80.58	0.64	
47	Slovakia	80.57	80.57	0.63	
48	Montenegro	80.42	80.42	0.63	
49	Zambia	80.16	80.16	0.62	●
50	Rwanda	79.69	79.69	0.61	
51	Kazakhstan	79.54	79.54	0.60	
52	Malaysia	79.20	79.20	0.60	
53	Costa Rica	78.98	78.98	0.59	
54	France	78.72	78.72	0.58	
55	Greece	78.22	78.22	0.57	
56	Belgium	77.31	77.31	0.56	
57	Lebanon	77.17	77.17	0.56	
58	Saudi Arabia	77.04	77.04	0.55	
59	Japan	77.03	77.03	0.54	
60	Namibia	74.97	74.97	0.53	
61	Uganda	74.71	74.71	0.52	
62	Hungary	74.46	74.46	0.52	
63	Serbia	74.36	74.36	0.51	
64	Jordan	73.94	73.94	0.50	
65	Bulgaria	72.81	72.81	0.49	
66	Ukraine	72.72	72.72	0.48	
67	Armenia	72.49	72.49	0.48	
68	Brunei Darussalam	72.43	72.43	0.47	
69	Ethiopia	72.06	72.06	0.46	
70	Yemen	71.64	71.64	0.45	●
71	Guatemala	71.55	71.55	0.44	
72	Israel	71.00	71.00	0.44	○
73	Albania	70.96	70.96	0.43	
74	Belarus	70.40	70.40	0.42	
75	Iran, Islamic Rep.	69.79	69.79	0.41	
76	Malawi	69.58	69.58	0.40	
77	Indonesia	69.25	69.25	0.40	
78	Peru	69.04	69.04	0.39	
79	Tunisia	68.96	68.96	0.38	
80	Thailand	68.68	68.68	0.37	
81	Mozambique	67.11	67.11	0.37	
82	Uruguay	66.08	66.08	0.36	
83	Mexico	65.81	65.81	0.35	
84	Philippines	65.74	65.74	0.34	
85	Jamaica	65.18	65.18	0.33	
86	Madagascar	64.80	64.80	0.33	
87	Chile	63.85	63.85	0.32	
88	Burundi	62.20	62.20	0.31	
89	Cambodia	61.97	61.97	0.30	
90	Kenya	61.72	61.72	0.29	
91	Italy	61.65	61.65	0.29	○
92	Turkey	60.83	60.83	0.28	
93	Dominican Republic	60.70	60.70	0.27	
94	China	60.46	60.46	0.26	
95	Bosnia and Herzegovina	60.08	60.08	0.25	
96	Ecuador	59.25	59.25	0.25	
97	Colombia	58.91	58.91	0.24	
98	Tajikistan	58.79	58.79	0.23	
99	Nepal	58.05	58.05	0.22	
100	Mali	57.50	57.50	0.21	
101	Trinidad and Tobago	57.33	57.33	0.21	
102	Kyrgyzstan	56.43	56.43	0.20	
103	Burkina Faso	55.77	55.77	0.19	
104	Bangladesh	55.56	55.56	0.18	
105	Honduras	54.97	54.97	0.17	
106	Paraguay	54.64	54.64	0.17	
107	Tanzania, United Rep.	54.13	54.13	0.16	
108	Algeria	53.99	53.99	0.15	
109	Pakistan	53.40	53.40	0.14	
110	Sri Lanka	53.16	53.16	0.13	○
111	Egypt	51.96	51.96	0.13	
112	Zimbabwe	51.15	51.15	0.12	
113	Niger	50.19	50.19	0.11	
114	El Salvador	49.51	49.51	0.10	
115	Viet Nam	49.39	49.39	0.10	○
116	Togo	48.22	48.22	0.09	
117	Panama	48.09	48.09	0.08	
118	India	46.58	46.58	0.07	○
119	Benin	44.61	44.61	0.06	
120	Senegal	43.70	43.70	0.06	○
121	Côte d'Ivoire	43.35	43.35	0.05	○
122	Argentina	39.76	39.76	0.04	○
123	Cameroon	35.87	35.87	0.03	○
124	Brazil	33.03	33.03	0.02	○
125	Nigeria	28.09	28.09	0.02	○
126	Guinea	24.28	24.28	0.01	○
127	Bolivia, Plurinational St.	21.41	21.41	0.00	○

SOURCE: World Bank, *Ease of Doing Business Index 2017: Equal Opportunity for All*
NOTE: ● indicates a strength; ○ a weakness

2.1.1 Expenditure on education

Government expenditure on education (% of GDP) | 2013

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Botswana (2009)	9.63	100.00	1.00	●
2	Denmark	8.61	88.03	0.99	●
3	Zimbabwe (2014)	8.43	85.90	0.98	●
4	Namibia (2010)	8.35	84.96	0.97	●
5	Malta	8.29	84.27	0.97	●
6	Iceland	7.81	78.65	0.96	
7	Sweden	7.72	77.56	0.95	
8	Costa Rica (2015)	7.59	76.05	0.94	●
9	Moldova, Rep. (2014)	7.46	74.59	0.93	●
10	Norway	7.37	73.49	0.92	
11	Bolivia, Plurinational St. (2014)	7.29	72.49	0.91	●
12	Senegal (2014)	7.22	71.76	0.91	●
13	Finland	7.16	71.00	0.90	
14	Niger (2014)	6.72	65.81	0.89	●
15	Mozambique	6.48	63.05	0.88	●
16	Cyprus	6.44	62.58	0.87	
17	Belgium (2011)	6.38	61.86	0.86	
18	New Zealand (2014)	6.35	61.52	0.85	
19	Tunisia (2012)	6.25	60.36	0.84	●
20	South Africa (2014)	6.06	58.09	0.84	●
21	Brazil	6.00	57.40	0.83	●
22	Ukraine (2014)	5.95	56.85	0.82	
23	Honduras	5.87	55.96	0.81	●
24	Israel	5.86	55.76	0.80	
25	United Kingdom (2014)	5.75	54.51	0.79	
26	Viet Nam	5.65	53.35	0.78	●
27	Malawi (2015)	5.61	52.84	0.78	●
28	Netherlands	5.61	52.83	0.77	
29	Austria	5.56	52.33	0.76	
30	Argentina (2014)	5.55	52.12	0.75	●
31	Kyrgyzstan (2014)	5.53	51.94	0.74	●
32	France	5.51	51.63	0.73	
33	Slovenia	5.49	51.43	0.72	
34	Jamaica (2015)	5.44	50.91	0.72	●
35	Burundi	5.41	50.57	0.71	●
36	Ireland	5.34	49.70	0.70	
37	Togo (2015)	5.33	49.62	0.69	●
38	Portugal	5.28	48.96	0.68	
39	Kenya (2015)	5.28	48.94	0.67	
40	Canada (2011)	5.27	48.92	0.66	
41	Australia	5.27	48.88	0.66	
42	Morocco (2009)	5.26	48.76	0.65	
43	Tajikistan (2015)	5.23	48.43	0.64	●
44	Mexico (2012)	5.17	47.65	0.63	
45	Saudi Arabia (2008)	5.14	47.32	0.62	
46	Switzerland	5.07	46.49	0.61	
47	Rwanda	5.03	46.03	0.60	
48	Oman	5.01	45.81	0.59	
49	Malaysia (2015)	4.98	45.47	0.59	
50	Mauritius (2015)	4.96	45.28	0.58	
51	Paraguay (2012)	4.96	45.27	0.57	●
52	Belarus (2015)	4.95	45.11	0.56	
53	Germany	4.94	45.06	0.55	
54	United States of America	4.94	45.05	0.54	
55	Poland	4.94	45.02	0.53	
56	Ecuador (2015)	4.92	44.77	0.53	
57	Latvia	4.91	44.71	0.52	
58	Estonia	4.82	43.57	0.51	○
59	Turkey	4.77	43.06	0.50	
60	Chile (2014)	4.76	42.94	0.49	
61	Côte d'Ivoire (2014)	4.72	42.42	0.48	●
62	Korea, Rep. (2012)	4.62	41.23	0.47	
63	Lithuania	4.61	41.17	0.47	
64	Mongolia (2011)	4.61	41.13	0.46	
65	Croatia	4.59	40.87	0.45	
66	Yemen (2008)	4.56	40.56	0.44	●
67	Ethiopia	4.50	39.83	0.43	
68	Colombia (2015)	4.49	39.75	0.42	
69	Uruguay (2011)	4.36	38.15	0.41	
70	Algeria (2008)	4.34	37.94	0.41	
71	Spain	4.30	37.56	0.40	○
72	Benin (2015)	4.26	37.05	0.39	
73	Hungary	4.23	36.67	0.38	
74	Serbia (2014)	4.18	36.10	0.37	
75	Italy	4.17	35.92	0.36	○
76	Luxembourg (2012)	4.14	35.64	0.35	
77	Thailand	4.13	35.49	0.34	
78	Czech Republic	4.11	35.30	0.34	○
79	Slovakia	4.11	35.22	0.33	○
80	Bulgaria	4.07	34.83	0.32	○
81	Peru (2015)	3.92	33.05	0.31	
82	Burkina Faso (2015)	3.91	32.94	0.30	
83	Russian Federation (2012)	3.86	32.34	0.29	
84	India	3.84	32.13	0.28	
85	Japan (2014)	3.77	31.31	0.28	○
86	Egypt (2008)	3.76	31.19	0.27	
87	Nepal (2015)	3.75	31.03	0.26	
88	Brunei Darussalam (2016)	3.69	30.40	0.25	
89	Mali (2014)	3.64	29.74	0.24	
90	Qatar (2014)	3.55	28.70	0.23	
91	Albania	3.54	28.57	0.22	
92	Tanzania, United Rep. (2014)	3.48	27.91	0.22	
93	El Salvador (2014)	3.45	27.53	0.21	
94	Indonesia (2014)	3.29	25.66	0.20	
95	Hong Kong (China) (2015)	3.26	25.37	0.19	○
96	Guinea (2014)	3.21	24.74	0.18	
97	Panama (2011)	3.19	24.47	0.17	
98	Cameroon	3.03	22.60	0.16	
99	Guatemala (2015)	2.95	21.73	0.16	
100	Romania (2012)	2.95	21.64	0.15	○
101	Iran, Islamic Rep. (2015)	2.92	21.33	0.14	
102	Singapore	2.91	21.24	0.13	○
103	Armenia (2015)	2.80	19.97	0.12	○
104	Kazakhstan (2015)	2.79	19.80	0.11	○
105	Pakistan (2015)	2.66	18.29	0.10	
106	Philippines (2009)	2.65	18.20	0.09	○
107	Bahrain (2012)	2.64	18.11	0.09	○
108	Azerbaijan (2014)	2.63	17.99	0.08	○
109	Lebanon	2.57	17.26	0.07	○
110	Sri Lanka (2015)	2.18	12.69	0.06	○
111	Bangladesh (2015)	2.18	12.65	0.05	
112	Madagascar	2.08	11.49	0.04	
113	Dominican Republic (2007)	2.05	11.15	0.03	○
114	Georgia (2012)	1.98	10.35	0.03	○
115	Cambodia (2014)	1.90	9.39	0.02	○
116	Uganda (2014)	1.70	7.09	0.01	○
117	Zambia (2008)	1.10	0.00	0.00	○
n/a	Bosnia and Herzegovina	n/a	n/a	n/a	
n/a	China	n/a	n/a	n/a	
n/a	Greece	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*
NOTE: ● indicates a strength; ○ a weakness

2.1.2 Government expenditure on education per pupil, secondary

Government expenditure per pupil, secondary (% of GDP per capita) | 2013

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Niger (2014)	72.56	100.00	1.00	●
2	Mozambique	52.02	69.62	0.99	●
3	Botswana (2007)	41.95	54.72	0.98	●
4	Malta	40.60	52.73	0.97	●
5	Moldova, Rep. (2015)	39.31	50.81	0.96	●
6	Rwanda	38.98	50.34	0.95	●
7	Cyprus	37.92	48.76	0.94	●
8	Belgium (2011)	37.58	48.25	0.93	●
9	Morocco (2012)	36.13	46.11	0.92	●
10	Zimbabwe	35.13	44.63	0.91	●
11	Finland (2011)	34.70	44.00	0.90	
12	Mauritius (2015)	31.16	38.76	0.90	●
13	Burundi	30.96	38.47	0.89	●
14	Portugal	30.34	37.55	0.88	●
15	Denmark	28.23	34.42	0.87	
16	Senegal (2011)	27.56	33.44	0.86	●
17	Austria	27.52	33.38	0.85	
18	Côte d'Ivoire (2014)	27.41	33.22	0.84	●
19	Jamaica (2015)	27.15	32.83	0.83	●
20	France	26.83	32.36	0.82	
21	Costa Rica (2015)	26.70	32.17	0.81	
22	Ukraine (2014)	26.25	31.50	0.80	
23	Switzerland (2012)	26.08	31.25	0.79	
24	Ireland (2012)	25.98	31.10	0.78	
25	Slovenia	25.92	31.02	0.77	
26	Norway (2011)	25.79	30.81	0.76	
27	Ethiopia (2012)	25.68	30.66	0.75	●
28	Latvia	25.51	30.40	0.74	
29	Japan (2014)	25.12	29.83	0.73	
30	Malawi (2015)	25.08	29.77	0.72	●
31	Kenya (2012)	24.87	29.45	0.71	
32	Sweden	24.64	29.12	0.70	
33	Netherlands	24.40	28.76	0.70	
34	Tunisia (2008)	24.36	28.70	0.69	●
35	Germany	23.69	27.72	0.68	
36	Czech Republic	23.67	27.68	0.67	
37	Korea, Rep.	23.37	27.24	0.66	
38	Italy	23.32	27.16	0.65	
39	United Kingdom (2014)	23.14	26.89	0.64	○
40	Estonia	23.10	26.84	0.63	
41	United States of America	22.66	26.20	0.62	
42	Spain	22.47	25.91	0.61	
43	Argentina (2014)	22.22	25.54	0.60	
44	Bulgaria	22.15	25.44	0.59	
45	Poland	22.14	25.43	0.58	
46	Mali (2014)	22.06	25.31	0.57	●
47	New Zealand (2014)	21.97	25.18	0.56	
48	Brazil	21.63	24.67	0.55	
49	Oman	21.48	24.44	0.54	
50	South Africa (2012)	20.89	23.57	0.53	
51	Hong Kong (China) (2015)	20.35	22.78	0.52	
52	Brunei Darussalam (2016)	20.13	22.45	0.51	
53	Slovakia	19.71	21.83	0.50	
54	Cameroon (2012)	19.70	21.81	0.50	●
55	Luxembourg	19.40	21.36	0.49	
56	Kazakhstan (2015)	19.16	21.01	0.48	
57	Bolivia, Plurinational St. (2014)	18.43	19.93	0.47	
58	Malaysia (2015)	18.39	19.87	0.46	
59	Iceland	18.35	19.81	0.45	○
60	Canada (2011)	18.33	19.78	0.44	○
61	Saudi Arabia (2007)	18.23	19.64	0.43	
62	Honduras	18.15	19.51	0.42	
63	Thailand	17.83	19.05	0.41	
64	Lithuania	17.83	19.05	0.40	
65	Kuwait (2014)	17.62	18.74	0.39	
66	Australia	16.90	17.67	0.38	○
67	India	16.81	17.54	0.37	
68	Singapore (2010)	16.68	17.35	0.36	○
69	Mexico	16.57	17.19	0.35	
70	Paraguay (2012)	16.55	17.16	0.34	
71	Jordan (2011)	16.47	17.04	0.33	
72	Hungary	16.21	16.65	0.32	
73	Burkina Faso (2015)	16.20	16.63	0.31	
74	Israel	16.13	16.53	0.30	○
75	Colombia (2015)	16.00	16.34	0.30	
76	Namibia (2008)	15.95	16.27	0.29	
77	Togo (2011)	15.64	15.81	0.28	
78	Mongolia (2010)	15.37	15.40	0.27	
79	Pakistan (2015)	15.24	15.22	0.26	
80	Chile (2014)	15.21	15.17	0.25	○
81	Iran, Islamic Rep. (2015)	15.12	15.04	0.24	
82	Armenia (2014)	15.00	14.86	0.23	
83	Dominican Republic (2015)	14.98	14.83	0.22	
84	Turkey	14.77	14.52	0.21	
85	Georgia (2008)	14.24	13.74	0.20	
86	Peru (2015)	14.12	13.56	0.19	
87	Romania	13.43	12.54	0.18	○
88	Serbia (2011)	13.06	11.99	0.17	○
89	Yemen (2011)	12.61	11.33	0.16	
90	Tanzania, United Rep. (2010)	12.31	10.88	0.15	
91	Guinea (2014)	12.03	10.47	0.14	
92	Benin (2015)	11.42	9.56	0.13	
93	Nepal (2015)	11.07	9.05	0.12	
94	Uganda (2014)	10.73	8.55	0.11	
95	Qatar (2009)	10.50	8.20	0.10	○
96	El Salvador (2014)	10.38	8.02	0.10	
97	Indonesia (2014)	9.93	7.36	0.09	○
98	Panama (2011)	9.21	6.29	0.08	
99	Philippines (2008)	9.13	6.18	0.07	○
100	Bangladesh (2015)	8.43	5.14	0.06	
101	Madagascar (2012)	8.39	5.08	0.05	
102	Sri Lanka	6.28	1.97	0.04	○
103	Lebanon	6.04	1.61	0.03	○
104	Albania	5.87	1.35	0.02	○
105	Guatemala (2014)	5.59	0.94	0.01	○
106	Ecuador (2015)	4.95	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Bahrain	n/a	n/a	n/a	
n/a	Belarus	n/a	n/a	n/a	
n/a	Bosnia and Herzegovina	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	China	n/a	n/a	n/a	
n/a	Croatia	n/a	n/a	n/a	
n/a	Egypt	n/a	n/a	n/a	
n/a	Greece	n/a	n/a	n/a	
n/a	Kyrgyzstan	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Russian Federation	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	Uruguay	n/a	n/a	n/a	
n/a	Viet Nam	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*
NOTE: ● indicates a strength; ○ a weakness

2.1.3 School life expectancy

School life expectancy, primary to tertiary education (years) | 2014

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Australia	20.47	100.00	1.00	●
2	Belgium	19.91	96.30	0.99	●
3	Iceland (2013)	19.63	94.48	0.98	●
4	Finland (2015)	19.34	92.56	0.97	●
5	New Zealand	19.23	91.81	0.96	●
6	Denmark	19.19	91.55	0.96	●
7	Ireland	19.00	90.29	0.95	●
8	Sweden	18.22	85.18	0.94	
9	Netherlands (2012)	18.12	84.48	0.93	
10	United Kingdom	17.94	83.29	0.92	
11	Spain (2015)	17.88	82.95	0.91	●
12	Greece	17.78	82.26	0.90	●
13	Norway (2015)	17.68	81.61	0.89	
14	Slovenia	17.35	79.41	0.89	●
15	Germany (2015)	17.29	79.00	0.88	
16	Argentina	17.29	79.00	0.87	●
17	Czech Republic	16.81	75.88	0.86	
18	Korea, Rep. (2013)	16.59	74.40	0.85	
19	Portugal	16.57	74.24	0.84	
20	United States of America	16.54	74.06	0.83	
21	Lithuania	16.52	73.96	0.82	●
22	Chile (2015)	16.48	73.67	0.82	
23	Italy	16.42	73.27	0.81	
24	Turkey (2013)	16.39	73.06	0.80	
25	Poland (2013)	16.37	72.98	0.79	
26	Estonia (2015)	16.35	72.83	0.78	
27	France	16.27	72.26	0.77	
28	Saudi Arabia	16.11	71.25	0.76	●
29	Latvia	16.05	70.87	0.75	
30	Switzerland	16.04	70.78	0.75	
31	Austria (2015)	16.04	70.78	0.74	
32	Thailand (2015)	16.03	70.71	0.73	
33	Israel	16.00	70.50	0.72	
34	Belarus (2015)	15.70	68.51	0.71	
35	Albania (2015)	15.52	67.37	0.70	●
36	Uruguay (2010)	15.51	67.29	0.69	
37	Georgia (2015)	15.44	66.80	0.68	
38	Hungary (2015)	15.37	66.35	0.68	
39	Japan	15.36	66.28	0.67	
40	Ukraine	15.31	65.93	0.66	
41	Brazil	15.27	65.71	0.65	
42	Croatia	15.26	65.62	0.64	
43	Costa Rica (2015)	15.22	65.35	0.63	
44	Montenegro (2010)	15.13	64.79	0.62	
45	Ecuador (2013)	15.11	64.60	0.61	●
46	Malta (2015)	15.05	64.22	0.61	
47	Mongolia (2015)	15.01	63.98	0.60	
48	Kazakhstan (2016)	15.01	63.96	0.59	
49	Slovakia	14.96	63.68	0.58	
50	Russian Federation	14.95	63.60	0.57	
51	Bulgaria (2015)	14.94	63.51	0.56	
52	Romania (2015)	14.93	63.48	0.55	
53	Iran, Islamic Rep. (2015)	14.93	63.43	0.54	
54	Mauritius (2015)	14.89	63.19	0.54	
55	Tunisia (2015)	14.75	62.29	0.53	
56	Brunei Darussalam (2015)	14.74	62.20	0.52	
57	Cyprus (2015)	14.57	61.07	0.51	
58	Serbia (2015)	14.55	60.95	0.50	
59	Colombia (2015)	14.41	60.02	0.49	
60	Algeria (2011)	14.36	59.67	0.48	●
61	Oman (2015)	14.14	58.20	0.47	
62	China (2015)	14.13	58.14	0.46	
63	Sri Lanka (2013)	13.99	57.22	0.46	
64	Luxembourg (2012)	13.86	56.41	0.45	
65	Peru (2010)	13.39	53.26	0.44	
66	Mexico	13.30	52.69	0.43	
67	Armenia (2015)	13.19	51.97	0.42	
68	Kuwait (2013)	13.17	51.86	0.41	
69	El Salvador	13.17	51.83	0.40	
70	Dominican Republic	13.17	51.83	0.39	
71	Egypt	13.10	51.36	0.39	
72	Kyrgyzstan	13.09	51.29	0.38	
73	Qatar (2011)	13.08	51.21	0.37	
74	Malaysia (2015)	12.93	50.25	0.36	
75	Indonesia	12.87	49.84	0.35	
76	TFYR of Macedonia	12.80	49.41	0.34	
77	Panama (2013)	12.80	49.38	0.33	
78	Singapore (2009)	12.79	49.35	0.32	○
79	South Africa (2012)	12.78	49.24	0.32	
80	Jordan (2012)	12.76	49.15	0.31	
81	Philippines (2013)	12.75	49.06	0.30	
82	Paraguay (2010)	12.32	46.21	0.29	
83	Nepal (2015)	12.19	45.37	0.28	
84	Cameroon (2015)	12.15	45.12	0.27	
85	Benin (2013)	12.14	45.01	0.26	
86	Morocco (2012)	12.05	44.47	0.25	
87	Botswana (2007)	12.05	44.47	0.25	
88	Togo (2011)	11.97	43.89	0.24	
89	India	11.88	43.35	0.23	
90	Moldova, Rep. (2015)	11.63	41.70	0.22	
91	Tajikistan (2013)	11.26	39.24	0.21	
92	Honduras	11.24	39.08	0.20	
93	Lebanon (2015)	11.13	38.37	0.19	
94	Kenya (2009)	11.07	38.00	0.18	
95	Rwanda (2013)	11.03	37.73	0.18	
96	Malawi (2011)	10.72	35.68	0.17	
97	Guatemala (2013)	10.72	35.67	0.16	
98	Burundi (2013)	10.65	35.19	0.15	
99	Cambodia (2008)	10.52	34.32	0.14	
100	Madagascar	10.50	34.24	0.13	
101	Zimbabwe (2013)	10.31	32.99	0.12	
102	Uganda (2011)	10.01	30.99	0.11	
103	Bangladesh (2011)	9.86	29.98	0.11	
104	Mozambique	9.57	28.07	0.10	
105	Côte d'Ivoire (2015)	9.20	25.61	0.09	
106	Yemen (2011)	8.99	24.24	0.08	
107	Senegal (2015)	8.98	24.21	0.07	○
108	Guinea	8.82	23.09	0.06	
109	Nigeria (2011)	8.63	21.86	0.05	
110	Ethiopia (2012)	8.44	20.62	0.04	
111	Tanzania, United Rep. (2013)	8.36	20.07	0.04	
112	Pakistan (2015)	8.24	19.32	0.03	○
113	Mali (2011)	7.72	15.86	0.02	○
114	Burkina Faso (2013)	7.69	15.69	0.01	○
115	Niger (2012)	5.32	0.00	0.00	○
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Bahrain	n/a	n/a	n/a	
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Bosnia and Herzegovina	n/a	n/a	n/a	
n/a	Canada	n/a	n/a	n/a	
n/a	Hong Kong (China)	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	Viet Nam	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*
NOTE: ● indicates a strength; ○ a weakness

2.1.4 Assessment in reading, mathematics, and science

PISA average scales in reading, mathematics, and science | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Singapore	551.62	100.00	1.00	●
2	Hong Kong (China)	532.63	91.19	0.99	●
3	Japan	528.93	89.48	0.97	●
4	Estonia	524.29	87.32	0.96	●
5	Canada	523.34	86.88	0.94	
6	Finland	522.72	86.60	0.93	
7	Korea, Rep.	519.12	84.93	0.91	
8	China	514.34	82.71	0.90	
9	Slovenia	509.33	80.39	0.89	●
10	Ireland	509.04	80.25	0.87	
11	Germany	508.07	79.80	0.86	
12	Netherlands	507.93	79.74	0.84	
13	Switzerland	506.32	78.99	0.83	
14	New Zealand	505.93	78.81	0.81	
15	Norway	504.47	78.13	0.80	
16	Denmark	504.28	78.04	0.79	
17	Poland	503.87	77.85	0.77	
18	Belgium	502.50	77.22	0.76	
19	Australia	502.26	77.11	0.74	
20	Viet Nam	501.98	76.98	0.73	
21	United Kingdom	499.89	76.01	0.71	
22	Portugal	496.95	74.65	0.70	
23	Sweden	495.83	74.13	0.69	
24	France	495.73	74.08	0.67	
25	Austria	492.22	72.45	0.66	
26	Russian Federation	491.77	72.24	0.64	
27	Spain	491.40	72.07	0.63	
28	Czech Republic	490.80	71.79	0.61	
29	United States of America	487.60	70.31	0.60	
30	Latvia	486.76	69.92	0.59	
31	Italy	485.01	69.11	0.57	
32	Luxembourg	483.34	68.33	0.56	
33	Iceland	480.93	67.21	0.54	
34	Croatia	475.43	64.66	0.53	
35	Lithuania	475.40	64.65	0.51	
36	Hungary	474.37	64.17	0.50	
37	United Arab Emirates	474.28	64.13	0.49	
38	Israel	471.73	62.95	0.47	○
39	Argentina	468.94	61.65	0.46	
40	Malta	463.36	59.07	0.44	
41	Slovakia	462.84	58.83	0.43	
42	Greece	458.50	56.81	0.41	
43	Serbia (2012)	446.60	51.29	0.40	
44	Chile	442.73	49.50	0.39	
45	Bulgaria	439.56	48.03	0.37	○
46	Cyprus	437.51	47.08	0.36	
47	Romania	437.49	47.07	0.34	
48	Uruguay	429.98	43.58	0.33	
49	Turkey	424.76	41.16	0.31	
50	Trinidad and Tobago	423.04	40.37	0.30	
51	Moldova, Rep.	421.30	39.56	0.29	
52	Montenegro	418.71	38.36	0.27	○
53	Kazakhstan (2012)	416.41	37.29	0.26	
54	Costa Rica	415.78	37.00	0.24	
55	Mexico	415.67	36.95	0.23	○
56	Thailand	415.31	36.78	0.21	
57	Albania	415.21	36.74	0.20	
58	Malaysia (2012)	412.74	35.59	0.19	○
59	Colombia	410.09	34.36	0.17	○
60	Qatar	407.30	33.07	0.16	○
61	Georgia	405.42	32.19	0.14	
62	Jordan	399.01	29.22	0.13	○
63	Indonesia	395.49	27.59	0.11	
64	Brazil	395.03	27.38	0.10	○
65	Peru	393.60	26.71	0.09	○
66	Lebanon	376.43	18.75	0.07	○
67	Tunisia	371.43	16.43	0.06	○
68	TFYR of Macedonia	368.91	15.26	0.04	○
69	Algeria	361.74	11.94	0.03	
70	Dominican Republic	339.03	1.40	0.01	○
71	India (2010)	336.00	0.00	0.00	○
n/a	Armenia	n/a	n/a	n/a	
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Bahrain	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Belarus	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Bosnia and Herzegovina	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Ecuador	n/a	n/a	n/a	
n/a	Egypt	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Kenya	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Kyrgyzstan	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Mauritius	n/a	n/a	n/a	
n/a	Mongolia	n/a	n/a	n/a	
n/a	Morocco	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Panama	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Philippines	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Senegal	n/a	n/a	n/a	
n/a	South Africa	n/a	n/a	n/a	
n/a	Sri Lanka	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	
n/a	Ukraine	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: OECD Programme for International Student Assessment (PISA)
NOTE: ● indicates a strength; ○ a weakness

2.1.5 Pupil-teacher ratio, secondary

Pupil-teacher ratio, secondary | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Kazakhstan (2016)	6.79	100.00	1.00	●
2	Ukraine	6.97	99.49	0.99	●
3	Kuwait	7.20	98.81	0.98	●
4	Georgia	7.25	98.68	0.97	●
5	Lebanon (2014)	7.74	97.24	0.96	●
6	Malta (2014)	7.82	97.00	0.95	
7	Croatia (2014)	8.02	96.44	0.95	●
8	Lithuania (2014)	8.08	96.26	0.94	●
9	Estonia (2013)	8.10	96.20	0.93	
10	Latvia (2014)	8.21	95.86	0.92	●
11	Greece (2014)	8.31	95.60	0.91	●
12	Belarus	8.36	95.43	0.90	●
13	Serbia	8.45	95.18	0.89	●
14	Russian Federation (2012)	8.76	94.26	0.88	●
15	Brunei Darussalam	8.84	94.05	0.87	●
16	Luxembourg (2014)	9.12	93.23	0.86	
17	Switzerland (2012)	9.33	92.62	0.85	
18	Moldova, Rep.	9.34	92.58	0.85	●
19	Belgium (2014)	9.42	92.34	0.84	
20	Poland (2013)	9.53	92.02	0.83	●
21	TFYR of Macedonia (2014)	9.56	91.93	0.82	●
22	Austria	9.58	91.90	0.81	
23	Bahrain	9.86	91.06	0.80	●
24	Portugal (2014)	9.89	90.97	0.79	
25	Slovenia (2013)	10.07	90.47	0.78	
26	Bosnia and Herzegovina	10.15	90.24	0.77	●
27	Hungary	10.29	89.82	0.76	
28	Benin	10.32	89.72	0.75	●
29	Cyprus	10.35	89.63	0.75	
30	Qatar	10.69	88.66	0.74	
31	Saudi Arabia (2014)	10.96	87.86	0.73	
32	Slovakia (2014)	11.11	87.42	0.72	
33	United Arab Emirates	11.22	87.10	0.71	
34	Denmark (2014)	11.29	86.91	0.70	
35	Uruguay (2010)	11.32	86.82	0.69	
36	Italy (2013)	11.38	86.66	0.68	
37	Czech Republic (2013)	11.55	86.15	0.67	
38	Japan (2012)	11.68	85.78	0.66	
39	Spain	11.98	84.89	0.65	
40	Malaysia	12.02	84.79	0.65	
41	Romania	12.10	84.56	0.64	
42	Germany	12.13	84.45	0.63	
43	Argentina (2008)	12.24	84.15	0.62	
44	Sweden (2013)	12.30	83.97	0.61	○
45	Kyrgyzstan (2014)	12.40	83.66	0.60	
46	Israel (2014)	12.44	83.55	0.59	
47	Guatemala (2014)	12.66	82.90	0.58	
48	Finland (2014)	12.76	82.63	0.57	○
49	Mauritius	12.88	82.29	0.56	
50	France (2013)	12.94	82.10	0.55	○
51	Hong Kong (China)	12.96	82.05	0.55	
52	Bulgaria (2014)	13.23	81.26	0.54	
53	Albania	13.51	80.45	0.53	
54	Tunisia (2011)	13.62	80.11	0.52	
55	China	13.82	79.55	0.51	
56	Botswana (2007)	13.82	79.54	0.50	
57	Costa Rica	13.95	79.16	0.49	
58	New Zealand (2014)	13.96	79.13	0.48	○
59	Peru	14.09	78.75	0.47	
60	Egypt (2014)	14.36	77.96	0.46	
61	Mongolia (2010)	14.49	77.58	0.45	
62	Netherlands (2014)	14.60	77.28	0.45	○
63	United States of America (2014)	14.79	76.72	0.44	○
64	Singapore (2009)	14.91	76.37	0.43	○
65	Tajikistan (2011)	15.44	74.83	0.42	
66	Indonesia (2014)	15.47	74.73	0.41	
67	Panama (2013)	15.52	74.59	0.40	
68	Korea, Rep. (2013)	15.61	74.32	0.39	
69	United Kingdom (2014)	15.83	73.69	0.38	○
70	Honduras	16.10	72.90	0.37	
71	Mexico (2014)	16.12	72.83	0.36	
72	Jamaica	16.43	71.94	0.35	
73	Brazil (2014)	16.69	71.18	0.35	
74	Iran, Islamic Rep.	17.02	70.23	0.34	
75	Sri Lanka (2012)	17.28	69.46	0.33	
76	Bolivia, Plurinational St. (2007)	18.17	66.89	0.32	
77	Paraguay (2012)	18.40	66.19	0.31	
78	Mali	19.19	63.89	0.30	
79	Nigeria (2013)	19.32	63.52	0.29	
80	Cameroon	19.87	61.93	0.28	
81	Turkey (2013)	20.13	61.16	0.27	
82	Senegal	20.37	60.46	0.26	
83	Chile (2013)	21.00	58.63	0.25	○
84	Pakistan	21.13	58.26	0.25	
85	Rwanda (2014)	21.65	56.74	0.24	
86	Uganda (2014)	21.75	56.44	0.23	
87	Dominican Republic	22.09	55.45	0.22	
88	Ecuador (2016)	22.35	54.71	0.21	
89	Zimbabwe (2013)	22.48	54.31	0.20	
90	Madagascar (2014)	23.12	52.47	0.19	
91	El Salvador (2011)	24.35	48.89	0.18	
92	Namibia (2007)	24.62	48.08	0.17	
93	South Africa (2009)	25.05	46.85	0.16	○
94	Burkina Faso	25.20	46.41	0.15	
95	Colombia	25.58	45.30	0.15	○
96	Togo (2011)	26.25	43.36	0.14	
97	Tanzania, United Rep. (2012)	26.39	42.93	0.13	
98	Côte d'Ivoire	26.61	42.29	0.12	
99	Philippines (2013)	26.99	41.19	0.11	○
100	Niger	27.96	38.37	0.10	
101	Thailand	28.15	37.80	0.09	○
102	Nepal (2016)	28.90	35.62	0.08	
103	Cambodia (2007)	28.92	35.56	0.07	
104	India (2014)	31.77	27.26	0.06	○
105	Guinea (2011)	33.14	23.29	0.05	
106	Bangladesh (2013)	35.20	17.27	0.05	○
107	Burundi	35.79	15.56	0.04	
108	Mozambique	39.69	4.22	0.03	○
109	Ethiopia (2012)	40.35	2.28	0.02	
110	Malawi	40.91	0.67	0.01	○
111	Kenya (2012)	41.13	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Armenia	n/a	n/a	n/a	
n/a	Australia	n/a	n/a	n/a	
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Canada	n/a	n/a	n/a	
n/a	Iceland	n/a	n/a	n/a	
n/a	Ireland	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Morocco	n/a	n/a	n/a	
n/a	Norway	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Viet Nam	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*
NOTE: ● indicates a strength; ○ a weakness

2.2.1 Tertiary enrolment

School enrolment, tertiary (% gross) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Greece (2014)	113.87	100.00	1.00	●
2	Korea, Rep. (2013)	95.35	83.62	0.99	●
3	Australia (2014)	90.31	79.16	0.98	●
4	Spain	89.67	78.60	0.98	●
5	Chile	88.58	77.63	0.97	●
6	Belarus	87.94	77.07	0.96	●
7	Finland	87.29	76.49	0.95	
8	Turkey (2014)	86.31	75.62	0.94	●
9	United States of America	85.80	75.17	0.93	
10	Slovenia (2014)	82.93	72.63	0.93	●
11	Argentina (2014)	82.92	72.62	0.92	●
12	Ukraine (2014)	82.31	72.08	0.91	●
13	Austria	81.54	71.41	0.90	
14	Denmark (2014)	81.52	71.39	0.89	
15	Iceland (2013)	81.26	71.16	0.88	
16	New Zealand (2014)	80.88	70.83	0.88	
17	Russian Federation (2014)	78.65	68.85	0.87	●
18	Netherlands (2012)	78.50	68.72	0.86	
19	Ireland (2014)	77.63	67.95	0.85	
20	Norway	76.70	67.12	0.84	
21	Bulgaria	73.93	64.68	0.83	●
22	Belgium (2014)	73.32	64.14	0.83	
23	Iran, Islamic Rep.	71.88	62.86	0.82	●
24	Poland (2013)	71.16	62.23	0.81	●
25	Singapore (2013)	69.81	61.03	0.80	
26	Estonia	69.55	60.80	0.79	
27	Croatia (2014)	69.54	60.80	0.78	
28	Mongolia	68.57	59.93	0.78	
29	Lithuania (2014)	68.53	59.90	0.77	
30	Hong Kong (China)	68.48	59.85	0.76	
31	Germany	68.27	59.67	0.75	
32	Latvia (2014)	67.04	58.58	0.74	
33	Israel (2014)	66.18	57.82	0.73	
34	Czech Republic (2014)	66.02	57.68	0.73	
35	Portugal (2014)	65.61	57.32	0.72	
36	France (2014)	64.39	56.24	0.71	
37	Japan (2014)	63.36	55.33	0.70	
38	Uruguay (2010)	63.13	55.13	0.69	
39	Italy (2014)	63.10	55.09	0.68	
40	Saudi Arabia	63.07	55.07	0.68	
41	Sweden (2014)	62.35	54.44	0.67	
42	Cyprus	60.10	52.45	0.66	
43	Serbia	58.29	50.84	0.65	
44	Albania	58.11	50.69	0.64	
45	Switzerland (2014)	57.23	49.91	0.63	
46	United Kingdom (2014)	56.48	49.24	0.63	○
47	Colombia	55.59	48.46	0.62	
48	Montenegro (2010)	55.34	48.24	0.61	
49	Costa Rica	53.63	46.72	0.60	
50	Romania	53.22	46.36	0.59	
51	Slovakia (2014)	52.92	46.10	0.58	
52	Hungary	50.86	44.28	0.58	
53	Brazil (2014)	49.28	42.88	0.57	
54	Thailand	48.86	42.50	0.56	
55	Dominican Republic (2014)	47.52	41.32	0.55	
56	Malta	46.97	40.84	0.54	
57	Kazakhstan (2016)	46.26	40.21	0.53	
58	Kyrgyzstan (2014)	45.92	39.90	0.53	
59	Jordan	44.87	38.98	0.52	
60	Armenia	44.31	38.48	0.51	
61	Georgia	43.42	37.69	0.50	
62	China	43.39	37.67	0.49	
63	Moldova, Rep.	41.21	35.74	0.48	
64	Peru (2010)	40.51	35.12	0.48	
65	Ecuador (2013)	40.48	35.09	0.47	
66	TFYR of Macedonia (2014)	39.59	34.31	0.46	
67	Panama (2013)	38.74	33.55	0.45	
68	Lebanon	38.48	33.33	0.44	
69	Bahrain	37.38	32.35	0.43	
70	Algeria	36.92	31.95	0.43	
71	Mauritius	36.67	31.72	0.42	
72	Egypt	36.23	31.33	0.41	
73	Philippines (2014)	35.75	30.91	0.40	
74	Paraguay (2010)	35.08	30.32	0.39	
75	Tunisia	34.61	29.90	0.38	
76	Oman	31.92	27.53	0.38	
77	Indonesia (2014)	31.10	26.80	0.37	
78	Brunei Darussalam	30.84	26.57	0.36	
79	Mexico (2014)	29.94	25.77	0.35	
80	Tajikistan (2016)	28.89	24.85	0.34	
81	El Salvador (2014)	28.85	24.81	0.33	
82	Viet Nam	28.84	24.80	0.33	
83	Morocco	28.14	24.18	0.32	
84	Botswana (2014)	27.51	23.63	0.31	
85	Jamaica	27.22	23.37	0.30	
86	Kuwait (2013)	27.03	23.20	0.29	
87	Malaysia	26.07	22.35	0.28	○
88	India (2014)	25.54	21.88	0.28	
89	Azerbaijan	25.48	21.83	0.27	
90	Honduras (2014)	21.18	18.03	0.26	
91	Sri Lanka	19.80	16.80	0.25	
92	Luxembourg (2012)	19.41	16.46	0.24	○
93	South Africa (2014)	19.38	16.43	0.23	○
94	Guatemala (2013)	18.33	15.50	0.23	
95	Cameroon	17.48	14.75	0.22	
96	Qatar	17.22	14.52	0.21	
97	Benin (2013)	15.36	12.88	0.20	
98	Nepal	14.94	12.51	0.19	
99	Bangladesh (2014)	13.44	11.18	0.18	
100	Cambodia	13.09	10.87	0.18	
101	Guinea (2014)	10.85	8.89	0.17	
102	Togo	10.63	8.69	0.16	
103	Senegal	10.39	8.48	0.15	
104	Nigeria (2011)	10.07	8.20	0.14	
105	Yemen (2011)	9.97	8.12	0.13	
106	Pakistan	9.93	8.07	0.13	
107	Namibia (2008)	9.33	7.55	0.12	
108	Côte d'Ivoire	9.16	7.39	0.11	
109	Zimbabwe	8.43	6.75	0.10	
110	Ethiopia (2014)	8.13	6.48	0.09	
111	Rwanda (2013)	7.53	5.95	0.08	
112	Mali (2012)	6.87	5.37	0.08	
113	Mozambique (2014)	5.97	4.58	0.07	
114	Burkina Faso (2013)	4.78	3.52	0.06	○
115	Madagascar (2014)	4.78	3.52	0.05	
116	Uganda (2011)	4.48	3.26	0.04	○
117	Burundi (2013)	4.41	3.19	0.03	
118	Kenya (2009)	4.05	2.87	0.03	○
119	Tanzania, United Rep. (2013)	3.65	2.52	0.02	○
120	Niger (2012)	1.71	0.81	0.01	○
121	Malawi (2011)	0.80	0.00	0.00	○
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Bosnia and Herzegovina	n/a	n/a	n/a	
n/a	Canada	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*

NOTE: ● indicates a strength; ○ a weakness

2.2.2 Graduates in science and engineering

Tertiary graduates in science, engineering, manufacturing, and construction (% of total tertiary graduates) | 2013

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Oman (2014)	48.69	100.00	1.00	●
2	Iran, Islamic Rep. (2014)	46.56	95.35	0.99	●
3	Tunisia (2014)	44.09	89.99	0.98	●
4	Morocco (2010)	34.91	70.06	0.97	●
5	Hong Kong (China) (2006)	34.67	69.54	0.96	
6	Brunei Darussalam (2014)	33.96	68.01	0.95	●
7	Malaysia	33.26	66.49	0.94	●
8	Korea, Rep. (2011)	31.92	63.57	0.93	
9	Zimbabwe	29.39	58.08	0.92	●
10	India	29.11	57.48	0.91	●
11	Greece (2012)	28.66	56.50	0.90	●
12	Belarus (2014)	28.62	56.40	0.89	●
13	Russian Federation (2009)	28.11	55.30	0.88	●
14	Tajikistan (2014)	28.07	55.22	0.87	●
15	Austria	27.87	54.77	0.86	
16	Finland	27.86	54.75	0.85	
17	Algeria (2014)	27.60	54.19	0.84	●
18	Qatar (2014)	27.56	54.11	0.83	
19	Mexico (2012)	26.88	52.64	0.82	●
20	Saudi Arabia (2014)	26.85	52.57	0.81	●
21	Kuwait	26.74	52.32	0.80	●
22	Serbia (2014)	26.21	51.17	0.79	
23	Portugal	26.09	50.92	0.78	
24	Moldova, Rep.	25.73	50.13	0.77	●
25	Sweden	25.71	50.08	0.76	
26	Kazakhstan (2014)	25.71	50.08	0.75	●
27	Philippines (2014)	25.53	49.70	0.74	●
28	Ukraine (2014)	25.52	49.67	0.73	
29	Romania	25.49	49.62	0.72	
30	United Kingdom	25.18	48.94	0.71	
31	Slovenia (2012)	24.74	47.98	0.70	
32	France	24.47	47.41	0.69	
33	Croatia (2012)	23.85	46.05	0.68	
34	Ireland (2012)	23.76	45.87	0.67	
35	Lebanon (2011)	23.35	44.96	0.66	
36	Czech Republic	23.22	44.68	0.65	
37	Mauritius (2014)	22.93	44.06	0.64	
38	Colombia (2014)	22.74	43.65	0.63	
39	Rwanda (2012)	22.45	43.01	0.62	
40	Viet Nam (2014)	22.40	42.90	0.61	
41	El Salvador	22.23	42.53	0.60	●
42	Spain (2012)	22.21	42.49	0.59	
43	Lithuania	22.20	42.47	0.58	
44	Estonia (2012)	22.12	42.30	0.57	
45	Switzerland	22.05	42.15	0.56	○
46	Azerbaijan (2014)	22.02	42.08	0.55	
47	Indonesia (2009)	21.68	41.35	0.54	
48	TFYR of Macedonia	21.23	40.35	0.53	
49	Cameroon (2010)	21.02	39.91	0.52	●
50	Turkey (2012)	20.89	39.61	0.51	
51	Slovakia	20.51	38.80	0.50	
52	United Arab Emirates (2014)	20.43	38.61	0.50	
53	Denmark	20.37	38.50	0.49	○
54	Madagascar	20.28	38.29	0.48	
55	Italy (2012)	20.18	38.08	0.47	
56	Bulgaria	20.13	37.97	0.46	
57	Norway	19.97	37.62	0.45	○
58	Sri Lanka (2014)	19.95	37.58	0.44	
59	Japan	19.93	37.55	0.43	○
60	Bahrain (2014)	19.48	36.56	0.42	
61	Mongolia (2014)	19.48	36.56	0.41	
62	Chile (2012)	19.18	35.91	0.40	
63	Malta (2012)	19.12	35.77	0.39	○
64	South Africa	19.00	35.52	0.38	
65	Cyprus	18.96	35.44	0.37	
66	New Zealand (2012)	18.79	35.06	0.36	○
67	Kyrgyzstan	18.28	33.96	0.35	
68	Latvia	17.90	33.14	0.34	○
69	Burkina Faso	17.55	32.38	0.33	
70	Botswana (2014)	17.49	32.25	0.32	
71	Poland	17.42	32.09	0.31	○
72	Hungary (2012)	16.84	30.82	0.30	
73	Albania (2014)	16.79	30.73	0.29	
74	Guatemala (2007)	16.76	30.66	0.28	
75	Georgia (2014)	16.69	30.51	0.27	
76	Belgium (2012)	16.44	29.97	0.26	○
77	Luxembourg	16.25	29.55	0.25	○
78	Jordan (2011)	16.12	29.27	0.24	○
79	Australia (2011)	15.93	28.85	0.23	○
80	Panama	15.86	28.69	0.22	
81	Iceland (2010)	15.64	28.21	0.21	○
82	Bangladesh (2012)	15.62	28.18	0.20	
83	Uruguay (2010)	15.60	28.14	0.19	○
84	Bosnia and Herzegovina (2014)	15.38	27.65	0.18	
85	United States of America	14.88	26.58	0.17	○
86	Ecuador	14.87	26.55	0.16	
87	Dominican Republic (2014)	14.42	25.58	0.15	
88	Netherlands (2012)	14.42	25.57	0.14	○
89	Argentina	14.14	24.97	0.13	
90	Armenia (2014)	14.14	24.96	0.12	○
91	Costa Rica (2014)	13.12	22.75	0.11	○
92	Benin (2011)	12.67	21.78	0.10	
93	Cambodia (2008)	12.49	21.39	0.09	
94	Honduras (2014)	12.37	21.12	0.08	○
95	Nepal (2014)	12.08	20.48	0.07	
96	Brazil (2012)	11.96	20.23	0.06	○
97	Egypt	11.79	19.87	0.05	○
98	Ethiopia (2008)	11.22	18.62	0.04	
99	Mozambique (2014)	8.13	11.92	0.03	○
100	Burundi	6.37	8.09	0.02	
101	Niger (2008)	4.28	3.55	0.01	
102	Namibia (2008)	2.64	0.00	0.00	○
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Canada	n/a	n/a	n/a	
n/a	China	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Germany	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Israel	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Kenya	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Peru	n/a	n/a	n/a	
n/a	Senegal	n/a	n/a	n/a	
n/a	Singapore	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Thailand	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*
NOTE: ● indicates a strength; ○ a weakness

2.2.3 Tertiary-level inbound mobility

Tertiary-level inbound mobility ratio (%) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Luxembourg (2012)	40.56	100.00	0.97	●
1	Qatar	37.71	100.00	0.97	●
1	Singapore (2013)	19.17	100.00	0.97	●
1	United Arab Emirates	46.90	100.00	0.97	●
5	New Zealand (2014)	18.74	97.80	0.96	●
6	Australia (2014)	18.30	95.50	0.95	●
7	United Kingdom (2014)	18.22	95.07	0.94	
8	Cyprus	17.56	91.61	0.93	
9	Switzerland (2014)	17.11	89.24	0.92	
10	Austria	15.89	82.89	0.92	●
11	Senegal	15.79	82.38	0.91	●
12	Bahrain	13.87	72.35	0.90	●
13	Jordan	12.91	67.32	0.89	●
14	Belgium (2014)	11.19	58.35	0.88	
15	Uganda (2011)	10.73	55.94	0.87	●
16	Hong Kong (China)	10.70	55.77	0.86	
17	Namibia (2008)	10.17	52.99	0.85	●
18	Denmark (2014)	9.93	51.76	0.84	
19	Lebanon	9.85	51.35	0.83	●
20	France (2014)	9.84	51.28	0.82	
21	Czech Republic (2014)	9.83	51.22	0.81	
22	Benin (2010)	7.92	41.24	0.80	●
23	Germany	7.68	40.00	0.79	
24	Finland	7.65	39.83	0.78	
25	Bosnia and Herzegovina	7.47	38.90	0.77	●
26	Malaysia	7.37	38.36	0.76	
27	Netherlands (2012)	7.25	37.72	0.75	
28	Hungary	7.05	36.71	0.75	
29	Ireland (2014)	7.00	36.42	0.74	
30	Iceland (2013)	6.54	34.03	0.73	
31	Malta	6.21	32.32	0.72	
32	Sweden (2014)	5.91	30.71	0.71	
33	Slovakia (2014)	5.61	29.19	0.70	
34	Niger (2012)	5.43	28.21	0.69	●
35	Estonia	5.18	26.91	0.68	
36	Latvia (2014)	4.99	25.94	0.67	
37	Brunei Darussalam	4.87	25.29	0.66	
38	Saudi Arabia	4.78	24.85	0.65	
39	Italy (2014)	4.72	24.52	0.64	
40	United States of America	4.65	24.13	0.63	
41	Kyrgyzstan (2014)	4.51	23.40	0.62	
42	Romania	4.26	22.11	0.61	
43	Yemen (2011)	4.26	22.11	0.60	●
44	Bulgaria	4.25	22.04	0.59	
45	Greece (2013)	4.19	21.73	0.58	
46	South Africa (2014)	4.18	21.71	0.58	
47	Armenia	4.14	21.49	0.57	
48	Serbia	4.13	21.41	0.56	
49	Portugal (2014)	4.11	21.33	0.55	
50	Mauritius	4.02	20.88	0.54	
51	Georgia	3.75	19.42	0.53	
52	Norway	3.55	18.40	0.52	○
53	Japan (2014)	3.44	17.81	0.51	
54	Belarus	3.33	17.25	0.50	
55	Ukraine	3.24	16.80	0.49	
56	Russian Federation (2014)	3.05	15.79	0.48	
57	Burkina Faso (2013)	2.90	15.01	0.47	
58	Spain (2013)	2.86	14.81	0.46	○
59	TFYR of Macedonia (2014)	2.84	14.68	0.45	
60	Oman	2.81	14.55	0.44	
61	Israel (2014)	2.78	14.37	0.43	○
62	Slovenia (2014)	2.75	14.21	0.42	
63	Moldova, Rep.	2.50	12.91	0.42	
64	Lithuania (2013)	2.45	12.67	0.41	
65	Dominican Republic (2014)	2.34	12.09	0.40	
66	Thailand	2.10	10.85	0.39	
67	Azerbaijan	2.05	10.58	0.38	
68	Kazakhstan (2016)	2.01	10.36	0.37	
69	Tunisia	2.00	10.29	0.36	
70	Egypt (2014)	1.88	9.68	0.35	
71	Morocco (2014)	1.80	9.27	0.34	
72	Côte d'Ivoire	1.80	9.25	0.33	
73	Madagascar (2014)	1.77	9.10	0.32	
74	Albania	1.69	8.66	0.31	
75	Korea, Rep. (2013)	1.66	8.54	0.30	○
76	Botswana (2014)	1.63	8.38	0.29	
77	Poland (2013)	1.46	7.48	0.28	○
78	Togo (2007)	1.41	7.23	0.27	
79	Malawi (2010)	1.14	5.79	0.26	
80	Cameroon (2012)	1.13	5.77	0.25	
81	Burundi (2013)	1.00	5.07	0.25	
82	Rwanda (2013)	0.96	4.85	0.24	
83	Guinea (2012)	0.92	4.66	0.23	
84	Turkey (2014)	0.88	4.46	0.22	
85	Honduras (2014)	0.69	3.48	0.21	
86	Mongolia	0.69	3.48	0.20	
87	Tajikistan (2016)	0.63	3.16	0.19	
88	Algeria	0.62	3.08	0.18	
89	Ecuador (2012)	0.59	2.94	0.17	
90	Mali (2011)	0.53	2.61	0.16	
91	Zimbabwe	0.47	2.29	0.15	
92	El Salvador (2014)	0.40	1.94	0.14	
93	Croatia (2014)	0.38	1.87	0.13	○
94	Mozambique (2014)	0.37	1.79	0.12	
95	Sri Lanka	0.32	1.53	0.11	○
96	Chile	0.31	1.48	0.10	○
97	Iran, Islamic Rep.	0.29	1.35	0.09	
98	China	0.28	1.34	0.08	○
99	Mexico (2013)	0.24	1.12	0.08	○
100	Brazil (2014)	0.24	1.09	0.07	○
101	Colombia	0.18	0.82	0.06	○
102	India (2014)	0.13	0.53	0.05	○
103	Viet Nam	0.12	0.46	0.04	○
104	Indonesia (2012)	0.12	0.46	0.03	○
105	Philippines (2008)	0.10	0.38	0.02	○
106	Bangladesh (2009)	0.10	0.38	0.01	○
107	Nepal (2011)	0.03	0.00	0.00	○
n/a	Argentina	n/a	n/a	n/a	
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Canada	n/a	n/a	n/a	
n/a	Costa Rica	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Kenya	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Panama	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Peru	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Uruguay	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*

NOTE: ● indicates a strength; ○ a weakness

2.3.1 Researchers

Researchers, full-time equivalence (FTE) (per million population) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Israel (2012)	8,255.40	100.00	1.00	●
2	Denmark	7,483.58	90.64	0.99	●
3	Korea, Rep.	7,087.35	85.83	0.98	●
4	Sweden	7,021.88	85.04	0.97	●
5	Finland	6,816.77	82.55	0.96	
6	Singapore (2014)	6,658.50	80.63	0.95	
7	Norway	5,915.60	71.62	0.94	
8	Iceland	5,902.53	71.46	0.93	
9	Japan	5,230.72	63.31	0.92	
10	Luxembourg	5,058.28	61.21	0.91	
11	Austria	4,955.03	59.96	0.90	
12	Belgium	4,875.34	59.00	0.89	
13	Ireland	4,575.20	55.35	0.88	
14	Netherlands	4,548.14	55.03	0.87	
15	Australia (2010)	4,530.73	54.81	0.86	
16	Canada (2013)	4,518.51	54.67	0.85	
17	Switzerland (2012)	4,481.07	54.21	0.84	
18	United Kingdom	4,470.78	54.09	0.83	
19	Germany	4,431.08	53.61	0.82	
20	United States of America (2014)	4,231.99	51.19	0.81	
21	France (2014)	4,168.78	50.42	0.80	
22	New Zealand (2013)	4,008.71	48.48	0.79	
23	Portugal	3,824.19	46.24	0.78	
24	Slovenia	3,820.99	46.20	0.77	
25	Czech Republic	3,611.91	43.67	0.76	
26	Hong Kong (China) (2014)	3,297.56	39.85	0.75	
27	Greece	3,201.27	38.69	0.74	
28	Estonia	3,189.19	38.54	0.73	
29	Russian Federation	3,131.11	37.84	0.72	
30	Lithuania	2,822.40	34.09	0.71	
31	Slovakia	2,654.78	32.06	0.70	
32	Spain	2,654.65	32.06	0.69	
33	Hungary	2,568.84	31.01	0.68	
34	Poland	2,139.10	25.80	0.67	
35	Serbia	2,071.22	24.98	0.66	
36	Italy	2,018.09	24.33	0.65	
37	Malaysia (2014)	2,017.42	24.32	0.64	
38	United Arab Emirates	2,003.39	24.15	0.63	
39	Bulgaria	1,989.43	23.99	0.62	
40	Malta	1,951.42	23.52	0.61	
41	Latvia	1,833.54	22.09	0.60	
42	Tunisia	1,787.26	21.53	0.59	
43	Croatia	1,501.54	18.07	0.58	
44	Argentina (2014)	1,202.07	14.43	0.57	
45	China	1,176.58	14.12	0.56	
46	Turkey (2014)	1,156.51	13.88	0.55	
47	Morocco (2014)	1,032.54	12.38	0.54	
48	Cyprus	1,013.77	12.15	0.53	
49	Ukraine	1,006.00	12.05	0.52	
50	Romania	894.81	10.71	0.51	
51	Thailand	874.29	10.46	0.50	
52	TFYR of Macedonia	858.81	10.27	0.49	
53	Montenegro	835.76	9.99	0.48	
54	Kazakhstan (2013)	734.05	8.76	0.47	
55	Brazil (2010)	698.10	8.32	0.46	
56	Iran, Islamic Rep. (2012)	691.41	8.24	0.45	
57	Egypt	679.81	8.10	0.44	
58	Viet Nam (2013)	674.81	8.04	0.43	
59	Moldova, Rep.	662.10	7.88	0.42	
60	Qatar (2012)	597.06	7.09	0.41	
61	Georgia (2014)	585.41	6.95	0.40	
62	Costa Rica (2014)	572.98	6.80	0.39	
63	Uruguay	524.25	6.21	0.38	
64	Chile	455.50	5.38	0.37	
65	South Africa (2013)	437.06	5.15	0.36	
66	Ecuador (2014)	400.72	4.71	0.35	
67	Bahrain (2014)	361.99	4.24	0.34	
68	Senegal (2010)	361.12	4.23	0.33	
69	Bosnia and Herzegovina	328.70	3.84	0.32	
70	Jordan	307.98	3.59	0.31	
71	Pakistan	294.36	3.42	0.30	
72	Mexico (2013)	241.80	2.78	0.29	
73	Kenya (2010)	230.73	2.65	0.28	
74	Oman	201.97	2.30	0.27	
75	Philippines (2013)	189.41	2.15	0.26	
76	Paraguay	184.06	2.08	0.25	
77	Mauritius (2012)	181.11	2.05	0.24	
78	Botswana (2013)	175.51	1.98	0.23	
79	Bolivia, Plurinational St. (2010)	165.95	1.86	0.22	
80	Albania (2008)	157.34	1.76	0.21	
81	India (2010)	156.64	1.75	0.20	
82	Namibia (2014)	141.41	1.57	0.19	
83	Kuwait (2012)	128.38	1.41	0.18	
84	Colombia (2014)	114.89	1.24	0.17	○
85	Sri Lanka (2013)	110.91	1.20	0.16	
86	Zimbabwe (2012)	89.61	0.94	0.15	
87	Indonesia (2009)	89.53	0.94	0.14	
88	Madagascar (2011)	51.02	0.47	0.13	
89	Malawi (2010)	49.57	0.45	0.12	
90	Burkina Faso (2010)	47.50	0.43	0.11	
91	Ethiopia (2013)	45.12	0.40	0.10	
92	Mozambique	41.53	0.35	0.09	
93	Zambia (2008)	40.87	0.35	0.08	
94	Panama (2013)	39.41	0.33	0.07	○
95	Nigeria (2007)	38.58	0.32	0.06	
96	Togo (2014)	38.17	0.31	0.05	
97	Uganda (2010)	38.09	0.31	0.04	○
98	Mali (2010)	29.17	0.20	0.03	○
99	Guatemala (2012)	26.74	0.18	0.02	○
100	Tanzania, United Rep. (2013)	18.49	0.08	0.01	○
101	Rwanda (2009)	12.29	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Armenia	n/a	n/a	n/a	
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Belarus	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Kyrgyzstan	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Mongolia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Peru	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*

NOTE: ● indicates a strength; ○ a weakness

2.3.2 Gross expenditure on R&D (GERD)

GERD: Gross expenditure on R&D (% of GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Israel	4.30	100.00	1.00	●
2	Korea, Rep.	4.23	98.40	0.99	●
3	Japan	3.49	81.17	0.98	●
4	Sweden	3.28	76.24	0.97	●
5	Austria	3.10	71.91	0.96	●
6	Denmark	3.02	70.12	0.95	
7	Switzerland (2012)	2.97	68.87	0.94	
8	Finland	2.93	68.01	0.94	
9	Germany	2.88	66.89	0.93	
10	United States of America	2.80	65.04	0.92	
11	Belgium	2.46	57.06	0.91	●
12	France	2.23	51.63	0.90	
13	Iceland	2.22	51.34	0.89	
14	Slovenia	2.21	51.30	0.88	
15	Singapore (2014)	2.20	50.91	0.87	
16	Australia (2013)	2.20	50.89	0.86	
17	China	2.09	48.51	0.85	
18	Netherlands	2.01	46.52	0.84	
19	Czech Republic	1.98	45.91	0.83	
20	Norway	1.93	44.59	0.83	
21	United Kingdom	1.71	39.50	0.82	
22	Canada (2014)	1.61	37.29	0.81	
23	Ireland (2014)	1.55	35.71	0.80	
24	Estonia	1.48	34.18	0.79	
25	Hungary	1.39	32.07	0.78	
26	Italy	1.34	30.87	0.77	
27	Luxembourg	1.29	29.70	0.76	
28	Portugal	1.28	29.43	0.75	
29	Malaysia (2014)	1.26	29.11	0.74	
30	Spain	1.22	28.08	0.73	
31	Slovakia	1.19	27.36	0.72	
32	Brazil (2014)	1.17	26.91	0.72	●
33	New Zealand (2013)	1.15	26.59	0.71	
34	Russian Federation	1.13	26.06	0.70	
35	Lithuania	1.04	23.93	0.69	
36	Poland	1.01	23.20	0.68	
37	Turkey (2014)	1.01	23.14	0.67	
38	Bulgaria	0.98	22.54	0.66	
39	Greece	0.96	21.97	0.65	
40	Serbia	0.88	20.20	0.64	
41	United Arab Emirates	0.87	19.85	0.63	
42	Croatia	0.85	19.57	0.62	
43	India (2011)	0.83	19.05	0.61	
44	Saudi Arabia (2013)	0.82	18.73	0.61	
45	Kenya (2010)	0.79	17.99	0.60	
46	Malta (2014)	0.76	17.44	0.59	
47	Hong Kong (China) (2014)	0.74	16.93	0.58	
48	South Africa (2013)	0.73	16.59	0.57	
49	Egypt	0.72	16.51	0.56	
50	Morocco (2010)	0.71	16.32	0.55	
51	Tunisia (2014)	0.65	14.92	0.54	
52	Thailand	0.63	14.24	0.53	
53	Latvia	0.62	14.23	0.52	
54	Ukraine	0.62	14.06	0.51	
55	Argentina (2014)	0.61	13.95	0.50	
56	Ethiopia (2013)	0.60	13.76	0.50	
57	Costa Rica (2014)	0.58	13.28	0.49	
58	Mali (2010)	0.58	13.27	0.48	
59	Mexico	0.55	12.51	0.47	
60	Botswana (2013)	0.54	12.27	0.46	
61	Senegal (2010)	0.54	12.27	0.45	
62	Tanzania, United Rep. (2013)	0.53	12.00	0.44	
63	Belarus	0.52	11.71	0.43	
64	Romania	0.49	11.03	0.42	
65	Uganda (2010)	0.48	10.75	0.41	
66	Qatar (2012)	0.47	10.61	0.40	
67	Cyprus	0.46	10.42	0.39	
68	Ecuador (2014)	0.45	10.06	0.39	
69	TFYR of Macedonia	0.44	9.99	0.38	
70	Jordan (2008)	0.43	9.79	0.37	
71	Chile	0.39	8.67	0.36	
72	Montenegro	0.38	8.51	0.35	
73	Viet Nam (2013)	0.37	8.37	0.34	
74	Moldova, Rep.	0.37	8.29	0.33	
75	Mozambique	0.34	7.58	0.32	
76	Namibia (2014)	0.34	7.55	0.31	
77	Uruguay (2014)	0.34	7.48	0.30	
78	Iran, Islamic Rep. (2012)	0.33	7.23	0.29	
79	Nepal (2010)	0.30	6.70	0.28	
80	Kuwait (2013)	0.30	6.69	0.28	
81	Zambia (2008)	0.28	6.14	0.27	
82	Togo (2014)	0.27	5.99	0.26	
83	Armenia	0.25	5.48	0.25	
84	Pakistan	0.25	5.40	0.24	
85	Oman	0.24	5.37	0.23	
86	Colombia	0.24	5.29	0.22	○
87	Azerbaijan	0.22	4.84	0.21	
88	Bosnia and Herzegovina	0.22	4.82	0.20	
89	Nigeria (2007)	0.22	4.76	0.19	
90	Burkina Faso (2009)	0.20	4.32	0.18	
91	Mauritius (2012)	0.18	3.88	0.17	○
92	Kazakhstan (2013)	0.17	3.53	0.17	
93	Bolivia, Plurinational St. (2009)	0.16	3.31	0.16	
94	Mongolia	0.15	3.26	0.15	
95	Albania (2008)	0.15	3.25	0.14	
96	Philippines (2013)	0.14	2.87	0.13	
97	Peru	0.13	2.75	0.12	○
98	Paraguay	0.13	2.61	0.11	
99	Burundi (2011)	0.12	2.48	0.10	
100	Kyrgyzstan	0.12	2.47	0.09	
101	Tajikistan (2013)	0.12	2.40	0.08	
102	Sri Lanka (2013)	0.10	2.00	0.07	○
103	Bahrain (2014)	0.10	1.98	0.06	○
104	Georgia (2014)	0.10	1.95	0.06	○
105	Indonesia (2013)	0.08	1.63	0.05	○
106	El Salvador (2014)	0.08	1.62	0.04	○
107	Trinidad and Tobago (2014)	0.08	1.47	0.03	○
108	Panama (2013)	0.06	1.12	0.02	○
109	Guatemala (2012)	0.04	0.69	0.01	○
110	Madagascar (2014)	0.02	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*

NOTE: ● indicates a strength; ○ a weakness

2.3.3 Global R&D companies, average expenditure top 3

Average expenditure of the top 3 global companies by R&D, mn $US | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United States of America	11,774.73	100.00	1.00	●
2	Germany	8,986.88	97.12	0.99	●
3	Switzerland	6,880.31	94.27	0.98	●
4	Japan	6,236.99	93.22	0.98	●
5	Korea, Rep.	5,969.54	92.75	0.97	
6	China	4,251.64	89.13	0.96	
7	United Kingdom	3,826.19	88.01	0.95	
8	France	3,510.28	87.09	0.94	●
9	Italy	2,756.74	84.51	0.94	●
10	Netherlands	2,382.30	82.96	0.93	
11	Sweden	2,177.94	82.00	0.92	
12	Ireland	1,999.59	81.09	0.91	
13	Spain	1,118.38	74.90	0.90	●
14	India	1,024.65	73.96	0.90	●
15	Finland	980.14	73.49	0.89	
16	Canada	955.01	73.21	0.88	
17	Denmark	880.30	72.34	0.87	
18	Israel	658.14	69.25	0.87	
19	Australia	621.34	68.63	0.86	
20	Belgium	517.07	66.68	0.85	
21	Brazil	489.77	66.10	0.84	●
22	Singapore	403.62	64.04	0.83	
23	Saudi Arabia	330.37	61.91	0.83	●
24	Norway	186.62	55.84	0.82	
25	Russian Federation	182.99	55.63	0.81	
26	Luxembourg	155.41	53.90	0.80	
27	Austria	126.49	51.72	0.79	
28	Slovenia	122.34	51.37	0.79	
29	Turkey	119.93	51.16	0.78	
30	Hungary	118.71	51.05	0.77	
31	South Africa	103.40	49.59	0.76	
32	New Zealand	75.80	46.31	0.75	
33	Colombia	73.29	45.96	0.75	
34	Iceland	62.16	44.23	0.74	
35	Argentina	58.77	43.64	0.73	●
36	Thailand	53.99	42.75	0.72	
37	Mexico	52.85	42.52	0.71	
38	Greece	39.45	39.47	0.71	
39	Portugal	34.15	37.97	0.70	
40	Czech Republic	32.58	37.49	0.69	
41	Malta	32.44	37.44	0.68	
42	Malaysia	26.88	35.50	0.67	
43	Albania	0.00	0.00	0.00	○
43	Algeria	0.00	0.00	0.00	○
43	Armenia	0.00	0.00	0.00	○
43	Azerbaijan	0.00	0.00	0.00	○
43	Bahrain	0.00	0.00	0.00	○
43	Bangladesh	0.00	0.00	0.00	○
43	Belarus	0.00	0.00	0.00	○
43	Benin	0.00	0.00	0.00	○
43	Bolivia, Plurinational St.	0.00	0.00	0.00	○
43	Bosnia and Herzegovina	0.00	0.00	0.00	○
43	Botswana	0.00	0.00	0.00	○
43	Brunei Darussalam	0.00	0.00	0.00	○
43	Bulgaria	0.00	0.00	0.00	○
43	Burkina Faso	0.00	0.00	0.00	○
43	Burundi	0.00	0.00	0.00	○
43	Cambodia	0.00	0.00	0.00	○
43	Cameroon	0.00	0.00	0.00	○
43	Chile	0.00	0.00	0.00	○
43	Costa Rica	0.00	0.00	0.00	○
43	Côte d'Ivoire	0.00	0.00	0.00	○
43	Croatia	0.00	0.00	0.00	○
43	Cyprus	0.00	0.00	0.00	○
43	Dominican Republic	0.00	0.00	0.00	○
43	Ecuador	0.00	0.00	0.00	○
43	Egypt	0.00	0.00	0.00	○
43	El Salvador	0.00	0.00	0.00	○
43	Estonia	0.00	0.00	0.00	○
43	Ethiopia	0.00	0.00	0.00	○
43	Georgia	0.00	0.00	0.00	○
43	Guatemala	0.00	0.00	0.00	○
43	Guinea	0.00	0.00	0.00	○
43	Honduras	0.00	0.00	0.00	○
43	Hong Kong (China)	0.00	0.00	0.00	○
43	Indonesia	0.00	0.00	0.00	○
43	Iran, Islamic Rep.	0.00	0.00	0.00	○
43	Jamaica	0.00	0.00	0.00	○
43	Jordan	0.00	0.00	0.00	○
43	Kazakhstan	0.00	0.00	0.00	○
43	Kenya	0.00	0.00	0.00	○
43	Kuwait	0.00	0.00	0.00	○
43	Kyrgyzstan	0.00	0.00	0.00	○
43	Latvia	0.00	0.00	0.00	○
43	Lebanon	0.00	0.00	0.00	○
43	Lithuania	0.00	0.00	0.00	○
43	Madagascar	0.00	0.00	0.00	○
43	Malawi	0.00	0.00	0.00	○
43	Mali	0.00	0.00	0.00	○
43	Mauritius	0.00	0.00	0.00	○
43	Moldova, Rep.	0.00	0.00	0.00	○
43	Mongolia	0.00	0.00	0.00	○
43	Montenegro	0.00	0.00	0.00	○
43	Morocco	0.00	0.00	0.00	○
43	Mozambique	0.00	0.00	0.00	○
43	Namibia	0.00	0.00	0.00	○
43	Nepal	0.00	0.00	0.00	○
43	Niger	0.00	0.00	0.00	○
43	Nigeria	0.00	0.00	0.00	○
43	Oman	0.00	0.00	0.00	○
43	Pakistan	0.00	0.00	0.00	○
43	Panama	0.00	0.00	0.00	○
43	Paraguay	0.00	0.00	0.00	○
43	Peru	0.00	0.00	0.00	○
43	Philippines	0.00	0.00	0.00	○
43	Poland	0.00	0.00	0.00	○
43	Qatar	0.00	0.00	0.00	○
43	Romania	0.00	0.00	0.00	○
43	Rwanda	0.00	0.00	0.00	○
43	Senegal	0.00	0.00	0.00	○
43	Serbia	0.00	0.00	0.00	○
43	Slovakia	0.00	0.00	0.00	○
43	Sri Lanka	0.00	0.00	0.00	○
43	Tajikistan	0.00	0.00	0.00	○
43	Tanzania, United Rep.	0.00	0.00	0.00	○
43	TFYR of Macedonia	0.00	0.00	0.00	○
43	Togo	0.00	0.00	0.00	○
43	Trinidad and Tobago	0.00	0.00	0.00	○
43	Tunisia	0.00	0.00	0.00	○
43	Uganda	0.00	0.00	0.00	○
43	Ukraine	0.00	0.00	0.00	○
43	United Arab Emirates	0.00	0.00	0.00	○
43	Uruguay	0.00	0.00	0.00	○
43	Viet Nam	0.00	0.00	0.00	○
43	Yemen	0.00	0.00	0.00	○
43	Zambia	0.00	0.00	0.00	○
43	Zimbabwe	0.00	0.00	0.00	○

SOURCE: EU JRC Industrial R&D Investment Scoreboard 2016

NOTE: ● indicates a strength; ○ a weakness

2.3.4 QS university ranking average score top 3 universities

Average score of the top 3 universities at the QS world university ranking | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United States of America	99.00	99.00	1.00	●
2	United Kingdom	96.53	96.53	0.99	●
3	Switzerland	84.37	84.37	0.98	●
4	China	82.23	82.23	0.98	●
5	Canada	81.97	81.97	0.97	●
6	Hong Kong (China)	81.77	81.77	0.96	
7	Australia	81.57	81.57	0.95	●
8	Japan	79.73	79.73	0.94	
9	Korea, Rep.	75.67	75.67	0.94	
10	France	71.40	71.40	0.93	●
11	Germany	70.77	70.77	0.92	
12	Singapore	70.33	70.33	0.91	
13	Netherlands	69.70	69.70	0.90	
14	Sweden	65.00	65.00	0.90	
15	Denmark	63.83	63.83	0.89	
16	Belgium	59.63	59.63	0.88	
17	Finland	54.83	54.83	0.87	
18	New Zealand	54.67	54.67	0.87	
19	Ireland	51.17	51.17	0.86	
20	Norway	49.80	49.80	0.85	
21	India	49.00	49.00	0.84	●
22	Israel	48.43	48.43	0.83	
23	Spain	48.20	48.20	0.83	
24	Brazil	47.43	47.43	0.82	●
25	Russian Federation	46.50	46.50	0.81	
26	Austria	46.33	46.33	0.80	
27	Italy	46.27	46.27	0.79	
28	Argentina	46.00	46.00	0.79	●
29	Malaysia	44.43	44.43	0.78	
30	Saudi Arabia	43.10	43.10	0.77	●
31	Chile	42.50	42.50	0.76	
32	Mexico	41.57	41.57	0.75	
33	South Africa	37.03	37.03	0.75	
34	Colombia	35.87	35.87	0.74	
35	Kazakhstan	35.13	35.13	0.73	●
36	Portugal	33.97	33.97	0.72	
37	Thailand	33.37	33.37	0.71	
38	Indonesia	29.77	29.77	0.71	●
39	Lebanon	29.27	29.27	0.70	
40	United Arab Emirates	28.93	28.93	0.69	
41	Turkey	28.00	28.00	0.68	
42	Czech Republic	27.57	27.57	0.67	
43	Ukraine	27.40	27.40	0.67	
44	Poland	26.90	26.90	0.66	
45	Iran, Islamic Rep.	25.93	25.93	0.65	●
46	Greece	24.80	24.80	0.64	
47	Philippines	24.40	24.40	0.63	
48	Egypt	22.87	22.87	0.63	●
49	Hungary	20.77	20.77	0.62	
50	Lithuania	20.07	20.07	0.61	
51	Pakistan	18.97	18.97	0.60	●
52	Costa Rica	18.10	18.10	0.60	
53	Estonia	17.93	17.93	0.59	
54	Peru	16.60	16.60	0.58	
55	Belarus	16.37	16.37	0.57	
56	Azerbaijan	14.67	14.67	0.56	
57	Bahrain	13.73	13.73	0.56	
58	Jordan	13.27	13.27	0.55	
59	Romania	12.77	12.77	0.54	
60	Uruguay	12.60	12.60	0.53	
61	Slovenia	11.63	11.63	0.52	
62	Ecuador	11.10	11.10	0.52	
63	Qatar	10.20	10.20	0.51	
64	Oman	9.07	9.07	0.50	
65	Croatia	6.43	6.43	0.49	
66	Bulgaria	6.23	6.23	0.48	
67	Latvia	6.10	6.10	0.48	
68	Slovakia	6.07	6.07	0.47	
69	Bangladesh	5.60	5.60	0.46	
70	Kuwait	5.33	5.33	0.45	
71	Serbia	5.07	5.07	0.44	
72	Sri Lanka	4.90	4.90	0.44	
73	Kenya	4.30	4.30	0.43	
74	Uganda	3.07	3.07	0.42	
75	Albania	0.00	0.00	0.00	○
75	Algeria	0.00	0.00	0.00	○
75	Armenia	0.00	0.00	0.00	○
75	Benin	0.00	0.00	0.00	○
75	Bolivia, Plurinational St.	0.00	0.00	0.00	○
75	Bosnia and Herzegovina	0.00	0.00	0.00	○
75	Botswana	0.00	0.00	0.00	○
75	Brunei Darussalam	0.00	0.00	0.00	○
75	Burkina Faso	0.00	0.00	0.00	○
75	Burundi	0.00	0.00	0.00	○
75	Cambodia	0.00	0.00	0.00	○
75	Cameroon	0.00	0.00	0.00	○
75	Côte d'Ivoire	0.00	0.00	0.00	○
75	Cyprus	0.00	0.00	0.00	○
75	Dominican Republic	0.00	0.00	0.00	○
75	El Salvador	0.00	0.00	0.00	○
75	Ethiopia	0.00	0.00	0.00	○
75	Georgia	0.00	0.00	0.00	○
75	Guatemala	0.00	0.00	0.00	○
75	Guinea	0.00	0.00	0.00	○
75	Honduras	0.00	0.00	0.00	○
75	Iceland	0.00	0.00	0.00	○
75	Jamaica	0.00	0.00	0.00	○
75	Kyrgyzstan	0.00	0.00	0.00	○
75	Luxembourg	0.00	0.00	0.00	○
75	Madagascar	0.00	0.00	0.00	○
75	Malawi	0.00	0.00	0.00	○
75	Mali	0.00	0.00	0.00	○
75	Malta	0.00	0.00	0.00	○
75	Mauritius	0.00	0.00	0.00	○
75	Moldova, Rep.	0.00	0.00	0.00	○
75	Mongolia	0.00	0.00	0.00	○
75	Montenegro	0.00	0.00	0.00	○
75	Morocco	0.00	0.00	0.00	○
75	Mozambique	0.00	0.00	0.00	○
75	Namibia	0.00	0.00	0.00	○
75	Nepal	0.00	0.00	0.00	○
75	Niger	0.00	0.00	0.00	○
75	Nigeria	0.00	0.00	0.00	○
75	Panama	0.00	0.00	0.00	○
75	Paraguay	0.00	0.00	0.00	○
75	Rwanda	0.00	0.00	0.00	○
75	Senegal	0.00	0.00	0.00	○
75	Tajikistan	0.00	0.00	0.00	○
75	Tanzania, United Rep.	0.00	0.00	0.00	○
75	TFYR of Macedonia	0.00	0.00	0.00	○
75	Togo	0.00	0.00	0.00	○
75	Trinidad and Tobago	0.00	0.00	0.00	○
75	Tunisia	0.00	0.00	0.00	○
75	Viet Nam	0.00	0.00	0.00	○
75	Yemen	0.00	0.00	0.00	○
75	Zambia	0.00	0.00	0.00	○
75	Zimbabwe	0.00	0.00	0.00	○

SOURCE: QS Quacquarelli Symonds Ltd, QS World University Ranking 2016/2017, Top Universities
NOTE: ● indicates a strength; ○ a weakness

3.1.1 ICT access

ICT access index | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Luxembourg	9.54	95.40	1.00	●
2	Iceland	9.42	94.20	0.99	●
3	United Kingdom	9.24	92.40	0.98	●
4	Hong Kong (China)	9.16	91.60	0.98	
5	Germany	9.09	90.90	0.97	●
6	Malta	9.04	90.40	0.96	●
7	Netherlands	9.02	90.20	0.95	
8	Korea, Rep.	8.99	89.90	0.94	
9	Switzerland	8.95	89.50	0.94	
10	Japan	8.80	88.00	0.93	
11	France	8.70	87.00	0.91	
11	Singapore	8.70	87.00	0.91	
13	Sweden	8.69	86.90	0.90	
14	Denmark	8.52	85.20	0.90	
15	Austria	8.35	83.50	0.89	
16	Belgium	8.34	83.40	0.88	
17	New Zealand	8.32	83.20	0.87	
18	Israel	8.28	82.80	0.86	
19	United States of America	8.27	82.70	0.86	
20	Australia	8.23	82.30	0.85	
21	Norway	8.21	82.10	0.84	
22	Ireland	8.19	81.90	0.83	
23	United Arab Emirates	8.14	81.40	0.82	
24	Estonia	8.02	80.20	0.82	
25	Canada	7.99	79.90	0.81	
26	Portugal	7.93	79.30	0.79	
26	Slovenia	7.93	79.30	0.79	
28	Spain	7.92	79.20	0.78	
29	Bahrain	7.91	79.10	0.77	
29	Qatar	7.91	79.10	0.77	
31	Greece	7.85	78.50	0.76	
32	Belarus	7.80	78.00	0.75	
33	Finland	7.69	76.90	0.74	
33	Italy	7.69	76.90	0.74	
35	Hungary	7.62	76.20	0.73	
36	Croatia	7.58	75.80	0.72	
37	Kazakhstan	7.56	75.60	0.71	
38	Czech Republic	7.46	74.60	0.70	
39	Kuwait	7.40	74.00	0.70	
40	Latvia	7.38	73.80	0.69	
41	Oman	7.37	73.70	0.68	●
42	Saudi Arabia	7.29	72.90	0.67	
43	Uruguay	7.25	72.50	0.66	
44	Russian Federation	7.23	72.30	0.66	
45	Serbia	7.22	72.20	0.64	
45	Slovakia	7.22	72.20	0.64	
47	Brunei Darussalam	7.21	72.10	0.63	
48	Poland	7.09	70.90	0.62	
49	Lithuania	7.08	70.80	0.62	
50	Trinidad and Tobago	7.03	70.30	0.61	●
51	Cyprus	7.02	70.20	0.60	
52	Romania	6.90	69.00	0.59	
53	Bulgaria	6.86	68.60	0.58	
53	Mauritius	6.86	68.60	0.58	
55	Montenegro	6.85	68.50	0.57	
56	Chile	6.81	68.10	0.56	
57	Azerbaijan	6.78	67.80	0.55	
58	Argentina	6.77	67.70	0.54	
59	Malaysia	6.75	67.50	0.54	
60	TFYR of Macedonia	6.68	66.80	0.53	
61	Moldova, Rep.	6.64	66.40	0.52	
62	Armenia	6.57	65.70	0.50	
62	Lebanon	6.57	65.70	0.50	
64	Ukraine	6.48	64.80	0.50	
65	Costa Rica	6.44	64.40	0.49	
66	Brazil	6.42	64.20	0.48	
67	Georgia	6.29	62.90	0.47	
68	Iran, Islamic Rep.	6.26	62.60	0.46	
69	Turkey	6.20	62.00	0.46	
70	Jordan	6.10	61.00	0.45	
71	Morocco	6.07	60.70	0.44	
72	Panama	5.99	59.90	0.43	
73	Colombia	5.83	58.30	0.42	
74	Bosnia and Herzegovina	5.78	57.80	0.42	
75	Thailand	5.50	55.00	0.41	
76	South Africa	5.46	54.60	0.40	
77	China	5.45	54.50	0.39	
78	Egypt	5.30	53.00	0.38	
79	Tunisia	5.29	52.90	0.38	
80	Mongolia	5.12	51.20	0.37	
81	Mexico	5.08	50.80	0.36	
82	Algeria	5.03	50.30	0.35	
83	El Salvador	4.95	49.50	0.34	
84	Ecuador	4.90	49.00	0.34	
85	Jamaica	4.83	48.30	0.33	
86	Peru	4.80	48.00	0.32	
87	Albania	4.73	47.30	0.31	
88	Indonesia	4.71	47.10	0.30	
89	Philippines	4.70	47.00	0.30	
90	Viet Nam	4.60	46.00	0.29	
91	Paraguay	4.59	45.90	0.28	
92	Sri Lanka	4.51	45.10	0.27	
93	Guatemala	4.47	44.70	0.26	
94	Dominican Republic	4.38	43.80	0.26	
95	Bolivia, Plurinational St.	4.37	43.70	0.25	
96	Botswana	4.33	43.30	0.24	
97	Kyrgyzstan	4.25	42.50	0.22	
97	Namibia	4.25	42.50	0.22	
99	Cambodia	4.21	42.10	0.22	
100	Honduras	4.17	41.70	0.21	
101	Côte d'Ivoire	3.79	37.90	0.20	
102	Senegal	3.59	35.90	0.19	
103	Kenya	3.54	35.40	0.18	
104	Pakistan	3.39	33.90	0.18	
105	Zimbabwe	3.35	33.50	0.17	
106	India	3.32	33.20	0.16	
107	Mali	3.30	33.00	0.15	
108	Nepal	3.16	31.60	0.14	
109	Bangladesh	3.06	30.60	0.14	
110	Nigeria	2.96	29.60	0.13	
111	Mozambique	2.90	29.00	0.12	
112	Burkina Faso	2.87	28.70	0.11	
113	Benin	2.86	28.60	0.10	
114	Zambia	2.84	28.40	0.10	
115	Cameroon	2.77	27.70	0.09	
116	Yemen	2.66	26.60	0.08	
117	Rwanda	2.65	26.50	0.06	○
117	Tanzania, United Rep.	2.65	26.50	0.06	
119	Togo	2.59	25.90	0.06	
120	Guinea	2.57	25.70	0.05	
121	Madagascar	2.39	23.90	0.04	
122	Uganda	2.37	23.70	0.03	○
123	Burundi	2.14	21.40	0.02	
124	Ethiopia	2.11	21.10	0.02	○
125	Niger	2.04	20.40	0.01	○
126	Malawi	2.03	20.30	0.00	○
n/a	Tajikistan	n/a	n/a	n/a	

SOURCE: International Telecommunication Union, *Measuring the Information Society 2016*, ICT Development Index 2016

NOTE: ● indicates a strength; ○ a weakness

3.1.2 ICT use
ICT use index | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Denmark	8.91	89.10	1.00	●
2	Switzerland	8.67	86.70	0.99	●
3	Korea, Rep.	8.57	85.70	0.98	●
4	Norway	8.48	84.80	0.98	●
5	Iceland	8.44	84.40	0.97	
6	Sweden	8.36	83.60	0.96	
7	Finland	8.18	81.80	0.95	
8	Japan	8.14	81.40	0.94	
9	United Kingdom	8.09	80.90	0.94	
10	Luxembourg	8.05	80.50	0.93	
11	New Zealand	8.03	80.30	0.92	
12	Hong Kong (China)	7.94	79.40	0.91	
13	Estonia	7.87	78.70	0.90	
14	Netherlands	7.77	77.70	0.90	
15	Australia	7.70	77.00	0.89	
16	France	7.61	76.10	0.88	
17	United States of America	7.57	75.70	0.87	
18	Singapore	7.54	75.40	0.86	
19	Germany	7.49	74.90	0.86	
20	Bahrain	7.48	74.80	0.85	●
21	Ireland	7.38	73.80	0.84	
22	Belgium	7.10	71.00	0.83	
23	Spain	6.93	69.30	0.82	
24	Canada	6.85	68.50	0.82	
25	United Arab Emirates	6.82	68.20	0.81	
26	Malta	6.75	67.50	0.80	
27	Austria	6.67	66.70	0.79	
28	Czech Republic	6.55	65.50	0.78	
29	Lithuania	6.40	64.00	0.78	
30	Slovakia	6.38	63.80	0.77	
31	Qatar	6.32	63.20	0.75	
31	Saudi Arabia	6.32	63.20	0.75	
33	Latvia	6.27	62.70	0.74	
34	Italy	6.25	62.50	0.74	
35	Uruguay	6.20	62.00	0.73	●
36	Kuwait	6.15	61.50	0.72	●
37	Croatia	6.13	61.30	0.71	
38	Israel	6.02	60.20	0.70	
39	Belarus	5.88	58.80	0.70	
40	Russian Federation	5.87	58.70	0.69	
41	Malaysia	5.86	58.60	0.68	
42	Bulgaria	5.84	58.40	0.67	
43	Costa Rica	5.80	58.00	0.66	
44	Slovenia	5.71	57.10	0.66	
45	Azerbaijan	5.70	57.00	0.65	
46	Portugal	5.67	56.70	0.64	
47	Brazil	5.60	56.00	0.63	
48	Lebanon	5.51	55.10	0.62	
49	Serbia	5.50	55.00	0.62	
50	Cyprus	5.46	54.60	0.60	
50	Greece	5.46	54.60	0.60	
52	Argentina	5.45	54.50	0.59	
53	Oman	5.39	53.90	0.58	
54	Poland	5.35	53.50	0.58	
55	Hungary	5.28	52.80	0.57	
56	TFYR of Macedonia	5.17	51.70	0.56	
57	Kazakhstan	5.15	51.50	0.55	
58	Romania	5.08	50.80	0.54	
59	Chile	4.91	49.10	0.54	
60	Montenegro	4.61	46.10	0.53	
61	China	4.58	45.80	0.52	
62	Trinidad and Tobago	4.53	45.30	0.51	
63	Thailand	4.33	43.30	0.50	
64	Moldova, Rep.	4.26	42.60	0.50	
65	Mexico	4.24	42.40	0.49	
66	Bosnia and Herzegovina	4.21	42.10	0.48	
67	Turkey	4.18	41.80	0.47	
68	Georgia	4.00	40.00	0.46	
68	South Africa	4.00	40.00	0.46	
70	Tunisia	3.95	39.50	0.45	
71	Albania	3.88	38.80	0.44	
72	Armenia	3.85	38.50	0.42	
72	Colombia	3.85	38.50	0.42	
74	Mauritius	3.78	37.80	0.42	
75	Mongolia	3.64	36.40	0.41	
76	Jamaica	3.55	35.50	0.40	
77	Viet Nam	3.51	35.10	0.39	
78	Dominican Republic	3.41	34.10	0.38	
79	Morocco	3.40	34.00	0.38	
80	Ecuador	3.31	33.10	0.37	
81	Botswana	3.26	32.60	0.36	
82	Panama	3.24	32.40	0.35	
83	Jordan	3.20	32.00	0.34	
84	Egypt	3.14	31.40	0.34	
85	Brunei Darussalam	2.97	29.70	0.33	
86	Paraguay	2.96	29.60	0.32	
87	Peru	2.94	29.40	0.31	
88	Philippines	2.93	29.30	0.30	
89	Algeria	2.92	29.20	0.30	
90	Namibia	2.91	29.10	0.29	
91	Iran, Islamic Rep.	2.74	27.40	0.28	
92	Bolivia, Plurinational St.	2.72	27.20	0.27	
93	Ukraine	2.57	25.70	0.26	
94	Nigeria	2.28	22.80	0.26	
95	Kyrgyzstan	2.25	22.50	0.25	
96	Indonesia	2.19	21.90	0.24	
97	Cambodia	2.09	20.90	0.23	
98	Côte d'Ivoire	2.08	20.80	0.22	
99	Kenya	2.05	20.50	0.22	
100	Zimbabwe	1.91	19.10	0.21	
101	El Salvador	1.87	18.70	0.20	
102	Sri Lanka	1.70	17.00	0.19	
103	Senegal	1.64	16.40	0.18	
104	Rwanda	1.47	14.70	0.18	
105	Guatemala	1.40	14.00	0.17	
106	Honduras	1.38	13.80	0.16	
107	Nepal	1.35	13.50	0.15	
108	Uganda	1.27	12.70	0.14	
109	India	1.25	12.50	0.14	
110	Zambia	1.17	11.70	0.13	
111	Yemen	1.12	11.20	0.12	
112	Pakistan	1.09	10.90	0.11	
113	Bangladesh	1.06	10.60	0.10	
114	Mali	0.97	9.70	0.10	
115	Burkina Faso	0.90	9.00	0.09	
116	Malawi	0.86	8.60	0.08	
117	Cameroon	0.84	8.40	0.07	
118	Ethiopia	0.82	8.20	0.06	
119	Guinea	0.62	6.20	0.05	
119	Mozambique	0.62	6.20	0.05	
121	Togo	0.49	4.90	0.04	
122	Madagascar	0.44	4.40	0.03	○
123	Burundi	0.42	4.20	0.02	
124	Benin	0.40	4.00	0.02	○
125	Tanzania, United Rep.	0.30	3.00	0.01	○
126	Niger	0.14	1.40	0.00	○
n/a	Tajikistan	n/a	n/a	n/a	

SOURCE: International Telecommunication Union, *Measuring the Information Society 2016*, ICT Development Index 2016

NOTE: ● indicates a strength; ○ a weakness

3.1.3 Government's online service

Government's online service index | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United Kingdom	1.00	100.00	1.00	●
2	Australia	0.98	97.83	0.99	●
3	Singapore	0.97	97.10	0.98	●
4	Canada	0.96	95.65	0.98	●
5	Finland	0.94	94.20	0.94	
5	France	0.94	94.20	0.94	●
5	Korea, Rep.	0.94	94.20	0.94	
5	New Zealand	0.94	94.20	0.94	
9	Netherlands	0.93	92.75	0.93	
9	United States of America	0.93	92.75	0.93	
11	Austria	0.91	91.30	0.91	●
11	Spain	0.91	91.30	0.91	●
13	Estonia	0.89	89.13	0.90	
13	United Arab Emirates	0.89	89.13	0.90	
15	Japan	0.88	87.68	0.88	
15	Sweden	0.88	87.68	0.88	
17	Italy	0.87	86.96	0.87	●
18	Israel	0.86	86.23	0.86	
19	Mexico	0.85	84.78	0.85	●
19	Slovenia	0.85	84.78	0.85	
21	Germany	0.84	84.06	0.84	
22	Bahrain	0.83	82.61	0.82	●
22	Lithuania	0.83	82.61	0.82	●
24	Serbia	0.82	81.88	0.82	●
25	Norway	0.80	80.44	0.81	
26	Malta	0.80	79.71	0.80	
27	Colombia	0.79	78.99	0.79	
28	Chile	0.78	77.54	0.77	
28	Denmark	0.78	77.54	0.77	
28	Uruguay	0.78	77.54	0.77	●
31	China	0.77	76.81	0.75	
31	Kazakhstan	0.77	76.81	0.75	●
33	Croatia	0.75	74.64	0.73	
33	India	0.75	74.64	0.73	
33	Portugal	0.75	74.64	0.73	
36	Morocco	0.74	73.91	0.72	
37	Brazil	0.73	73.19	0.70	●
37	Russian Federation	0.73	73.19	0.70	
39	Ireland	0.72	72.46	0.70	
40	Luxembourg	0.72	71.74	0.67	
40	Malaysia	0.72	71.74	0.67	
40	Tunisia	0.72	71.74	0.67	
43	Argentina	0.71	71.01	0.66	
43	Belgium	0.71	71.01	0.66	
45	Mauritius	0.70	70.29	0.64	
45	Poland	0.70	70.29	0.64	
47	Azerbaijan	0.68	68.12	0.62	
47	Montenegro	0.68	68.12	0.62	
49	Qatar	0.67	67.39	0.61	
49	Saudi Arabia	0.67	67.39	0.61	
51	Guatemala	0.67	66.67	0.59	
51	Philippines	0.67	66.67	0.59	
53	Kuwait	0.65	65.22	0.58	
53	Sri Lanka	0.65	65.22	0.58	
55	Costa Rica	0.64	63.77	0.56	
55	Georgia	0.64	63.77	0.56	
57	Ecuador	0.63	63.04	0.54	
57	Hungary	0.63	63.04	0.54	
57	Peru	0.63	63.04	0.54	
60	Bangladesh	0.62	62.32	0.52	●
60	Iceland	0.62	62.32	0.52	
62	Latvia	0.61	60.87	0.50	
62	TFYR of Macedonia	0.61	60.87	0.50	
64	Paraguay	0.60	60.15	0.48	
64	Switzerland	0.60	60.15	0.48	○
64	Turkey	0.60	60.15	0.48	
67	Albania	0.59	59.42	0.46	
67	Moldova, Rep.	0.59	59.42	0.46	
67	Oman	0.59	59.42	0.46	
70	Ukraine	0.59	58.70	0.45	
71	Greece	0.58	57.97	0.44	
72	Tanzania, United Rep.	0.57	57.25	0.42	
72	Viet Nam	0.57	57.25	0.42	
74	Bulgaria	0.57	56.52	0.42	
75	Kenya	0.56	55.80	0.40	
75	South Africa	0.56	55.80	0.40	
77	Thailand	0.55	55.07	0.39	
78	Cyprus	0.54	53.62	0.38	
79	Ethiopia	0.53	52.90	0.37	
79	Trinidad and Tobago	0.53	52.90	0.37	
81	Lebanon	0.51	51.45	0.35	
81	Mongolia	0.51	51.45	0.35	
83	Brunei Darussalam	0.51	50.73	0.34	
83	Dominican Republic	0.51	50.73	0.34	
85	Uganda	0.50	50.00	0.33	
86	Bolivia, Plurinational St.	0.49	49.28	0.32	
87	Belarus	0.49	48.55	0.30	
87	El Salvador	0.49	48.55	0.30	
89	Czech Republic	0.48	47.83	0.30	○
90	Egypt	0.47	47.10	0.29	
91	Jordan	0.46	45.65	0.26	
91	Romania	0.46	45.65	0.26	○
91	Rwanda	0.46	45.65	0.26	
94	Bosnia and Herzegovina	0.45	44.93	0.26	
95	Slovakia	0.44	44.20	0.25	○
96	Armenia	0.43	42.75	0.23	
96	Kyrgyzstan	0.43	42.75	0.23	
98	Nigeria	0.41	41.30	0.22	
99	Nepal	0.40	39.86	0.22	
100	Senegal	0.38	37.68	0.21	
101	Zambia	0.37	36.96	0.20	
102	Indonesia	0.36	36.23	0.19	
103	Jamaica	0.36	35.51	0.18	
104	Iran, Islamic Rep.	0.33	33.33	0.17	
104	Panama	0.33	33.33	0.17	
106	Pakistan	0.33	32.61	0.16	
107	Togo	0.32	31.88	0.15	
108	Honduras	0.31	31.16	0.14	
109	Botswana	0.28	28.26	0.13	
109	Namibia	0.28	28.26	0.13	
111	Zimbabwe	0.26	26.09	0.12	
112	Madagascar	0.22	22.46	0.11	
113	Cameroon	0.22	21.74	0.10	
113	Malawi	0.22	21.74	0.10	
115	Mozambique	0.20	20.29	0.09	
116	Burkina Faso	0.19	18.84	0.07	
116	Côte d'Ivoire	0.19	18.84	0.07	○
118	Burundi	0.15	15.22	0.06	
119	Benin	0.14	14.49	0.05	○
119	Yemen	0.14	14.49	0.05	
121	Tajikistan	0.12	12.32	0.04	
122	Mali	0.09	9.42	0.03	○
123	Guinea	0.09	8.70	0.02	
124	Niger	0.07	7.25	0.02	
125	Algeria	0.07	6.52	0.01	○
126	Cambodia	0.05	5.07	0.00	○
n/a	Hong Kong (China)	n/a	n/a	n/a	

SOURCE: United Nations Public Administration Network, *e-Government Survey 2016*

NOTE: ● indicates a strength; ○ a weakness

3.1.4 Online e-participation

E-Participation Index | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United Kingdom	1.00	100.00	1.00	●
2	Australia	0.98	98.31	0.98	●
2	Japan	0.98	98.31	0.98	●
4	Korea, Rep.	0.97	96.61	0.98	●
5	Netherlands	0.95	94.92	0.96	●
5	New Zealand	0.95	94.92	0.96	
7	Spain	0.93	93.22	0.95	●
8	Canada	0.92	91.53	0.92	
8	Finland	0.92	91.53	0.92	
8	Italy	0.92	91.53	0.92	●
8	Singapore	0.92	91.53	0.92	
12	France	0.90	89.83	0.90	
12	United States of America	0.90	89.83	0.90	
14	Austria	0.88	88.14	0.88	
14	Mexico	0.88	88.14	0.88	●
14	Poland	0.88	88.14	0.88	●
17	Israel	0.83	83.05	0.84	
17	Lithuania	0.83	83.05	0.84	●
17	Montenegro	0.83	83.05	0.84	●
17	Morocco	0.83	83.05	0.84	●
17	Serbia	0.83	83.05	0.84	●
22	China	0.81	81.36	0.82	
22	Denmark	0.81	81.36	0.82	
22	Estonia	0.81	81.36	0.82	
25	Croatia	0.78	77.97	0.80	●
25	Malta	0.78	77.97	0.80	
27	Colombia	0.76	76.27	0.76	
27	Germany	0.76	76.27	0.76	
27	India	0.76	76.27	0.76	
27	Norway	0.76	76.27	0.76	
27	Sweden	0.76	76.27	0.76	
32	Bahrain	0.75	74.58	0.72	
32	Chile	0.75	74.58	0.72	
32	Russian Federation	0.75	74.58	0.72	
32	Ukraine	0.75	74.58	0.72	
32	United Arab Emirates	0.75	74.58	0.72	
37	Brazil	0.73	72.88	0.70	●
37	Slovenia	0.73	72.88	0.70	
39	Ireland	0.71	71.19	0.67	
39	Mongolia	0.71	71.19	0.67	
39	Saudi Arabia	0.71	71.19	0.67	
39	Uruguay	0.71	71.19	0.67	
43	Bulgaria	0.69	69.49	0.64	
43	Luxembourg	0.69	69.49	0.64	
43	Tunisia	0.69	69.49	0.64	
43	Viet Nam	0.69	69.49	0.64	
47	Azerbaijan	0.68	67.80	0.62	
47	Malaysia	0.68	67.80	0.62	
49	Iceland	0.66	66.10	0.58	
49	Mauritius	0.66	66.10	0.58	
49	Moldova, Rep.	0.66	66.10	0.58	
49	Portugal	0.66	66.10	0.58	
49	Sri Lanka	0.66	66.10	0.58	
54	Albania	0.64	64.41	0.54	
54	Belgium	0.64	64.41	0.54	○
54	Costa Rica	0.64	64.41	0.54	
54	Kuwait	0.64	64.41	0.54	
54	Qatar	0.64	64.41	0.54	
59	Argentina	0.63	62.71	0.51	
59	Guatemala	0.63	62.71	0.51	
59	Romania	0.63	62.71	0.51	
59	Turkey	0.63	62.71	0.51	
63	Greece	0.61	61.02	0.50	
63	TFYR of Macedonia	0.61	61.02	0.50	
65	Kazakhstan	0.59	59.32	0.46	
65	Kyrgyzstan	0.59	59.32	0.46	
65	Philippines	0.59	59.32	0.46	
65	Tanzania, United Rep.	0.59	59.32	0.46	
65	Thailand	0.59	59.32	0.46	
70	Bolivia, Plurinational St.	0.58	57.63	0.42	
70	Ecuador	0.58	57.63	0.42	
70	Paraguay	0.58	57.63	0.42	
70	Switzerland	0.58	57.63	0.42	○
74	Belarus	0.56	55.93	0.38	
74	Czech Republic	0.56	55.93	0.38	○
74	El Salvador	0.56	55.93	0.38	
74	Georgia	0.56	55.93	0.38	
74	Oman	0.56	55.93	0.38	
74	South Africa	0.56	55.93	0.38	
80	Peru	0.54	54.24	0.36	
80	Slovakia	0.54	54.24	0.36	
82	Armenia	0.53	52.54	0.32	
82	Bangladesh	0.53	52.54	0.32	
82	Cyprus	0.53	52.54	0.32	
82	Kenya	0.53	52.54	0.32	
82	Latvia	0.53	52.54	0.32	○
87	Bosnia and Herzegovina	0.51	50.85	0.30	
87	Nepal	0.51	50.85	0.30	
89	Dominican Republic	0.49	49.15	0.26	
89	Ethiopia	0.49	49.15	0.26	
89	Hungary	0.49	49.15	0.26	○
89	Lebanon	0.49	49.15	0.26	
89	Rwanda	0.49	49.15	0.26	
89	Uganda	0.49	49.15	0.26	
95	Jordan	0.46	45.76	0.25	
96	Trinidad and Tobago	0.44	44.07	0.24	
97	Egypt	0.41	40.68	0.23	
98	Honduras	0.39	38.98	0.21	
98	Senegal	0.39	38.98	0.21	
98	Togo	0.39	38.98	0.21	
101	Brunei Darussalam	0.37	37.29	0.18	
101	Indonesia	0.37	37.29	0.18	
101	Pakistan	0.37	37.29	0.18	
101	Panama	0.37	37.29	0.18	
105	Nigeria	0.36	35.59	0.16	
105	Zambia	0.36	35.59	0.16	
107	Botswana	0.29	28.81	0.14	
107	Malawi	0.29	28.81	0.14	
107	Zimbabwe	0.29	28.81	0.14	
110	Jamaica	0.27	27.12	0.13	○
111	Burkina Faso	0.24	23.73	0.11	
111	Namibia	0.24	23.73	0.11	
113	Iran, Islamic Rep.	0.20	20.34	0.08	○
113	Madagascar	0.20	20.34	0.08	
113	Mozambique	0.20	20.34	0.08	
113	Tajikistan	0.20	20.34	0.08	
117	Benin	0.17	16.95	0.06	
117	Cameroon	0.17	16.95	0.06	
119	Burundi	0.15	15.25	0.05	
119	Côte d'Ivoire	0.15	15.25	0.05	○
121	Yemen	0.14	13.56	0.04	
122	Algeria	0.12	11.86	0.03	
123	Guinea	0.08	8.48	0.02	○
123	Niger	0.08	8.48	0.02	
125	Cambodia	0.07	6.78	0.00	○
125	Mali	0.07	6.78	0.00	○
n/a	Hong Kong (China)	n/a	n/a	n/a	

SOURCE: United Nations Public Administration Network, *e-Government Survey 2016*
NOTE: ● indicates a strength; ○ a weakness

3.2.1 Electricity output

Electricity output (kWh per capita) | 2014

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Iceland	56,966.67	100.00	0.99	●
1	Norway	27,803.66	100.00	0.99	●
3	Bahrain	20,038.97	72.06	0.98	●
4	Qatar	17,830.41	64.11	0.97	●
5	Canada	17,594.07	63.26	0.97	●
6	Kuwait	17,370.67	62.45	0.96	●
7	Sweden	16,520.68	59.39	0.95	
8	United States of America	13,342.40	47.96	0.94	
9	Finland	12,494.72	44.90	0.93	
10	United Arab Emirates	12,098.90	43.48	0.92	●
11	Korea, Rep.	10,756.72	38.65	0.92	
12	Brunei Darussalam	10,728.57	38.55	0.91	●
13	Australia	10,388.17	37.32	0.90	
14	Saudi Arabia	10,094.08	36.27	0.89	●
15	New Zealand	9,821.33	35.28	0.88	
16	Singapore	9,027.42	32.43	0.87	
17	France	8,470.55	30.42	0.86	
18	Paraguay	8,440.00	30.31	0.86	●
19	Switzerland	7,975.42	28.64	0.85	
20	Japan	7,948.11	28.54	0.84	
21	Germany	7,915.44	28.42	0.83	
22	Estonia	7,891.67	28.34	0.82	
23	Israel	7,849.70	28.19	0.81	
24	Czech Republic	7,823.01	28.09	0.81	
25	Russian Federation	7,386.55	26.52	0.80	
26	Trinidad and Tobago	7,326.67	26.31	0.79	●
27	Austria	7,206.53	25.87	0.78	
28	Slovenia	7,153.14	25.68	0.77	
29	Oman	6,869.81	24.66	0.76	●
30	Bulgaria	6,499.58	23.33	0.75	
31	Netherlands	6,497.52	23.32	0.75	
32	Ireland	6,102.15	21.90	0.74	
33	Kazakhstan	6,076.81	21.81	0.73	●
34	Belgium	5,969.55	21.42	0.72	
35	Spain	5,940.70	21.32	0.71	
36	Hong Kong (China)	5,511.33	19.77	0.70	
37	Malta	5,220.93	18.73	0.69	
38	United Kingdom	5,155.45	18.49	0.69	
39	Montenegro	5,119.35	18.36	0.68	
40	Denmark	5,075.97	18.21	0.67	
41	Cyprus	5,058.14	18.14	0.66	
42	Malaysia	4,932.07	17.69	0.65	
43	Portugal	4,900.29	17.57	0.64	
44	Slovakia	4,787.32	17.17	0.64	
45	Serbia	4,690.88	16.82	0.63	
46	South Africa	4,619.83	16.56	0.62	
47	Italy	4,597.36	16.48	0.61	
48	Greece	4,374.43	15.68	0.60	
49	Poland	4,263.42	15.28	0.59	
50	Bosnia and Herzegovina	4,230.37	15.16	0.58	
51	China	4,152.95	14.88	0.58	
52	Chile	4,118.79	14.76	0.57	
53	Ukraine	4,011.73	14.38	0.56	
54	Lebanon	3,945.49	14.14	0.55	
55	Uruguay	3,804.39	13.63	0.54	
56	Belarus	3,667.90	13.14	0.53	
57	Iran, Islamic Rep.	3,514.32	12.59	0.53	
58	Turkey	3,351.70	12.00	0.52	
59	Argentina	3,286.64	11.77	0.51	
60	Romania	3,274.84	11.72	0.50	
61	Croatia	3,168.87	11.34	0.49	
62	Hungary	3,061.97	10.96	0.48	
63	Brazil	2,866.03	10.25	0.47	
64	Jordan	2,756.43	9.86	0.47	
65	Azerbaijan	2,592.03	9.27	0.46	
66	TFYR of Macedonia	2,583.65	9.24	0.45	
67	Latvia	2,583.42	9.23	0.44	
68	Armenia	2,574.75	9.20	0.43	
69	Thailand	2,563.58	9.16	0.42	
70	Mexico	2,538.55	9.07	0.42	
71	Kyrgyzstan	2,499.49	8.93	0.41	
72	Panama	2,399.74	8.57	0.40	
73	Mauritius	2,328.57	8.32	0.39	
74	Georgia	2,304.67	8.23	0.38	
75	Luxembourg	2,289.47	8.18	0.37	
76	Costa Rica	2,146.43	7.66	0.36	
77	Tajikistan	1,984.58	7.08	0.36	
78	Egypt	1,917.25	6.84	0.35	
79	Mongolia	1,847.42	6.59	0.34	
80	Dominican Republic	1,784.15	6.36	0.33	
81	Tunisia	1,729.45	6.16	0.32	
82	Algeria	1,650.19	5.88	0.31	
83	Albania	1,634.60	5.82	0.31	
84	Viet Nam	1,553.10	5.53	0.30	
85	Ecuador	1,528.74	5.44	0.29	
86	Jamaica	1,516.18	5.39	0.28	
87	Moldova, Rep.	1,503.09	5.35	0.27	
88	Peru	1,470.04	5.23	0.26	
89	Colombia	1,463.07	5.20	0.25	
90	Lithuania	1,265.53	4.49	0.25	○
91	Botswana	1,064.41	3.77	0.24	
92	El Salvador	1,018.49	3.60	0.23	
93	Honduras	1,009.80	3.57	0.22	
94	India	993.91	3.51	0.21	
95	Zambia	919.34	3.25	0.20	
96	Indonesia	898.20	3.17	0.19	
97	Morocco	847.46	2.99	0.19	○
98	Bolivia, Plurinational St.	829.07	2.92	0.18	
99	Philippines	779.32	2.74	0.17	
100	Guatemala	669.48	2.35	0.16	
101	Zimbabwe	657.25	2.30	0.15	
102	Mozambique	651.87	2.28	0.14	
103	Namibia	624.17	2.18	0.14	
104	Sri Lanka	603.73	2.11	0.13	○
105	Pakistan	569.09	1.99	0.12	
106	Côte d'Ivoire	373.92	1.28	0.11	
107	Bangladesh	351.05	1.20	0.10	
108	Cameroon	304.00	1.03	0.09	
109	Yemen	292.06	0.99	0.08	
110	Senegal	254.19	0.85	0.08	
111	Kenya	206.38	0.68	0.07	○
112	Cambodia	199.54	0.66	0.06	○
113	Nigeria	171.23	0.55	0.05	
114	Nepal	134.74	0.42	0.04	○
115	Tanzania, United Rep.	120.01	0.37	0.03	
116	Ethiopia	99.16	0.29	0.03	
117	Niger	36.11	0.07	0.02	
118	Togo	19.94	0.01	0.01	○
119	Benin	17.36	0.00	0.00	○
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	

SOURCE: International Energy Agency (IEA) *World Energy Balances on-line data service, 2015 edition*
NOTE: ● indicates a strength; ○ a weakness

3.2.2 Logistics performance

Logistics Performance Index | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Germany	4.23	100.00	1.00	●
2	Luxembourg	4.22	99.70	0.99	●
3	Sweden	4.20	99.01	0.98	●
4	Netherlands	4.19	98.22	0.98	●
5	Singapore	4.14	96.19	0.97	
6	Belgium	4.11	94.57	0.96	●
7	Austria	4.10	94.08	0.95	●
8	United Kingdom	4.07	92.77	0.94	
9	Hong Kong (China)	4.07	92.75	0.94	
10	United States of America	3.99	89.19	0.93	
11	Switzerland	3.99	88.96	0.92	
12	Japan	3.97	88.19	0.91	
13	United Arab Emirates	3.94	86.86	0.90	●
14	Canada	3.93	86.35	0.90	
15	Finland	3.92	85.89	0.89	
16	France	3.90	84.98	0.88	
17	Denmark	3.82	81.04	0.87	
18	Ireland	3.79	80.07	0.87	
19	Australia	3.79	80.00	0.86	
20	South Africa	3.78	79.17	0.85	●
21	Italy	3.76	78.25	0.84	
22	Norway	3.73	77.17	0.83	
23	Spain	3.73	76.95	0.83	
24	Korea, Rep.	3.72	76.48	0.82	
25	Czech Republic	3.67	74.50	0.81	
26	China	3.66	73.89	0.80	
27	Israel	3.66	73.85	0.79	
28	Lithuania	3.63	72.53	0.79	
29	Qatar	3.60	71.03	0.78	
30	Hungary	3.43	63.16	0.77	
31	Malaysia	3.43	63.03	0.76	
32	Poland	3.43	63.01	0.75	
33	Turkey	3.42	62.91	0.75	
34	India	3.42	62.74	0.74	
35	Portugal	3.41	62.25	0.73	
36	New Zealand	3.39	61.26	0.72	
37	Estonia	3.36	60.13	0.71	
38	Iceland	3.35	59.30	0.71	
39	Panama	3.34	58.94	0.70	
40	Slovakia	3.34	58.90	0.69	
41	Kenya	3.33	58.64	0.68	
42	Latvia	3.33	58.45	0.67	
43	Bahrain	3.31	57.84	0.67	
44	Thailand	3.26	55.12	0.66	
45	Chile	3.25	54.81	0.65	
46	Greece	3.24	54.40	0.64	
47	Oman	3.23	54.16	0.63	
48	Egypt	3.18	51.88	0.63	●
49	Slovenia	3.18	51.86	0.62	
50	Croatia	3.16	50.76	0.61	
51	Saudi Arabia	3.16	50.56	0.60	
52	Kuwait	3.15	50.34	0.60	
53	Mexico	3.11	48.60	0.59	
54	Brazil	3.09	47.39	0.58	
55	Malta	3.07	46.53	0.57	
56	Botswana	3.05	45.43	0.56	
57	Uganda	3.04	45.33	0.56	
58	Cyprus	3.00	43.28	0.55	
59	Romania	2.99	43.01	0.54	
60	Tanzania, United Rep.	2.99	42.87	0.53	●
61	Rwanda	2.99	42.69	0.52	
62	Indonesia	2.98	42.61	0.52	
63	Viet Nam	2.98	42.25	0.51	
64	Uruguay	2.97	42.15	0.50	
65	Argentina	2.96	41.60	0.49	
66	Jordan	2.96	41.32	0.48	
67	Pakistan	2.92	39.78	0.48	
68	Peru	2.89	38.40	0.47	
69	Brunei Darussalam	2.87	37.34	0.46	
70	Philippines	2.86	36.68	0.45	
71	Malawi (2014)	2.81	34.68	0.44	
72	Bulgaria	2.81	34.44	0.44	
73	Cambodia	2.80	34.11	0.43	
74	Ecuador	2.78	33.11	0.42	
75	Algeria	2.77	32.68	0.41	
76	Serbia	2.76	32.35	0.40	
77	Kazakhstan	2.75	31.86	0.40	
78	Namibia	2.74	31.53	0.39	
79	Ukraine	2.74	31.15	0.38	
80	Burkina Faso	2.73	30.88	0.37	
81	Lebanon	2.72	30.26	0.37	
82	El Salvador	2.71	29.72	0.36	
83	Sri Lanka (2014)	2.70	29.24	0.35	
84	Mozambique	2.68	28.72	0.34	
85	Morocco	2.67	27.89	0.33	
86	Bangladesh	2.66	27.79	0.33	
87	Costa Rica	2.65	27.10	0.32	
88	Nigeria	2.63	26.13	0.31	
89	Dominican Republic	2.63	26.10	0.30	
90	Togo	2.62	25.66	0.29	
91	Moldova, Rep.	2.61	25.50	0.29	
92	Colombia	2.61	25.41	0.28	
93	Côte d'Ivoire	2.60	24.95	0.27	
94	Iran, Islamic Rep.	2.60	24.89	0.26	
95	Bosnia and Herzegovina	2.60	24.66	0.25	
96	Russian Federation	2.57	23.49	0.25	○
97	Niger	2.56	23.08	0.24	
98	Paraguay	2.56	23.05	0.23	
99	Mauritius (2014)	2.51	20.90	0.22	
100	TFYR of Macedonia	2.51	20.69	0.21	○
101	Burundi	2.51	20.67	0.21	
102	Mongolia	2.51	20.49	0.20	
103	Mali	2.50	20.36	0.19	
104	Tunisia	2.50	20.06	0.18	○
105	Guatemala	2.48	19.12	0.17	
106	Honduras	2.46	18.49	0.17	
107	Azerbaijan (2014)	2.45	17.83	0.16	
108	Zambia	2.43	16.97	0.15	
109	Benin	2.43	16.89	0.14	
110	Albania	2.41	16.17	0.13	
111	Jamaica	2.40	15.60	0.13	○
112	Belarus	2.40	15.55	0.12	○
113	Trinidad and Tobago	2.40	15.52	0.11	
114	Montenegro	2.38	14.67	0.10	○
115	Nepal	2.38	14.52	0.10	
116	Ethiopia	2.38	14.52	0.09	
117	Guinea	2.36	13.69	0.08	
118	Georgia	2.35	13.42	0.07	○
119	Senegal	2.33	12.25	0.06	○
120	Bolivia, Plurinational St.	2.25	8.72	0.06	○
121	Armenia	2.21	6.60	0.05	○
122	Yemen (2014)	2.18	5.60	0.04	
123	Kyrgyzstan	2.16	4.31	0.03	○
124	Madagascar	2.15	4.25	0.02	○
125	Cameroon	2.15	4.10	0.02	○
126	Zimbabwe	2.08	0.91	0.01	○
127	Tajikistan	2.06	0.00	0.00	○

SOURCE: World Bank and Turku School of Economics, *Logistics Performance Index 2016*; Arvis et al., 2016, *Connecting to Compete 2016: Trade Logistics in the Global Economy*

NOTE: ● indicates a strength; ○ a weakness

3.2.3 Gross capital formation

Gross capital formation (% of GDP) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Algeria	47.81	100.00	1.00	●
2	Panama	47.20	98.64	0.99	●
3	China	43.66	90.70	0.98	●
4	Niger	42.52	88.13	0.98	●
5	Brunei Darussalam	40.94	84.58	0.97	●
6	Ethiopia	39.74	81.89	0.96	●
7	Mozambique	38.55	79.22	0.95	●
8	Indonesia	34.65	70.49	0.94	●
9	Nepal	33.96	68.92	0.93	●
10	Georgia	33.43	67.75	0.93	●
11	Kyrgyzstan	33.43	67.73	0.92	●
12	India	31.67	63.78	0.91	●
13	Saudi Arabia	31.66	63.77	0.90	●
14	Zambia	31.50	63.40	0.89	●
15	Oman	31.00	62.29	0.89	●
16	Tanzania, United Rep.	30.74	61.70	0.88	●
17	Botswana	30.44	61.04	0.87	●
18	Morocco	30.24	60.59	0.86	●
19	Azerbaijan	29.77	59.53	0.85	●
20	Rwanda	29.53	58.99	0.85	●
21	Namibia	29.23	58.32	0.84	●
22	Korea, Rep.	28.90	57.57	0.83	
23	Iran, Islamic Rep.	28.87	57.51	0.82	●
24	Albania	28.83	57.41	0.81	●
25	Bangladesh	28.45	56.57	0.80	●
26	Sri Lanka	28.34	56.31	0.80	●
27	Norway	28.31	56.25	0.79	
28	Kazakhstan	28.09	55.75	0.78	●
29	Viet Nam	28.03	55.63	0.77	●
30	Montenegro	27.08	53.50	0.76	
31	Mongolia	27.02	53.36	0.76	
32	Belarus	26.86	53.01	0.75	
33	Senegal	26.58	52.38	0.74	●
34	Benin	26.25	51.63	0.73	●
35	Malaysia	26.15	51.40	0.72	
36	Czech Republic	26.06	51.19	0.72	
37	Togo	26.02	51.12	0.71	●
38	Honduras	25.98	51.03	0.70	●
39	Singapore	25.97	51.00	0.69	
40	Uganda	25.63	50.25	0.68	●
41	Sweden	25.63	50.24	0.67	
42	Malta	25.60	50.18	0.67	
43	Romania	25.01	48.84	0.66	
44	Colombia	25.00	48.83	0.65	
45	Australia	24.92	48.66	0.64	
46	Ecuador	24.73	48.23	0.63	●
47	Peru	24.63	48.00	0.63	
48	Thailand	24.42	47.52	0.62	
49	Estonia	24.04	46.68	0.61	
50	Philippines	23.74	45.99	0.60	
51	Belgium	23.65	45.81	0.59	
52	Kuwait	23.49	45.44	0.59	
53	New Zealand	23.29	44.99	0.58	
54	Mexico	23.10	44.56	0.57	
55	Switzerland	23.08	44.53	0.56	○
56	Canada	23.07	44.50	0.55	
57	Cambodia	22.90	44.12	0.54	●
58	Slovakia	22.78	43.85	0.54	
59	Kenya	22.52	43.27	0.53	
60	Ireland	22.45	43.12	0.52	○
61	Austria	22.45	43.11	0.51	○
62	France	22.39	42.97	0.50	○
63	Chile	22.34	42.85	0.50	
64	Hong Kong (China)	22.06	42.23	0.49	
65	Bulgaria	21.96	42.00	0.48	
66	Cameroon	21.88	41.83	0.47	●
67	Tunisia	21.71	41.45	0.46	
68	Mauritius	21.67	41.37	0.46	
69	Russian Federation	21.63	41.27	0.45	
70	Latvia	21.61	41.22	0.44	
71	Japan	21.53	41.05	0.43	
72	Finland	21.42	40.79	0.42	○
73	Moldova, Rep.	21.07	40.01	0.41	
74	Spain	20.97	39.79	0.41	○
75	Hungary	20.95	39.75	0.40	
76	Armenia	20.62	39.00	0.39	
77	Iceland	20.55	38.83	0.38	○
78	Poland	20.33	38.34	0.37	○
79	Côte d'Ivoire	20.17	37.99	0.37	
80	Dominican Republic	20.06	37.75	0.36	
81	Uruguay	20.02	37.65	0.35	
82	United States of America	19.76	37.08	0.34	○
83	Bahrain	19.68	36.89	0.33	
84	United Arab Emirates	19.67	36.87	0.33	○
85	South Africa	19.60	36.71	0.32	
86	Denmark	19.56	36.61	0.31	○
87	Netherlands	19.50	36.48	0.30	○
88	Jordan	19.48	36.44	0.29	
89	Israel	19.45	36.38	0.28	○
90	Mali	19.40	36.26	0.28	
91	Germany	19.27	35.98	0.27	○
92	Bolivia, Plurinational St.	19.18	35.77	0.26	
93	Costa Rica	18.80	34.92	0.25	
94	Slovenia	18.79	34.90	0.24	○
95	Croatia	18.74	34.79	0.24	○
96	Luxembourg	18.58	34.43	0.23	○
97	Serbia	18.25	33.69	0.22	
98	Brazil	17.96	33.04	0.21	○
99	Tajikistan	17.89	32.88	0.20	
100	Lithuania	17.66	32.36	0.20	○
101	Turkey	17.40	31.79	0.19	○
102	United Kingdom	17.34	31.65	0.18	○
103	Bosnia and Herzegovina	17.12	31.16	0.17	
104	Guinea	16.90	30.66	0.16	
105	Italy	16.65	30.08	0.15	○
106	Argentina	16.50	29.77	0.15	
107	Paraguay	15.82	28.23	0.14	
108	Ukraine	15.81	28.22	0.13	○
109	Jamaica	15.43	27.35	0.12	○
110	Madagascar	15.33	27.13	0.11	
111	Pakistan	15.21	26.86	0.11	
112	Portugal	14.97	26.33	0.10	○
113	Egypt	14.53	25.34	0.09	
114	Burkina Faso	14.27	24.75	0.08	
115	Zimbabwe	14.23	24.67	0.07	
116	El Salvador	14.22	24.65	0.07	
117	Nigeria	13.81	23.71	0.06	
118	Trinidad and Tobago	13.42	22.85	0.05	○
119	Guatemala	13.36	22.71	0.04	○
120	Malawi	12.55	20.90	0.03	
121	Cyprus	10.44	16.17	0.02	○
122	Greece	10.33	15.91	0.02	○
123	Burundi	4.19	2.15	0.01	○
124	Yemen	3.24	0.00	0.00	○
n/a	Lebanon	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	

SOURCE: International Monetary Fund, *World Economic Outlook Database*, October 2016

NOTE: ● indicates a strength; ○ a weakness

3.3.1 GDP per unit of energy use

GDP per unit of energy use (2010 PPP$ per kg of oil equivalent) | 2014

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Hong Kong (China)	26.32	100.00	1.00	●
2	Sri Lanka	20.00	75.32	0.99	●
3	Panama	17.86	66.95	0.98	●
4	Colombia	17.54	65.73	0.96	●
4	Ireland	17.54	65.73	0.96	●
4	Switzerland	17.54	65.73	0.96	
7	Dominican Republic	16.95	63.40	0.95	●
8	Mauritius	15.63	58.23	0.94	●
9	Malta	15.15	56.38	0.92	
9	Singapore	15.15	56.38	0.92	
11	Denmark	14.93	55.50	0.92	
12	Peru	14.49	53.81	0.91	●
13	Uruguay	14.08	52.21	0.90	●
14	United Kingdom	13.89	51.45	0.89	
15	Costa Rica	13.51	49.98	0.88	●
16	Philippines	13.51	49.98	0.87	●
17	Luxembourg	13.33	49.28	0.86	
18	Bangladesh	13.16	48.59	0.85	●
18	Italy	13.16	48.59	0.85	
20	Cyprus	12.99	47.92	0.84	
21	Morocco	12.66	46.64	0.83	●
22	Albania	12.50	46.02	0.82	●
23	Spain	12.50	46.02	0.81	
23	Yemen	12.50	46.02	0.81	●
25	Botswana	12.35	45.42	0.79	●
25	Portugal	12.35	45.42	0.79	
27	Namibia	12.35	45.42	0.78	●
28	Ecuador	11.90	43.69	0.77	●
29	Egypt	11.76	43.15	0.75	●
29	El Salvador	11.76	43.15	0.75	●
31	Romania	11.49	42.09	0.75	
32	Austria	11.24	41.08	0.71	
32	Germany	11.24	41.08	0.71	
32	Greece	11.24	41.08	0.71	
32	Tunisia	11.24	41.08	0.71	●
36	Indonesia	11.11	40.59	0.70	●
37	Israel	11.11	40.59	0.69	
37	Turkey	11.11	40.59	0.69	
39	Azerbaijan	10.87	39.65	0.68	
40	Netherlands	10.75	39.19	0.67	○
41	Mexico	10.64	38.75	0.66	
42	Paraguay	10.53	38.31	0.65	●
43	Chile	10.42	37.88	0.63	
43	Lithuania	10.42	37.88	0.63	
43	Norway	10.42	37.88	0.63	
46	Japan	10.20	37.05	0.62	
47	Brazil	10.10	36.65	0.61	
48	Algeria	10.00	36.25	0.59	●
48	TFYR of Macedonia	10.00	36.25	0.59	
50	Croatia	10.00	36.25	0.58	
51	France	9.90	35.87	0.58	○
52	Lebanon	9.90	35.87	0.57	
53	Hungary	9.80	35.49	0.55	
53	Latvia	9.80	35.49	0.55	
55	Poland	9.71	35.11	0.54	
56	Argentina	9.35	33.70	0.53	
57	Pakistan	9.26	33.36	0.53	●
58	Montenegro	9.17	33.03	0.52	
59	Slovakia	9.09	32.70	0.51	
60	Jordan	9.09	32.70	0.50	
61	Slovenia	8.85	31.76	0.49	
62	Sweden	8.62	30.86	0.48	○
63	Belgium	8.47	30.29	0.47	○
63	Guatemala	8.47	30.29	0.47	
65	India	8.40	30.01	0.46	
66	Cameroon	8.33	29.74	0.45	●
67	Australia	8.20	29.21	0.44	○
68	United Arab Emirates	8.13	28.95	0.43	
69	Jamaica	8.06	28.69	0.42	
69	Senegal	8.06	28.69	0.42	
71	Malaysia	8.00	28.44	0.41	
72	Bolivia, Plurinational St.	7.87	27.95	0.40	
73	Brunei Darussalam	7.81	27.71	0.39	
74	Armenia	7.69	27.24	0.38	
75	New Zealand	7.63	27.01	0.37	○
76	Kuwait	7.58	26.78	0.36	
76	United States of America	7.58	26.78	0.36	○
78	Czech Republic	7.46	26.34	0.35	○
79	Tajikistan	7.46	26.34	0.34	
80	Thailand	7.41	26.12	0.33	
81	Cambodia	7.35	25.91	0.32	
82	Nigeria	7.30	25.70	0.31	
83	Georgia	7.25	25.49	0.31	
84	Viet Nam	7.14	25.09	0.30	
85	Saudi Arabia	7.04	24.70	0.29	
86	Honduras	6.80	23.76	0.28	
87	Bulgaria	6.54	22.72	0.27	○
88	Qatar	6.49	22.55	0.26	
89	Finland	6.33	21.91	0.25	○
90	Oman	6.29	21.75	0.25	
91	Korea, Rep.	6.29	21.75	0.24	○
92	Estonia	6.13	21.15	0.23	○
93	Mongolia	6.06	20.86	0.22	
94	Belarus	5.81	19.90	0.20	
94	Niger	5.81	19.90	0.20	
96	Zambia	5.71	19.51	0.19	
97	Canada	5.56	18.89	0.19	○
98	China	5.52	18.77	0.18	○
99	Nepal	5.35	18.07	0.17	
100	Iran, Islamic Rep.	5.32	17.96	0.16	
101	Kenya	5.24	17.64	0.15	
102	Kazakhstan	5.10	17.12	0.14	
103	Moldova, Rep.	5.03	16.81	0.14	○
104	Côte d'Ivoire	4.85	16.15	0.13	
105	Tanzania, United Rep.	4.81	15.97	0.12	
106	Kyrgyzstan	4.78	15.88	0.11	
107	Benin	4.69	15.52	0.10	
108	Bosnia and Herzegovina	4.52	14.86	0.08	○
108	Russian Federation	4.52	14.86	0.08	○
110	South Africa	4.48	14.70	0.08	○
111	Bahrain	4.10	13.19	0.07	○
112	Ukraine	3.28	9.99	0.06	○
113	Togo	2.88	8.44	0.05	
114	Ethiopia	2.81	8.16	0.04	
115	Mozambique	2.47	6.83	0.03	
116	Iceland	2.41	6.60	0.03	○
117	Zimbabwe	2.31	6.20	0.02	○
118	Trinidad and Tobago	2.07	5.27	0.01	○
119	Serbia	0.72	0.00	0.00	○
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	

SOURCE: International Energy Agency (IEA) *World Energy Balances on-line data service, 2016 edition*

NOTE: ● indicates a strength; ○ a weakness

3.3.2 Environmental performance

Environmental Performance Index | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Finland	90.68	90.68	1.00	●
2	Iceland	90.51	90.51	0.99	●
3	Sweden	90.43	90.43	0.98	●
4	Denmark	89.21	89.21	0.98	●
5	Slovenia	88.98	88.98	0.97	●
6	Spain	88.91	88.91	0.96	●
7	Portugal	88.63	88.63	0.95	●
8	Estonia	88.59	88.59	0.94	●
9	Malta	88.48	88.48	0.93	
10	France	88.20	88.20	0.93	●
11	New Zealand	88.00	88.00	0.92	
12	United Kingdom	87.38	87.38	0.91	
13	Australia	87.22	87.22	0.90	
14	Singapore	87.04	87.04	0.89	
15	Croatia	86.98	86.98	0.89	●
16	Switzerland	86.93	86.93	0.88	
17	Norway	86.90	86.90	0.87	
18	Austria	86.64	86.64	0.86	
19	Ireland	86.60	86.60	0.85	
20	Luxembourg	86.58	86.58	0.84	
21	Greece	85.81	85.81	0.84	●
22	Latvia	85.71	85.71	0.83	
23	Lithuania	85.49	85.49	0.82	
24	Slovakia	85.42	85.42	0.81	
25	Canada	85.06	85.06	0.80	
26	United States of America	84.72	84.72	0.80	
27	Czech Republic	84.67	84.67	0.79	
28	Hungary	84.60	84.60	0.78	
29	Italy	84.48	84.48	0.77	
30	Germany	84.26	84.26	0.76	
31	Azerbaijan	83.78	83.78	0.75	●
32	Russian Federation	83.52	83.52	0.75	
33	Bulgaria	83.40	83.40	0.74	
34	Romania	83.24	83.24	0.73	
35	Belarus	82.30	82.30	0.72	
36	Netherlands	82.03	82.03	0.71	
37	Armenia	81.60	81.60	0.70	
38	Poland	81.26	81.26	0.70	
39	Japan	80.59	80.59	0.69	
40	Cyprus	80.24	80.24	0.68	
41	Belgium	80.15	80.15	0.67	
42	Costa Rica	80.03	80.03	0.66	
43	Argentina	79.84	79.84	0.66	
44	Ukraine	79.69	79.69	0.65	
45	Brazil	78.90	78.90	0.64	
46	Montenegro	78.89	78.89	0.63	
47	Serbia	78.67	78.67	0.62	
48	Israel	78.14	78.14	0.61	
49	TFYR of Macedonia	78.02	78.02	0.61	
50	Panama	78.00	78.00	0.60	
51	Chile	77.67	77.67	0.59	
52	Tunisia	77.28	77.28	0.58	
53	Jamaica	77.02	77.02	0.57	
54	Moldova, Rep.	76.69	76.69	0.57	
55	Colombia	75.93	75.93	0.56	
56	Dominican Republic	75.32	75.32	0.55	
57	Albania	74.38	74.38	0.54	
58	Trinidad and Tobago	74.34	74.34	0.53	
59	Malaysia	74.23	74.23	0.52	
60	Morocco	74.18	74.18	0.52	
61	Uruguay	73.98	73.98	0.51	
62	Philippines	73.70	73.70	0.50	
63	Mexico	73.59	73.59	0.49	
64	Kazakhstan	73.29	73.29	0.48	
65	Kyrgyzstan	73.13	73.13	0.48	
66	Tajikistan	73.05	73.05	0.47	
67	Peru	72.95	72.95	0.46	
68	Jordan	72.24	72.24	0.45	
69	Bolivia, Plurinational St.	71.09	71.09	0.44	
70	Mauritius	70.85	70.85	0.43	
71	Namibia	70.84	70.84	0.43	
72	Botswana	70.72	70.72	0.42	
73	Korea, Rep.	70.61	70.61	0.41	
74	South Africa	70.52	70.52	0.40	
75	Paraguay	70.36	70.36	0.39	
76	Algeria	70.28	70.28	0.39	
77	Bahrain	70.07	70.07	0.38	
78	Qatar	69.94	69.94	0.37	
79	Guatemala	69.64	69.64	0.35	
79	Honduras	69.64	69.64	0.35	
81	Thailand	69.54	69.54	0.34	
82	United Arab Emirates	69.35	69.35	0.34	
83	Lebanon	69.14	69.14	0.33	
84	Saudi Arabia	68.63	68.63	0.32	
85	El Salvador	68.07	68.07	0.31	
86	Brunei Darussalam	67.86	67.86	0.30	
87	Turkey	67.68	67.68	0.30	
88	Ecuador	66.58	66.58	0.29	
89	Egypt	66.45	66.45	0.28	
90	Iran, Islamic Rep.	66.32	66.32	0.27	
91	Indonesia	65.85	65.85	0.26	
92	Sri Lanka	65.55	65.55	0.25	
93	China	65.10	65.10	0.25	
94	Georgia	64.96	64.96	0.24	
95	Kuwait	64.41	64.41	0.23	
96	Mongolia	64.39	64.39	0.22	
97	Senegal	63.73	63.73	0.21	
98	Bosnia and Herzegovina	63.28	63.28	0.20	
99	Kenya	62.49	62.49	0.20	
100	Oman	60.13	60.13	0.19	
101	Côte d'Ivoire	59.89	59.89	0.18	
102	Viet Nam	58.50	58.50	0.17	
103	Tanzania, United Rep.	58.34	58.34	0.16	
104	Nigeria	58.27	58.27	0.16	
105	Uganda	57.56	57.56	0.15	
106	Cameroon	57.13	57.13	0.14	
107	Guinea	55.40	55.40	0.13	
108	India	53.58	53.58	0.12	○
109	Pakistan	51.42	51.42	0.11	
110	Cambodia	51.24	51.24	0.11	
111	Rwanda	50.34	50.34	0.10	
112	Nepal	50.21	50.21	0.09	
113	Malawi	49.69	49.69	0.08	
114	Togo	46.10	46.10	0.07	
115	Ethiopia	45.83	45.83	0.07	
116	Burkina Faso	43.71	43.71	0.06	○
117	Benin	43.66	43.66	0.05	
118	Burundi	43.37	43.37	0.04	
119	Mozambique	41.82	41.82	0.03	○
120	Bangladesh	41.77	41.77	0.02	○
121	Mali	41.48	41.48	0.02	○
122	Niger	37.48	37.48	0.01	○
123	Madagascar	37.10	37.10	0.00	○
n/a	Hong Kong (China)	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: Yale University and Columbia University *Environmental Performance Index 2016*
NOTE: ● indicates a strength; ○ a weakness

3.3.3 ISO 14001 environmental certificates

ISO 14001 Environmental management systems—Requirements with guidance for use: Number of certificates issued (per billion PPP$ GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Estonia	14.75	100.00	0.99	●
1	Romania	25.51	100.00	0.99	●
3	Slovakia	14.11	95.68	0.98	●
4	Serbia	11.46	77.70	0.98	●
5	Czech Republic	11.34	76.83	0.97	●
6	Bulgaria	10.82	73.34	0.96	●
7	Italy	10.27	69.63	0.95	●
8	Croatia	9.68	65.62	0.94	●
9	Cyprus	8.79	59.54	0.94	●
10	Lithuania	8.74	59.18	0.93	●
11	Spain	8.22	55.72	0.92	●
12	Latvia	7.92	53.68	0.91	●
13	Sweden	7.77	52.63	0.90	
14	Hungary	7.49	50.74	0.90	●
15	Switzerland	6.70	45.40	0.89	
16	United Kingdom	6.60	44.67	0.88	
17	Finland	6.52	44.14	0.87	
18	China	5.80	39.29	0.86	
19	Slovenia	5.60	37.89	0.86	
20	Japan	5.38	36.44	0.85	
21	Portugal	4.38	29.64	0.84	
22	TFYR of Macedonia	4.26	28.83	0.83	●
23	Colombia	4.21	28.51	0.82	●
24	Denmark	3.90	26.37	0.82	
25	Greece	3.89	26.32	0.81	●
26	Australia	3.86	26.09	0.80	
27	Iceland	3.69	24.94	0.79	
28	Bosnia and Herzegovina	3.66	24.72	0.78	●
29	Norway	3.54	23.94	0.78	
30	Singapore	3.45	23.32	0.77	
31	Albania	3.25	21.94	0.76	●
32	Uruguay	3.10	20.95	0.75	●
33	Austria	2.99	20.18	0.74	
34	Israel	2.95	19.94	0.74	
35	Malaysia	2.94	19.85	0.73	
36	United Arab Emirates	2.94	19.84	0.72	
37	Korea, Rep.	2.93	19.82	0.71	
38	Netherlands	2.93	19.78	0.70	
39	Chile	2.87	19.38	0.70	
40	Poland	2.78	18.77	0.69	
41	Thailand	2.75	18.56	0.68	
42	Malta	2.65	17.89	0.67	
43	France	2.57	17.34	0.66	
44	Belarus	2.56	17.25	0.66	
45	Ireland	2.48	16.75	0.65	
46	Belgium	2.32	15.68	0.64	
47	Viet Nam	2.16	14.60	0.63	
48	Germany	2.13	14.37	0.62	
49	Luxembourg	1.91	12.88	0.62	
50	Tunisia	1.81	12.18	0.61	
51	Turkey	1.80	12.11	0.60	
52	Montenegro	1.71	11.49	0.59	
53	Hong Kong (China)	1.70	11.43	0.58	
54	South Africa	1.64	11.06	0.58	
55	Argentina	1.61	10.83	0.57	
56	New Zealand	1.54	10.38	0.56	
57	Costa Rica	1.48	9.95	0.55	
58	Bahrain	1.45	9.75	0.54	
59	Honduras	1.17	7.83	0.54	
60	Ecuador	1.16	7.80	0.53	
61	Peru	1.04	6.98	0.52	
62	Moldova, Rep.	1.00	6.72	0.51	
63	Zimbabwe	1.00	6.69	0.50	
64	Qatar	0.98	6.54	0.50	
65	Brazil	0.97	6.52	0.49	
66	Brunei Darussalam	0.90	6.05	0.48	
67	Mauritius	0.89	5.97	0.47	
68	Sri Lanka	0.86	5.77	0.46	
69	India	0.85	5.67	0.46	
70	Egypt	0.81	5.41	0.45	
71	Jordan	0.80	5.32	0.44	
72	Indonesia	0.79	5.25	0.43	
73	Canada	0.77	5.15	0.42	○
74	Bolivia, Plurinational St.	0.74	4.92	0.42	
75	Philippines	0.73	4.89	0.41	
76	Namibia	0.70	4.69	0.40	
77	Oman	0.67	4.48	0.39	
78	Mexico	0.62	4.13	0.38	
79	Morocco	0.62	4.12	0.38	
80	Iran, Islamic Rep.	0.55	3.63	0.37	
81	Trinidad and Tobago	0.52	3.45	0.36	
82	Jamaica	0.49	3.21	0.35	
83	Pakistan	0.48	3.16	0.34	
84	Senegal	0.46	3.05	0.34	
85	Ukraine	0.46	3.01	0.33	
86	Lebanon	0.42	2.77	0.32	
87	Mozambique	0.42	2.76	0.31	
88	Zambia	0.40	2.63	0.30	
89	Azerbaijan	0.38	2.51	0.30	
90	Kenya	0.35	2.30	0.29	
91	United States of America	0.34	2.20	0.28	○
92	Cambodia	0.33	2.16	0.27	
93	Kuwait	0.32	2.12	0.26	
94	Russian Federation	0.31	2.02	0.26	○
95	Georgia	0.31	2.01	0.25	
96	Uganda	0.30	1.95	0.24	
97	Nepal	0.30	1.95	0.23	
98	Panama	0.30	1.94	0.22	
99	Kazakhstan	0.30	1.93	0.22	
100	Côte d'Ivoire	0.29	1.88	0.21	
101	El Salvador	0.27	1.71	0.20	
102	Cameroon	0.26	1.69	0.19	
103	Botswana	0.26	1.66	0.18	
104	Paraguay	0.25	1.58	0.18	
105	Tanzania, United Rep.	0.22	1.43	0.17	
106	Saudi Arabia	0.21	1.33	0.16	○
107	Madagascar	0.20	1.25	0.15	
108	Dominican Republic	0.19	1.18	0.14	
109	Togo	0.18	1.16	0.14	
110	Algeria	0.18	1.11	0.13	
111	Guatemala	0.17	1.10	0.12	
112	Bangladesh	0.17	1.10	0.11	
113	Mongolia	0.17	1.04	0.10	
114	Niger	0.16	0.99	0.10	
115	Armenia	0.12	0.72	0.09	○
116	Malawi	0.10	0.58	0.08	
117	Tajikistan	0.08	0.48	0.07	
118	Guinea	0.07	0.36	0.06	
119	Burkina Faso	0.06	0.35	0.06	○
120	Mali	0.06	0.30	0.05	
121	Nigeria	0.05	0.28	0.04	
122	Kyrgyzstan (2014)	0.05	0.27	0.03	○
123	Rwanda	0.05	0.25	0.02	○
124	Benin	0.04	0.21	0.02	○
125	Yemen	0.01	0.01	0.01	
126	Ethiopia	0.01	0.00	0.00	○
n/a	Burundi	n/a	n/a	n/a	

SOURCE: International Organization for Standardization, *The ISO Survey 2015*; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)
NOTE: ● indicates a strength; ○ a weakness

4.1.1 Ease of getting credit

Ease of getting credit (distance to frontier) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	New Zealand	100.00	100.00	1.00	●
2	Colombia	95.00	95.00	0.98	●
2	Rwanda	95.00	95.00	0.98	●
2	United States of America	95.00	95.00	0.98	●
5	Australia	90.00	90.00	0.96	●
5	Mexico	90.00	90.00	0.96	●
7	Cambodia	85.00	85.00	0.90	●
7	Canada	85.00	85.00	0.90	
7	Costa Rica	85.00	85.00	0.90	●
7	Georgia	85.00	85.00	0.90	●
7	Honduras	85.00	85.00	0.90	●
7	Latvia	85.00	85.00	0.90	●
7	Montenegro	85.00	85.00	0.90	●
7	Romania	85.00	85.00	0.90	●
15	Guatemala	80.00	80.00	0.87	●
15	Jamaica	80.00	80.00	0.87	●
15	Peru	80.00	80.00	0.87	●
15	TFYR of Macedonia	80.00	80.00	0.87	●
19	Armenia	75.00	75.00	0.79	●
19	Hong Kong (China)	75.00	75.00	0.79	
19	Hungary	75.00	75.00	0.79	
19	Malaysia	75.00	75.00	0.79	
19	Panama	75.00	75.00	0.79	●
19	Poland	75.00	75.00	0.79	
19	Singapore	75.00	75.00	0.79	
19	Ukraine	75.00	75.00	0.79	
19	United Kingdom	75.00	75.00	0.79	
19	Zambia	75.00	75.00	0.79	●
29	Bulgaria	70.00	70.00	0.70	
29	Czech Republic	70.00	70.00	0.70	
29	Denmark	70.00	70.00	0.70	
29	Estonia	70.00	70.00	0.70	
29	Germany	70.00	70.00	0.70	
29	Ireland	70.00	70.00	0.70	
29	Kenya	70.00	70.00	0.70	
29	Kyrgyzstan	70.00	70.00	0.70	●
29	Lithuania	70.00	70.00	0.70	
29	Moldova, Rep.	70.00	70.00	0.70	
29	Viet Nam	70.00	70.00	0.70	
40	Albania	65.00	65.00	0.58	
40	Bosnia and Herzegovina	65.00	65.00	0.58	
40	El Salvador	65.00	65.00	0.58	
40	Finland	65.00	65.00	0.58	
40	India	65.00	65.00	0.58	
40	Israel	65.00	65.00	0.58	
40	Korea, Rep.	65.00	65.00	0.58	
40	Mauritius	65.00	65.00	0.58	
40	Nigeria	65.00	65.00	0.58	●
40	Russian Federation	65.00	65.00	0.58	
40	Serbia	65.00	65.00	0.58	
40	Slovakia	65.00	65.00	0.58	
40	Tanzania, United Rep.	65.00	65.00	0.58	●
40	Trinidad and Tobago	65.00	65.00	0.58	●
40	Uganda	65.00	65.00	0.58	
55	Austria	60.00	60.00	0.48	○
55	Brunei Darussalam	60.00	60.00	0.48	
55	China	60.00	60.00	0.48	
55	Cyprus	60.00	60.00	0.48	
55	Iceland	60.00	60.00	0.48	
55	Indonesia	60.00	60.00	0.48	
55	Mongolia	60.00	60.00	0.48	
55	Namibia	60.00	60.00	0.48	
55	South Africa	60.00	60.00	0.48	
55	Spain	60.00	60.00	0.48	○
55	Switzerland	60.00	60.00	0.48	○
55	Uruguay	60.00	60.00	0.48	
67	Botswana	55.00	55.00	0.44	
67	Croatia	55.00	55.00	0.44	
67	Kazakhstan	55.00	55.00	0.44	
67	Norway	55.00	55.00	0.44	○
67	Sweden	55.00	55.00	0.44	○
72	Argentina	50.00	50.00	0.35	
72	Chile	50.00	50.00	0.35	
72	Egypt	50.00	50.00	0.35	
72	France	50.00	50.00	0.35	○
72	Greece	50.00	50.00	0.35	
72	Japan	50.00	50.00	0.35	○
72	Netherlands	50.00	50.00	0.35	○
72	Pakistan	50.00	50.00	0.35	
72	Saudi Arabia	50.00	50.00	0.35	
72	Thailand	50.00	50.00	0.35	
72	Turkey	50.00	50.00	0.35	
72	Zimbabwe	50.00	50.00	0.35	
84	Bahrain	45.00	45.00	0.24	
84	Belarus	45.00	45.00	0.24	
84	Belgium	45.00	45.00	0.24	○
84	Brazil	45.00	45.00	0.24	
84	Dominican Republic	45.00	45.00	0.24	
84	Ecuador	45.00	45.00	0.24	
84	Iran, Islamic Rep.	45.00	45.00	0.24	
84	Italy	45.00	45.00	0.24	○
84	Malawi	45.00	45.00	0.24	
84	Morocco	45.00	45.00	0.24	
84	Paraguay	45.00	45.00	0.24	
84	Portugal	45.00	45.00	0.24	○
84	Tunisia	45.00	45.00	0.24	
84	United Arab Emirates	45.00	45.00	0.24	○
98	Azerbaijan	40.00	40.00	0.19	
98	Kuwait	40.00	40.00	0.19	
98	Lebanon	40.00	40.00	0.19	
98	Philippines	40.00	40.00	0.19	
98	Sri Lanka	40.00	40.00	0.19	
98	Tajikistan	40.00	40.00	0.19	
104	Bolivia, Plurinational St.	35.00	35.00	0.16	
104	Cameroon	35.00	35.00	0.16	
104	Oman	35.00	35.00	0.16	
104	Slovenia	35.00	35.00	0.16	○
108	Benin	30.00	30.00	0.07	
108	Burkina Faso	30.00	30.00	0.07	
108	Côte d'Ivoire	30.00	30.00	0.07	○
108	Guinea	30.00	30.00	0.07	
108	Mali	30.00	30.00	0.07	
108	Malta	30.00	30.00	0.07	○
108	Nepal	30.00	30.00	0.07	
108	Niger	30.00	30.00	0.07	
108	Qatar	30.00	30.00	0.07	○
108	Senegal	30.00	30.00	0.07	
108	Togo	30.00	30.00	0.07	
119	Bangladesh	25.00	25.00	0.06	
119	Mozambique	25.00	25.00	0.06	
121	Ethiopia	15.00	15.00	0.03	
121	Luxembourg	15.00	15.00	0.03	○
121	Madagascar	15.00	15.00	0.03	○
124	Algeria	10.00	10.00	0.02	○
124	Burundi	10.00	10.00	0.02	○
126	Jordan	0.00	0.00	0.00	○
126	Yemen	0.00	0.00	0.00	○

SOURCE: World Bank, *Ease of Doing Business Index 2017: Equal Opportunity for All*
NOTE: ● indicates a strength; ○ a weakness

4.1.2 Domestic credit to private sector

Domestic credit to private sector (% of GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Cyprus	247.64	100.00	1.00	●
2	Hong Kong (China)	208.03	83.82	0.99	●
3	United States of America	188.83	75.97	0.98	●
4	Japan	182.88	73.54	0.98	●
5	Denmark	174.09	69.95	0.97	●
6	Switzerland	172.58	69.33	0.96	
7	China	153.34	61.47	0.95	
8	Thailand	151.31	60.64	0.94	●
9	South Africa	149.18	59.77	0.94	●
10	New Zealand (2010)	142.33	56.97	0.93	
11	Korea, Rep.	140.57	56.26	0.92	
12	Norway	138.42	55.38	0.91	
13	Australia	137.64	55.06	0.90	
14	United Kingdom	134.07	53.60	0.90	
15	Singapore	129.75	51.83	0.89	
16	Sweden	128.95	51.51	0.88	
17	Malaysia	125.21	49.98	0.87	●
18	Canada (2008)	124.41	49.65	0.86	
19	Portugal	120.06	47.88	0.86	
20	Spain	118.86	47.39	0.85	
21	Greece	113.22	45.08	0.84	●
22	Viet Nam	111.93	44.55	0.83	●
23	Netherlands	111.50	44.38	0.82	
24	Chile	110.96	44.16	0.82	●
25	Lebanon	106.64	42.39	0.81	●
26	Mauritius	102.81	40.83	0.80	●
27	Kuwait	98.60	39.11	0.79	●
28	Malta	98.02	38.87	0.78	
29	France	95.85	37.98	0.78	
30	Finland	95.45	37.82	0.77	
31	Luxembourg	95.36	37.78	0.76	
32	Iceland	92.06	36.44	0.75	
33	Panama	88.52	34.99	0.74	
34	Italy	88.05	34.80	0.74	
35	Austria	86.98	34.36	0.73	
36	Turkey	80.04	31.52	0.72	
37	Tunisia	79.60	31.34	0.71	●
38	Germany	77.95	30.67	0.70	
39	United Arab Emirates	76.48	30.07	0.70	
40	Bahrain	73.72	28.94	0.69	
41	Estonia	70.26	27.53	0.68	
42	Jordan	70.25	27.53	0.67	●
43	Qatar	69.59	27.26	0.66	
44	Brazil	67.86	26.55	0.66	
45	Israel	66.61	26.04	0.65	
46	Oman	65.57	25.61	0.64	
47	Croatia	65.47	25.57	0.63	
48	Nepal	65.04	25.40	0.62	●
49	Morocco	64.31	25.10	0.62	
50	Cambodia	63.10	24.60	0.61	●
51	Belgium	61.55	23.97	0.60	
52	Bolivia, Plurinational St.	58.07	22.55	0.59	●
53	Paraguay	57.94	22.49	0.58	●
54	Ukraine	56.97	22.10	0.58	
55	Costa Rica	56.79	22.03	0.57	
56	Saudi Arabia	56.63	21.96	0.56	
57	Russian Federation	56.36	21.85	0.55	
58	Bulgaria	55.41	21.46	0.54	
59	Honduras	55.37	21.45	0.54	
60	Mongolia	54.83	21.23	0.53	
61	Iran, Islamic Rep. (2014)	54.41	21.05	0.52	
62	Ireland	54.35	21.03	0.51	○
63	Namibia	53.79	20.80	0.50	
64	Bosnia and Herzegovina	53.71	20.77	0.50	
65	Poland	53.65	20.74	0.49	
66	Slovakia	53.46	20.66	0.48	
67	India	52.62	20.32	0.47	
68	TFYR of Macedonia	50.88	19.61	0.46	
69	Montenegro	50.63	19.51	0.46	
70	Czech Republic	50.31	19.38	0.45	○
71	Slovenia	50.20	19.33	0.44	
72	Georgia	49.76	19.15	0.43	
73	Latvia	48.75	18.74	0.42	
74	Colombia	47.13	18.08	0.42	
75	Armenia	45.74	17.51	0.41	
76	El Salvador	44.86	17.15	0.40	
77	Bangladesh	43.93	16.77	0.39	
78	Serbia	43.37	16.54	0.38	
79	Philippines	41.81	15.91	0.38	
80	Lithuania	41.81	15.90	0.37	
81	Brunei Darussalam	41.44	15.75	0.36	
82	Sri Lanka	40.73	15.46	0.35	
83	Indonesia	39.07	14.79	0.34	
84	Azerbaijan	38.45	14.53	0.34	
85	Kazakhstan	37.73	14.24	0.33	
86	Peru	37.42	14.11	0.32	
87	Trinidad and Tobago	37.11	13.98	0.31	
88	Togo	37.08	13.97	0.30	
89	Hungary	36.12	13.58	0.30	
90	Albania	35.46	13.31	0.29	
91	Mozambique	35.09	13.16	0.28	
92	Kenya	34.89	13.08	0.27	
93	Moldova, Rep.	34.76	13.02	0.26	
94	Guatemala	34.37	12.87	0.26	
95	Botswana	33.85	12.65	0.25	
96	Senegal	33.30	12.43	0.24	
97	Mexico	32.70	12.18	0.23	
98	Uruguay	30.02	11.09	0.22	
99	Jamaica	29.89	11.04	0.22	
100	Romania	29.89	11.04	0.21	○
101	Burkina Faso	27.23	9.95	0.20	
102	Dominican Republic	27.13	9.91	0.19	
103	Ecuador	26.92	9.82	0.18	
104	Egypt	26.47	9.64	0.18	
105	Mali	24.39	8.79	0.17	
106	Côte d'Ivoire	23.09	8.26	0.16	
107	Kyrgyzstan	22.96	8.20	0.15	
108	Tajikistan	22.72	8.11	0.14	
109	Rwanda	21.61	7.65	0.14	
110	Algeria	21.60	7.65	0.13	
111	Benin	21.49	7.60	0.12	
112	Zambia	19.76	6.90	0.11	
113	Ethiopia (2008)	17.71	6.06	0.10	
114	Cameroon	16.39	5.52	0.10	
115	Pakistan	15.38	5.11	0.09	○
116	Tanzania, United Rep.	15.17	5.02	0.08	
117	Argentina	14.70	4.83	0.07	○
118	Uganda	14.58	4.78	0.06	○
119	Guinea	14.38	4.70	0.06	
120	Burundi	14.26	4.65	0.05	
121	Nigeria	14.22	4.63	0.04	
122	Niger	14.17	4.61	0.03	
123	Madagascar	13.33	4.27	0.02	○
124	Malawi	12.20	3.81	0.02	○
125	Yemen (2013)	5.64	1.13	0.01	
126	Belarus	2.88	0.00	0.00	○
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: International Monetary Fund, International Financial Statistics and data files; and World Bank and OECD GDP estimates; extracted from the World Bank's *World Development Indicators* database

NOTE: ● indicates a strength; ○ a weakness

4.1.3 Microfinance institutions' gross loan portfolio

Microfinance institutions: Gross loan portfolio (% of GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Bolivia, Plurinational St.	19.59	100.00	0.96	●
1	Cambodia	29.59	100.00	0.96	●
1	Mongolia	18.36	100.00	0.96	●
1	Tajikistan	5.64	100.00	0.96	●
5	Paraguay	5.34	94.70	0.95	●
6	Peru	4.84	85.88	0.94	●
7	Armenia	4.78	84.76	0.93	●
8	Ecuador	4.72	83.73	0.91	●
9	Kenya	4.28	75.84	0.90	●
10	Azerbaijan	4.27	75.71	0.89	●
11	Kyrgyzstan	4.16	73.80	0.88	●
12	Viet Nam	3.52	62.40	0.86	●
13	Burundi	3.42	60.71	0.85	●
14	Togo	2.65	47.04	0.84	●
15	Georgia	2.29	40.63	0.83	
16	Bangladesh	1.94	34.39	0.81	●
17	Colombia	1.75	30.99	0.80	●
18	Nepal	1.73	30.76	0.79	●
19	Burkina Faso	1.53	27.16	0.78	●
20	Senegal	1.53	27.09	0.76	●
21	Benin	1.50	26.58	0.75	●
22	El Salvador	1.28	22.78	0.74	●
23	Bosnia and Herzegovina	1.25	22.09	0.73	●
24	Madagascar	1.24	21.99	0.71	●
25	Cameroon	1.11	19.61	0.70	●
26	Montenegro	1.01	17.98	0.69	
27	Niger	0.77	13.68	0.68	●
28	Chile	0.75	13.27	0.66	
29	Dominican Republic	0.73	12.90	0.65	●
30	Belarus	0.71	12.55	0.64	
31	Rwanda	0.70	12.35	0.63	
32	Honduras	0.57	10.17	0.61	●
33	Morocco	0.56	9.98	0.60	
34	India	0.56	9.88	0.59	
35	Albania	0.46	8.17	0.58	
36	Jordan	0.45	7.94	0.56	
37	Côte d'Ivoire	0.36	6.33	0.55	●
38	Moldova, Rep.	0.35	6.28	0.54	
39	Philippines	0.34	6.04	0.53	
40	TFYR of Macedonia	0.34	5.99	0.51	
41	Tunisia	0.34	5.95	0.50	
42	Malawi	0.30	5.32	0.49	
43	Panama	0.30	5.23	0.48	
44	Mali	0.27	4.85	0.46	
45	Serbia	0.26	4.53	0.45	
46	Guinea (2012)	0.25	4.42	0.44	●
47	Mexico	0.24	4.18	0.43	
48	Tanzania, United Rep.	0.24	4.17	0.41	
49	Uganda	0.23	4.04	0.40	
50	Pakistan	0.22	3.85	0.39	
51	Mozambique	0.20	3.54	0.38	
52	Guatemala	0.19	3.30	0.36	
53	Jamaica	0.14	2.49	0.35	
54	Malaysia (2011)	0.13	2.27	0.34	
55	Poland	0.12	2.04	0.33	○
56	Nigeria	0.11	1.90	0.31	
57	Lebanon	0.10	1.76	0.30	
58	Zambia	0.10	1.71	0.29	
59	Kazakhstan	0.08	1.40	0.28	
60	Russian Federation	0.08	1.37	0.26	
61	Egypt	0.05	0.84	0.25	
62	Brazil	0.05	0.79	0.24	
63	Sri Lanka	0.04	0.69	0.23	
64	Yemen	0.04	0.69	0.21	
65	Namibia (2012)	0.03	0.52	0.20	
66	Ethiopia	0.03	0.49	0.19	
67	Costa Rica	0.02	0.26	0.18	○
68	Indonesia	0.01	0.25	0.16	
69	Zimbabwe	0.01	0.23	0.15	
70	Croatia (2007)	0.01	0.19	0.14	○
71	Uruguay	0.01	0.17	0.13	○
72	Romania	0.01	0.16	0.11	○
73	China	0.01	0.15	0.10	○
74	South Africa	0.01	0.11	0.09	○
75	Bulgaria	0.01	0.10	0.08	○
76	Turkey	0.00	0.04	0.06	○
77	Trinidad and Tobago (2013)	0.00	0.03	0.05	
78	Argentina	0.00	0.02	0.04	○
79	Hungary (2007)	0.00	0.01	0.03	○
80	Ukraine	0.00	0.01	0.01	○
81	Thailand (2011)	0.00	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Australia	n/a	n/a	n/a	
n/a	Austria	n/a	n/a	n/a	
n/a	Bahrain	n/a	n/a	n/a	
n/a	Belgium	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Canada	n/a	n/a	n/a	
n/a	Cyprus	n/a	n/a	n/a	
n/a	Czech Republic	n/a	n/a	n/a	
n/a	Denmark	n/a	n/a	n/a	
n/a	Estonia	n/a	n/a	n/a	
n/a	Finland	n/a	n/a	n/a	
n/a	France	n/a	n/a	n/a	
n/a	Germany	n/a	n/a	n/a	
n/a	Greece	n/a	n/a	n/a	
n/a	Hong Kong (China)	n/a	n/a	n/a	
n/a	Iceland	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Ireland	n/a	n/a	n/a	
n/a	Israel	n/a	n/a	n/a	
n/a	Italy	n/a	n/a	n/a	
n/a	Japan	n/a	n/a	n/a	
n/a	Korea, Rep.	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Latvia	n/a	n/a	n/a	
n/a	Lithuania	n/a	n/a	n/a	
n/a	Luxembourg	n/a	n/a	n/a	
n/a	Malta	n/a	n/a	n/a	
n/a	Mauritius	n/a	n/a	n/a	
n/a	Netherlands	n/a	n/a	n/a	
n/a	New Zealand	n/a	n/a	n/a	
n/a	Norway	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Portugal	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Singapore	n/a	n/a	n/a	
n/a	Slovakia	n/a	n/a	n/a	
n/a	Slovenia	n/a	n/a	n/a	
n/a	Spain	n/a	n/a	n/a	
n/a	Sweden	n/a	n/a	n/a	
n/a	Switzerland	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	United Kingdom	n/a	n/a	n/a	
n/a	United States of America	n/a	n/a	n/a	

SOURCE: Microfinance Information Exchange, *Mix Market database*; International Monetary Fund, *World Economic Outlook Database*, October 2016

NOTE: ● indicates a strength; ○ a weakness

4.2.1 Ease of protecting minority investors

Ease of protecting minority investors (distance to frontier) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	New Zealand	83.33	83.33	0.99	●
1	Singapore	83.33	83.33	0.99	●
3	Hong Kong (China)	80.00	80.00	0.97	●
3	Kazakhstan	80.00	80.00	0.97	●
3	Malaysia	80.00	80.00	0.97	●
6	United Kingdom	78.33	78.33	0.96	
7	Canada	76.67	76.67	0.94	
7	Georgia	76.67	76.67	0.94	●
9	Israel	75.00	75.00	0.91	
9	Norway	75.00	75.00	0.91	
9	Slovenia	75.00	75.00	0.91	●
9	United Arab Emirates	75.00	75.00	0.91	●
13	Bulgaria	73.33	73.33	0.87	●
13	Colombia	73.33	73.33	0.87	●
13	India	73.33	73.33	0.87	●
13	Ireland	73.33	73.33	0.87	
13	Korea, Rep.	73.33	73.33	0.87	
13	TFYR of Macedonia	73.33	73.33	0.87	●
19	Albania	71.67	71.67	0.84	●
19	Denmark	71.67	71.67	0.84	
19	Sweden	71.67	71.67	0.84	
22	Iceland	70.00	70.00	0.82	
22	South Africa	70.00	70.00	0.82	●
22	Turkey	70.00	70.00	0.82	●
25	Mongolia	68.33	68.33	0.81	●
26	Croatia	66.67	66.67	0.77	
26	Cyprus	66.67	66.67	0.77	
26	Pakistan	66.67	66.67	0.77	●
26	Tajikistan	66.67	66.67	0.77	●
26	Thailand	66.67	66.67	0.77	
31	Austria	65.00	65.00	0.70	
31	Azerbaijan	65.00	65.00	0.70	●
31	Brazil	65.00	65.00	0.70	
31	Chile	65.00	65.00	0.70	
31	France	65.00	65.00	0.70	
31	Malta	65.00	65.00	0.70	
31	Mauritius	65.00	65.00	0.70	
31	Nigeria	65.00	65.00	0.70	●
31	Spain	65.00	65.00	0.70	
40	United States of America	64.67	64.67	0.69	
41	Belarus	63.33	63.33	0.62	
41	Greece	63.33	63.33	0.62	
41	Italy	63.33	63.33	0.62	
41	Kyrgyzstan	63.33	63.33	0.62	
41	Latvia	63.33	63.33	0.62	
41	Moldova, Rep.	63.33	63.33	0.62	
41	Montenegro	63.33	63.33	0.62	
41	Poland	63.33	63.33	0.62	
41	Sri Lanka	63.33	63.33	0.62	●
50	Argentina	61.67	61.67	0.60	
50	Lithuania	61.67	61.67	0.60	
52	Armenia	60.00	60.00	0.52	
52	Czech Republic	60.00	60.00	0.52	
52	Estonia	60.00	60.00	0.52	
52	Germany	60.00	60.00	0.52	
52	Japan	60.00	60.00	0.52	
52	Mexico	60.00	60.00	0.52	
52	Peru	60.00	60.00	0.52	
52	Romania	60.00	60.00	0.52	
52	Russian Federation	60.00	60.00	0.52	
52	Trinidad and Tobago	60.00	60.00	0.52	
62	Australia	58.33	58.33	0.48	
62	Belgium	58.33	58.33	0.48	○
62	Jamaica	58.33	58.33	0.48	
62	Nepal	58.33	58.33	0.48	●
62	Saudi Arabia	58.33	58.33	0.48	
67	Bangladesh	56.67	56.67	0.42	
67	Finland	56.67	56.67	0.42	○
67	Indonesia	56.67	56.67	0.42	
67	Netherlands	56.67	56.67	0.42	○
67	Panama	56.67	56.67	0.42	
67	Portugal	56.67	56.67	0.42	○
67	Serbia	56.67	56.67	0.42	
67	Ukraine	56.67	56.67	0.42	
75	Bosnia and Herzegovina	55.00	55.00	0.38	
75	Botswana	55.00	55.00	0.38	
75	Hungary	55.00	55.00	0.38	
75	Kuwait	55.00	55.00	0.38	
75	Namibia	55.00	55.00	0.38	
80	Dominican Republic	53.33	53.33	0.33	
80	Kenya	53.33	53.33	0.33	
80	Morocco	53.33	53.33	0.33	
80	Slovakia	53.33	53.33	0.33	○
80	Viet Nam	53.33	53.33	0.33	
80	Zambia	53.33	53.33	0.33	
86	Brunei Darussalam	51.67	51.67	0.31	
86	Rwanda	51.67	51.67	0.31	
86	Zimbabwe	51.67	51.67	0.31	
89	Bahrain	50.00	50.00	0.29	
89	Switzerland	50.00	50.00	0.29	○
89	Uganda	50.00	50.00	0.29	
92	Cambodia	48.33	48.33	0.26	
92	Egypt	48.33	48.33	0.26	
92	Madagascar	48.33	48.33	0.26	
95	Ecuador	46.67	46.67	0.24	
95	Oman	46.67	46.67	0.24	
95	Tunisia	46.67	46.67	0.24	
98	China	45.00	45.00	0.21	○
98	Luxembourg	45.00	45.00	0.21	○
98	Uruguay	45.00	45.00	0.21	○
101	Honduras	43.33	43.33	0.18	
101	Malawi	43.33	43.33	0.18	
101	Mozambique	43.33	43.33	0.18	
101	Yemen	43.33	43.33	0.18	
105	Bolivia, Plurinational St.	41.67	41.67	0.13	
105	Burundi	41.67	41.67	0.13	
105	Cameroon	41.67	41.67	0.13	
105	Paraguay	41.67	41.67	0.13	
105	Philippines	41.67	41.67	0.13	
105	Senegal	41.67	41.67	0.13	
111	Benin	40.00	40.00	0.06	
111	Burkina Faso	40.00	40.00	0.06	
111	Côte d'Ivoire	40.00	40.00	0.06	○
111	Guinea	40.00	40.00	0.06	
111	Lebanon	40.00	40.00	0.06	○
111	Mali	40.00	40.00	0.06	
111	Niger	40.00	40.00	0.06	
111	Tanzania, United Rep.	40.00	40.00	0.06	
111	Togo	40.00	40.00	0.06	
120	El Salvador	38.33	38.33	0.06	○
121	Costa Rica	35.00	35.00	0.03	○
121	Iran, Islamic Rep.	35.00	35.00	0.03	○
121	Jordan	35.00	35.00	0.03	○
124	Algeria	33.33	33.33	0.02	○
124	Guatemala	33.33	33.33	0.02	○
126	Ethiopia	31.67	31.67	0.01	○
127	Qatar	26.67	26.67	0.00	○

SOURCE: World Bank, *Ease of Doing Business Index 2017: Equal Opportunity for All*
NOTE: ● indicates a strength; ○ a weakness

4.2.2 Market capitalization

Market capitalization of listed companies (% of GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Hong Kong (China)	1,029.92	100.00	0.99	●
1	Singapore	218.61	93.44	0.96	
3	South Africa	233.95	100.00	0.99	●
4	Switzerland	226.50	96.81	0.98	●
5	United States of America	138.98	59.40	0.95	
6	Malaysia	129.26	55.25	0.94	●
7	Japan	111.68	47.73	0.93	
8	Canada	102.76	43.92	0.92	
9	Netherlands	97.09	41.50	0.91	
10	Montenegro (2012)	92.65	39.60	0.89	●
11	Belgium	91.09	38.93	0.88	
12	Korea, Rep.	89.36	38.19	0.87	
13	Australia	88.65	37.89	0.86	
14	Thailand	88.27	37.73	0.85	●
15	Qatar	86.59	37.01	0.84	
16	France	86.34	36.90	0.82	
17	Philippines	81.66	34.90	0.81	●
18	Luxembourg	81.55	34.86	0.80	
19	Israel	81.46	34.82	0.79	
20	Chile	79.05	33.79	0.78	
21	China	74.38	31.79	0.76	
22	India	72.36	30.93	0.75	
23	Jordan	67.84	29.00	0.74	●
24	Spain	65.65	28.06	0.73	
25	Saudi Arabia	65.18	27.86	0.72	
26	United Kingdom (2008)	64.97	27.77	0.71	
27	Mauritius	61.96	26.48	0.69	
28	Bahrain	61.85	26.43	0.68	
29	Oman	58.89	25.17	0.67	
30	United Arab Emirates	52.90	22.61	0.66	
31	Germany	51.01	21.80	0.65	
32	Norway	50.16	21.44	0.64	
33	Morocco	45.66	19.51	0.62	
34	Malta	45.20	19.32	0.61	
35	Ireland	45.12	19.28	0.60	○
36	El Salvador (2012)	45.11	19.28	0.59	
37	New Zealand	42.79	18.29	0.58	
38	Indonesia	40.99	17.52	0.56	
39	Côte d'Ivoire	39.34	16.81	0.55	●
40	Bangladesh (2011)	37.08	15.85	0.54	●
41	Croatia (2011)	36.24	15.49	0.53	
42	Mexico	35.17	15.03	0.52	
43	Jamaica (2011)	34.69	14.82	0.51	
44	Panama (2011)	31.08	13.28	0.49	
45	Uganda (2012)	31.03	13.26	0.48	
46	Portugal	30.08	12.85	0.47	
47	Peru	29.91	12.78	0.46	
48	Russian Federation	29.54	12.62	0.45	
49	Colombia	29.43	12.58	0.44	
50	Poland	28.88	12.34	0.42	
51	Brazil	27.64	11.81	0.41	
52	Iran, Islamic Rep. (2014)	27.42	11.72	0.40	
53	Italy (2014)	27.32	11.67	0.39	○
54	Viet Nam	26.80	11.45	0.38	
55	Turkey	26.31	11.24	0.36	
56	Austria	25.49	10.89	0.35	○
57	Sri Lanka	25.27	10.80	0.34	
58	Kenya (2011)	24.32	10.39	0.33	
59	Lebanon (2011)	22.57	9.65	0.32	
60	Greece	21.60	9.23	0.31	
61	Tunisia (2011)	21.09	9.01	0.29	
62	Kazakhstan	18.92	8.08	0.28	
63	Czech Republic (2008)	17.39	7.43	0.27	○
64	Egypt	16.69	7.13	0.26	
65	Bolivia, Plurinational St. (2012)	16.41	7.01	0.25	
66	Ukraine (2011)	15.72	6.72	0.24	
67	Pakistan (2011)	15.25	6.51	0.22	
68	Hungary	14.53	6.21	0.21	○
69	Bulgaria (2011)	14.37	6.14	0.20	○
70	Slovenia	14.11	6.03	0.19	○
71	Cyprus	13.76	5.88	0.18	○
72	Zambia (2011)	13.57	5.80	0.16	
73	Malawi (2012)	12.60	5.38	0.15	
74	Bosnia and Herzegovina (2011)	12.15	5.19	0.14	
75	Mongolia (2012)	10.52	4.49	0.13	
76	Nigeria	10.39	4.44	0.12	
77	Argentina	9.63	4.11	0.11	○
78	Serbia (2011)	8.73	3.73	0.09	○
79	Romania (2011)	7.57	3.23	0.08	○
80	Georgia (2012)	5.95	2.54	0.07	○
81	TFYR of Macedonia (2012)	5.74	2.45	0.06	○
82	Slovakia (2013)	4.88	2.08	0.05	○
83	Costa Rica (2011)	3.55	1.51	0.04	○
84	Kyrgyzstan (2012)	2.50	1.06	0.02	○
85	Armenia (2012)	1.24	0.53	0.01	○
86	Namibia (2011)	0.01	0.00	0.00	○
n/a	Albania	n/a	n/a	n/a	
n/a	Algeria	n/a	n/a	n/a	
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Belarus	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Denmark	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	Ecuador	n/a	n/a	n/a	
n/a	Estonia	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Finland	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Iceland	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Latvia	n/a	n/a	n/a	
n/a	Lithuania	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Moldova, Rep.	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Senegal	n/a	n/a	n/a	
n/a	Sweden	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Uruguay	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: World Federation of Exchanges database; extracted from the World Bank's *World Development Indicators* database
NOTE: ● indicates a strength; ○ a weakness

4.2.3 Venture capital deals

Venture capital per investment location: Number of deals (per billion PPP$ GDP) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Canada	0.55	100.00	0.97	●
1	France	0.31	100.00	0.97	●
1	Israel	0.43	100.00	0.97	●
1	United States of America	0.39	100.00	0.97	●
5	Finland	0.28	89.93	0.96	
6	Denmark	0.22	70.83	0.95	
7	United Kingdom	0.21	67.39	0.93	
8	Sweden	0.19	61.88	0.92	
9	Iceland	0.19	59.04	0.91	
10	Switzerland	0.18	57.20	0.90	
11	Netherlands	0.18	56.50	0.89	
12	Estonia	0.16	49.23	0.88	
13	Luxembourg	0.15	48.64	0.87	
14	Singapore	0.13	39.74	0.86	
15	Malta	0.12	38.87	0.85	
16	Germany	0.12	37.93	0.84	
17	Ireland	0.11	36.17	0.82	
18	Lithuania (2015)	0.11	34.72	0.81	
19	Belgium	0.10	31.13	0.80	
20	New Zealand	0.09	27.14	0.79	
21	Portugal	0.08	26.62	0.78	
22	Australia	0.08	26.34	0.77	
23	Lebanon	0.08	26.00	0.76	●
24	Guinea (2015)	0.07	20.66	0.75	●
25	Austria	0.06	19.72	0.74	
26	China	0.06	18.37	0.73	
27	Spain	0.06	17.52	0.71	
28	United Arab Emirates	0.05	16.51	0.70	
29	Kenya	0.05	16.49	0.69	
30	Italy	0.05	15.58	0.68	
31	Rwanda (2015)	0.05	15.48	0.67	●
32	Tunisia	0.05	14.41	0.66	
33	Norway	0.04	13.77	0.65	
34	Hong Kong (China)	0.04	12.47	0.64	
35	Mauritius	0.04	12.12	0.63	
36	Zimbabwe	0.04	11.04	0.62	●
37	Mali (2015)	0.03	10.72	0.60	●
38	Cyprus	0.03	10.68	0.59	
39	Burkina Faso (2015)	0.03	10.01	0.58	●
40	India	0.03	9.88	0.57	
41	Slovenia	0.03	9.43	0.56	
42	Czech Republic	0.03	8.87	0.55	
43	Senegal (2015)	0.03	8.57	0.54	
44	Georgia	0.03	8.31	0.53	
45	Hungary	0.03	8.12	0.52	
46	Panama (2015)	0.02	7.54	0.51	
47	Poland	0.02	7.36	0.49	
48	Brazil	0.02	7.21	0.48	
49	Japan	0.02	7.15	0.47	
50	Morocco	0.02	6.55	0.46	
51	South Africa	0.02	6.28	0.45	
52	Latvia	0.02	6.05	0.44	
53	Korea, Rep.	0.02	5.73	0.43	
54	Cambodia (2015)	0.02	5.67	0.42	
55	Malaysia	0.02	5.32	0.41	
56	Zambia	0.02	4.67	0.40	
57	Bahrain	0.02	4.59	0.38	
58	Greece (2015)	0.01	4.31	0.37	
59	Uruguay	0.01	4.10	0.36	
60	Viet Nam	0.01	4.07	0.35	
61	Côte d'Ivoire (2015)	0.01	3.85	0.34	
62	Costa Rica	0.01	3.81	0.33	
63	Uganda (2015)	0.01	3.78	0.32	
64	Peru	0.01	3.67	0.31	
65	Jordan	0.01	3.48	0.30	
66	Ethiopia	0.01	3.43	0.29	
67	Romania	0.01	3.40	0.27	
68	Croatia	0.01	3.17	0.26	○
69	Colombia	0.01	3.02	0.25	
70	Mexico	0.01	2.82	0.24	
71	Chile	0.01	2.71	0.23	○
72	Egypt	0.01	2.67	0.22	
73	Turkey	0.01	2.65	0.21	
74	Philippines	0.01	2.57	0.20	
75	Ukraine	0.01	2.52	0.19	
76	Bulgaria	0.01	2.01	0.18	○
77	Thailand	0.01	1.98	0.16	○
78	Argentina	0.01	1.96	0.15	
79	Tanzania, United Rep.	0.01	1.90	0.14	
80	Indonesia	0.01	1.89	0.13	
81	Algeria	0.01	1.87	0.12	
82	Belarus	0.01	1.71	0.11	○
83	Slovakia	0.01	1.67	0.10	○
84	Saudi Arabia	0.01	1.62	0.09	○
85	Ecuador (2015)	0.01	1.54	0.08	
86	Nigeria	0.00	1.25	0.07	
87	Kuwait (2015)	0.00	0.89	0.05	○
88	Kazakhstan (2015)	0.00	0.52	0.04	○
89	Pakistan (2015)	0.00	0.47	0.03	○
90	Russian Federation	0.00	0.29	0.02	○
91	Bangladesh	0.00	0.29	0.01	○
92	Iran, Islamic Rep.	0.00	0.00	0.00	○
n/a	Albania	n/a	n/a	n/a	
n/a	Armenia	n/a	n/a	n/a	
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Bosnia and Herzegovina	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Kyrgyzstan	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Moldova, Rep.	n/a	n/a	n/a	
n/a	Mongolia	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Serbia	n/a	n/a	n/a	
n/a	Sri Lanka	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	

SOURCE: Thomson Reuters, *Thomson One Banker Private Equity, SDC Platinum* database; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)

NOTE: ● indicates a strength; ○ a weakness

4.3.1 Applied tariff rate, weighted mean

Tariff rate, applied, weighted mean, all products (%) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Hong Kong (China)	0.00	100.00	0.98	●
1	Singapore	0.00	100.00	0.98	●
1	Switzerland	0.00	100.00	0.98	●
4	Georgia	0.30	98.26	0.98	●
5	Brunei Darussalam (2014)	0.46	97.33	0.97	●
6	Botswana	0.54	96.86	0.96	●
7	Mauritius	0.63	96.34	0.95	●
8	Chile	0.64	96.28	0.94	●
9	Iceland	0.77	95.53	0.94	
10	Namibia	0.87	94.95	0.93	●
11	Canada	0.96	94.43	0.92	
12	Mexico (2014)	1.02	94.08	0.91	●
13	Norway	1.04	93.96	0.90	
14	Bosnia and Herzegovina	1.09	93.67	0.90	●
15	Albania	1.11	93.55	0.89	●
16	TFYR of Macedonia	1.12	93.50	0.88	●
17	Malaysia (2014)	1.28	92.57	0.87	●
18	Croatia (2013)	1.30	92.45	0.86	●
19	New Zealand	1.32	92.33	0.86	
20	Japan	1.36	92.10	0.85	
21	Guatemala	1.39	91.93	0.84	●
22	Peru (2014)	1.43	91.70	0.83	●
23	Austria	1.57	90.88	0.62	
23	Belgium	1.57	90.88	0.62	
23	Bulgaria	1.57	90.88	0.62	
23	Cyprus	1.57	90.88	0.62	
23	Czech Republic	1.57	90.88	0.62	
23	Denmark	1.57	90.88	0.62	
23	Estonia	1.57	90.88	0.62	
23	Finland	1.57	90.88	0.62	
23	France	1.57	90.88	0.62	
23	Germany	1.57	90.88	0.62	
23	Greece	1.57	90.88	0.62	
23	Hungary	1.57	90.88	0.62	
23	Ireland	1.57	90.88	0.62	
23	Italy	1.57	90.88	0.62	
23	Latvia	1.57	90.88	0.62	
23	Lithuania	1.57	90.88	0.62	
23	Luxembourg	1.57	90.88	0.62	
23	Malta	1.57	90.88	0.62	
23	Netherlands	1.57	90.88	0.62	○
23	Poland	1.57	90.88	0.62	
23	Portugal	1.57	90.88	0.62	
23	Romania	1.57	90.88	0.62	
23	Slovakia	1.57	90.88	0.62	
23	Slovenia	1.57	90.88	0.62	
23	Spain	1.57	90.88	0.62	
23	Sweden	1.57	90.88	0.62	○
23	United Kingdom	1.57	90.88	0.62	○
50	United States of America	1.64	90.48	0.61	
51	El Salvador	1.79	89.61	0.60	
52	Belarus	1.80	89.55	0.59	
53	Australia	1.89	89.02	0.58	
54	Oman	1.90	88.97	0.58	
55	Ukraine	1.93	88.79	0.57	
56	Philippines (2013)	2.15	87.51	0.56	
57	Israel	2.23	87.05	0.55	
58	Indonesia (2013)	2.27	86.82	0.54	
59	Armenia	2.52	85.37	0.54	
60	Montenegro (2012)	2.63	84.73	0.53	
61	Costa Rica (2014)	2.66	84.55	0.52	
62	Kyrgyzstan	2.74	84.09	0.51	
63	Lebanon	2.77	83.91	0.50	
64	Honduras	2.79	83.80	0.49	
64	Morocco	2.79	83.80	0.49	
66	Russian Federation	2.80	83.74	0.48	
67	United Arab Emirates	2.83	83.57	0.47	
68	Kuwait	2.96	82.81	0.46	
69	Viet Nam	3.14	81.77	0.46	
70	Turkey	3.20	81.42	0.45	
71	Bahrain	3.29	80.89	0.44	
72	Moldova, Rep.	3.35	80.55	0.42	
72	Zambia (2013)	3.35	80.55	0.42	
74	Qatar	3.36	80.49	0.42	
75	Saudi Arabia (2014)	3.40	80.26	0.41	
76	China	3.41	80.20	0.40	
77	Thailand	3.47	79.85	0.39	
78	Tunisia	3.94	77.12	0.38	
79	Jordan	3.98	76.89	0.38	
80	Mozambique (2014)	4.17	75.78	0.37	
81	Colombia (2014)	4.21	75.55	0.36	
82	South Africa	4.22	75.49	0.35	
83	Malawi	4.24	75.38	0.34	
84	Paraguay	4.43	74.27	0.34	
85	Mongolia	4.57	73.46	0.33	
86	Kazakhstan	4.72	72.59	0.32	
87	Bolivia, Plurinational St.	4.75	72.42	0.31	
88	Korea, Rep.	4.78	72.24	0.30	○
89	Uruguay	4.79	72.18	0.30	
90	Cambodia (2014)	4.85	71.84	0.29	
91	Yemen	5.14	70.15	0.28	●
92	Azerbaijan	5.19	69.86	0.27	
93	Sri Lanka (2014)	5.25	69.51	0.26	
94	Burundi	5.39	68.70	0.26	
95	Zimbabwe	5.43	68.47	0.25	
96	Ecuador	5.60	67.48	0.24	
97	Uganda	5.93	65.56	0.23	
98	Madagascar (2014)	5.99	65.21	0.22	
99	Panama (2013)	6.08	64.69	0.22	
100	Dominican Republic	6.30	63.41	0.20	
100	India (2013)	6.30	63.41	0.20	
102	Tanzania, United Rep.	6.54	62.02	0.19	
103	Egypt	7.04	59.12	0.18	
104	Rwanda	7.15	58.48	0.18	
105	Tajikistan	7.18	58.30	0.17	
106	Argentina	7.35	57.32	0.16	
107	Kenya	7.60	55.87	0.15	
108	Algeria	8.27	51.97	0.13	
108	Brazil	8.27	51.97	0.13	○
108	Trinidad and Tobago (2013)	8.27	51.97	0.13	
111	Pakistan	9.53	44.66	0.12	
112	Burkina Faso	9.59	44.31	0.10	
112	Jamaica (2013)	9.59	44.31	0.10	○
114	Nigeria	9.75	43.38	0.10	
115	Côte d'Ivoire	10.63	38.27	0.09	
116	Mali	10.64	38.21	0.08	
117	Togo	11.41	33.74	0.07	
118	Senegal	11.64	32.40	0.06	○
119	Nepal	11.72	31.94	0.06	○
120	Niger	11.77	31.65	0.05	
121	Bangladesh	11.89	30.95	0.04	○
122	Guinea (2012)	11.91	30.84	0.03	
123	Ethiopia	12.14	29.50	0.02	
124	Iran, Islamic Rep. (2011)	15.23	11.56	0.02	○
125	Cameroon (2014)	15.78	8.36	0.01	○
126	Benin	17.22	0.00	0.00	○
n/a	Serbia	n/a	n/a	n/a	

SOURCE: World Bank, based on data from United Nations Conference on Trade and Development's Trade Analysis and Information System (TRAINS) database and the World Trade Organization's (WTO) Integrated Data Base (IDB) and Consolidated Tariff Schedules (CTS) database; extracted from World Bank *World Development Indicators* database

NOTE: ● indicates a strength; ○ a weakness

4.3.2 Intensity of local competition

Average answer to the question: In your country, how intense is competition in the local markets? [1 = not intense at all; 7 = extremely intense] | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Japan	6.23	87.11	1.00	●
2	Hong Kong (China)	6.16	86.02	0.99	●
3	United Kingdom	5.99	83.23	0.98	●
4	Malta	5.99	83.22	0.98	●
5	United States of America	5.98	82.95	0.97	
6	Australia	5.92	81.94	0.96	●
7	Korea, Rep.	5.92	81.92	0.95	
8	United Arab Emirates	5.90	81.75	0.94	●
9	Germany	5.90	81.74	0.93	
10	Netherlands	5.90	81.64	0.93	
11	Turkey	5.88	81.29	0.92	●
12	Belgium	5.85	80.83	0.91	●
13	France	5.76	79.36	0.90	
14	Czech Republic	5.76	79.35	0.89	●
15	Estonia	5.75	79.17	0.89	
16	Qatar	5.74	79.04	0.88	●
17	Spain	5.64	77.27	0.87	
18	Kenya	5.63	77.24	0.86	●
19	Singapore	5.62	76.94	0.85	
20	Dominican Republic	5.60	76.60	0.84	●
21	Sweden	5.59	76.49	0.84	
22	Austria	5.59	76.49	0.83	
23	Colombia	5.58	76.26	0.82	●
24	Slovakia	5.52	75.39	0.81	
25	Guatemala	5.52	75.33	0.80	●
26	Lithuania	5.51	75.25	0.80	
27	Jamaica	5.49	74.76	0.79	●
28	New Zealand	5.48	74.62	0.78	
29	South Africa	5.46	74.29	0.77	
30	Denmark	5.45	74.24	0.76	
31	Canada	5.45	74.10	0.75	
32	Lebanon	5.44	73.92	0.75	●
33	Panama	5.42	73.74	0.74	
34	Latvia	5.42	73.68	0.73	
35	China	5.41	73.54	0.72	
36	Saudi Arabia	5.40	73.36	0.71	
37	Jordan	5.40	73.27	0.70	●
38	Switzerland	5.39	73.19	0.70	
39	Malaysia	5.38	73.08	0.69	
40	TFYR of Macedonia	5.38	72.98	0.68	
41	Luxembourg	5.32	71.93	0.67	
42	Cyprus	5.31	71.90	0.66	
43	Thailand	5.31	71.89	0.66	
44	Uganda	5.31	71.83	0.65	●
45	Italy	5.31	71.82	0.64	
46	Poland	5.31	71.81	0.63	
47	Mauritius	5.30	71.68	0.62	
48	Costa Rica	5.30	71.59	0.61	
49	Botswana	5.27	71.25	0.61	
50	Indonesia	5.27	71.24	0.60	
51	Brazil	5.26	71.01	0.59	
52	El Salvador	5.26	70.99	0.58	
53	Senegal	5.24	70.59	0.57	●
54	Slovenia	5.23	70.54	0.57	
55	Portugal	5.23	70.52	0.56	
56	Mexico	5.22	70.30	0.55	
57	Trinidad and Tobago	5.22	70.28	0.54	
58	Kuwait	5.21	70.23	0.53	
59	Philippines	5.21	70.21	0.52	
60	Bahrain	5.21	70.14	0.52	
61	Chile	5.20	70.05	0.51	
62	Zambia	5.20	69.94	0.50	●
63	Ireland	5.19	69.88	0.49	○
64	Israel	5.19	69.82	0.48	
65	Sri Lanka	5.18	69.67	0.48	
66	Peru	5.18	69.63	0.47	
67	Norway	5.14	68.94	0.46	○
68	Morocco	5.12	68.75	0.45	
69	Bangladesh	5.11	68.48	0.44	
70	Greece	5.06	67.62	0.43	
71	Paraguay	5.04	67.31	0.43	
72	Nigeria	5.03	67.23	0.42	●
73	Ecuador	5.02	66.93	0.41	
74	Rwanda	4.98	66.39	0.40	
75	Georgia	4.97	66.09	0.39	
76	Honduras	4.95	65.86	0.39	
77	Viet Nam	4.95	65.86	0.38	
78	Russian Federation	4.95	65.83	0.37	
79	Bolivia, Plurinational St.	4.94	65.64	0.36	
80	Nepal	4.91	65.23	0.35	
81	Tunisia	4.85	64.19	0.34	
82	Iceland	4.84	63.96	0.34	○
83	Cameroon	4.83	63.84	0.33	
84	Benin	4.82	63.72	0.32	
85	Zimbabwe	4.82	63.64	0.31	
86	Armenia	4.81	63.50	0.30	
87	Croatia	4.80	63.27	0.30	○
88	Romania	4.79	63.14	0.29	
89	Finland	4.78	63.04	0.28	○
90	Côte d'Ivoire	4.77	62.92	0.27	
91	India	4.75	62.49	0.26	
92	Tajikistan	4.73	62.16	0.25	
93	Cambodia	4.73	62.12	0.25	
94	Tanzania, United Rep.	4.72	62.01	0.24	
95	Namibia	4.67	61.13	0.23	
96	Uruguay	4.64	60.61	0.22	
97	Kazakhstan	4.63	60.53	0.21	
98	Bulgaria	4.62	60.28	0.20	○
99	Ukraine	4.61	60.16	0.20	
100	Mongolia	4.60	60.06	0.19	
101	Madagascar	4.60	60.05	0.18	
102	Brunei Darussalam	4.60	60.05	0.17	
103	Oman	4.60	59.99	0.16	
104	Malawi	4.58	59.72	0.16	
105	Moldova, Rep.	4.55	59.13	0.15	○
106	Azerbaijan	4.52	58.65	0.14	○
107	Albania	4.50	58.31	0.13	○
108	Mozambique	4.48	57.96	0.12	
109	Pakistan	4.47	57.81	0.11	
110	Bosnia and Herzegovina	4.46	57.61	0.11	○
111	Mali	4.43	57.16	0.10	
112	Argentina	4.42	57.07	0.09	○
113	Burundi	4.36	56.08	0.08	
114	Montenegro	4.28	54.59	0.07	○
115	Yemen	4.27	54.58	0.07	
116	Iran, Islamic Rep.	4.24	53.97	0.06	○
117	Egypt	4.24	53.95	0.05	○
118	Serbia	4.23	53.91	0.04	○
119	Guinea (2015)	4.20	53.28	0.03	
120	Hungary	4.16	52.74	0.02	○
121	Kyrgyzstan	4.15	52.51	0.02	○
122	Ethiopia	3.88	48.08	0.01	○
123	Algeria	3.78	46.35	0.00	○
n/a	Belarus	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	

SOURCE: World Economic Forum, *Executive Opinion Survey 2016–2017*

NOTE: ● indicates a strength; ○ a weakness

4.3.3 Domestic market scale

Domestic market scale as measured by GDP, billion PPP$ | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	China	21,269.02	100.00	1.00	●
2	United States of America	18,561.93	98.63	0.99	●
3	India	8,720.51	91.05	0.98	●
4	Japan	4,931.88	85.32	0.98	●
5	Germany	3,979.08	83.16	0.97	●
6	Russian Federation	3,745.08	82.56	0.96	●
7	Brazil	3,134.89	80.77	0.95	●
8	Indonesia	3,027.83	80.42	0.94	●
9	United Kingdom	2,787.74	79.59	0.94	
10	France	2,736.72	79.40	0.93	●
11	Mexico	2,306.67	77.68	0.92	●
12	Italy	2,220.58	77.30	0.91	●
13	Korea, Rep.	1,928.62	75.88	0.90	
14	Saudi Arabia	1,731.23	74.79	0.90	●
15	Spain	1,689.71	74.55	0.89	
16	Canada	1,674.31	74.45	0.88	
17	Turkey	1,669.89	74.43	0.87	●
18	Iran, Islamic Rep.	1,459.20	73.07	0.87	●
19	Australia	1,188.76	71.00	0.86	
20	Thailand	1,161.33	70.76	0.85	●
21	Egypt	1,105.04	70.26	0.84	●
22	Nigeria	1,088.94	70.11	0.83	●
23	Poland	1,052.25	69.77	0.83	●
24	Pakistan	988.22	69.13	0.82	●
25	Argentina	879.45	67.96	0.81	●
26	Netherlands	865.91	67.80	0.80	
27	Malaysia	863.77	67.77	0.79	
28	Philippines	801.90	67.02	0.79	●
29	South Africa	736.33	66.16	0.78	●
30	Colombia	690.39	65.50	0.77	
31	United Arab Emirates	667.21	65.16	0.76	
32	Bangladesh	628.37	64.55	0.75	●
33	Algeria	609.39	64.24	0.75	●
34	Viet Nam	594.89	63.99	0.74	
35	Belgium	508.60	62.40	0.73	
36	Sweden	498.13	62.19	0.72	
37	Switzerland	494.30	62.11	0.71	
38	Singapore	486.91	61.96	0.71	
39	Kazakhstan	460.69	61.39	0.70	
40	Romania	441.03	60.95	0.69	
41	Chile	436.14	60.84	0.68	
42	Hong Kong (China)	427.39	60.63	0.67	
43	Austria	415.94	60.35	0.67	
44	Peru	409.85	60.20	0.66	●
45	Norway	364.69	59.01	0.65	
46	Czech Republic	350.86	58.61	0.64	
47	Ukraine	349.77	58.58	0.63	
48	Qatar	334.49	58.12	0.63	
49	Ireland	324.30	57.81	0.62	
50	Kuwait	301.06	57.04	0.61	
51	Portugal	297.09	56.91	0.60	
52	Israel	297.05	56.91	0.60	
53	Greece	290.49	56.68	0.59	
54	Morocco	282.78	56.40	0.58	
55	Hungary	267.62	55.83	0.57	
56	Denmark	264.84	55.73	0.56	○
57	Sri Lanka	237.79	54.61	0.56	
58	Finland	229.95	54.27	0.55	○
59	Ecuador	182.42	51.86	0.54	
60	New Zealand	174.85	51.42	0.53	
61	Ethiopia	174.74	51.41	0.52	●
62	Oman	173.07	51.31	0.52	
63	Slovakia	169.07	51.07	0.51	
64	Azerbaijan	167.91	51.00	0.50	
65	Belarus	165.36	50.84	0.49	
66	Dominican Republic	160.86	50.55	0.48	
67	Kenya	152.74	50.00	0.48	
68	Tanzania, United Rep.	150.63	49.86	0.47	●
69	Bulgaria	143.10	49.32	0.46	
70	Guatemala	132.34	48.49	0.45	
71	Tunisia	130.83	48.37	0.44	
72	Serbia	101.46	45.66	0.44	
73	Croatia	94.24	44.86	0.43	
74	Panama	93.12	44.73	0.42	
75	Côte d'Ivoire	87.12	44.01	0.41	
76	Jordan	86.19	43.89	0.40	
77	Lithuania	85.79	43.84	0.40	
78	Lebanon	85.16	43.76	0.39	
79	Uganda	84.93	43.73	0.38	
80	Costa Rica	79.26	42.97	0.37	
81	Bolivia, Plurinational St.	78.35	42.84	0.37	
82	Cameroon	77.24	42.69	0.36	
83	Uruguay	73.93	42.20	0.35	
84	Yemen	73.45	42.13	0.34	●
85	Nepal	71.52	41.84	0.33	
86	Bahrain	66.37	41.00	0.33	
87	Slovenia	66.13	40.96	0.32	○
88	Zambia	65.17	40.80	0.31	
89	Paraguay	64.12	40.61	0.30	
90	Cambodia	58.94	39.66	0.29	
91	Luxembourg	58.74	39.63	0.29	○
92	El Salvador	54.79	38.83	0.28	
93	Latvia	50.87	37.97	0.27	○
94	Trinidad and Tobago	43.57	36.15	0.26	
95	Honduras	43.19	36.05	0.25	
96	Bosnia and Herzegovina	42.53	35.86	0.25	
97	Senegal	39.72	35.04	0.24	
98	Estonia	38.70	34.72	0.23	○
99	Mali	38.09	34.53	0.22	
100	Madagascar	37.49	34.33	0.21	
101	Georgia	37.38	34.30	0.21	
102	Mongolia	36.65	34.05	0.20	
103	Botswana	36.51	34.00	0.19	
104	Mozambique	35.31	33.59	0.18	
105	Albania	34.21	33.20	0.17	
106	Brunei Darussalam	33.73	33.02	0.17	
107	Burkina Faso	32.99	32.73	0.16	
108	TFYR of Macedonia	30.13	31.57	0.15	○
109	Cyprus	29.26	31.19	0.14	○
110	Zimbabwe	28.33	30.76	0.13	
111	Namibia	27.04	30.14	0.13	
112	Armenia	26.56	29.90	0.12	○
113	Mauritius	25.85	29.53	0.11	○
114	Tajikistan	25.81	29.51	0.10	
115	Jamaica	25.39	29.28	0.10	○
116	Benin	24.31	28.68	0.09	
117	Rwanda	21.97	27.23	0.08	
118	Malawi	21.23	26.72	0.07	
119	Kyrgyzstan	21.01	26.57	0.06	
120	Niger	20.27	26.03	0.06	
121	Moldova, Rep.	18.54	24.64	0.05	○
122	Malta	16.32	22.52	0.04	○
123	Iceland	16.15	22.33	0.03	○
124	Guinea	16.08	22.26	0.02	
125	Togo	11.61	15.57	0.02	○
126	Montenegro	10.61	13.19	0.01	○
127	Burundi	7.89	0.00	0.00	○

SOURCE: World Bank; International Monetary Fund, *World Economic Outlook Database* October 2016 (PPP$ GDP)

NOTE: ● indicates a strength; ○ a weakness

5.1.1 Employment in knowledge-intensive services

Employment in knowledge-intensive services (% of workforce) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Luxembourg	56.81	100.00	1.00	●
2	Singapore	54.33	95.58	0.99	●
3	Switzerland	52.98	93.17	0.98	●
4	Norway	51.68	90.86	0.97	●
5	Sweden	50.38	88.54	0.96	
6	Israel	48.30	84.82	0.95	
7	Iceland	47.83	83.98	0.94	
8	United Kingdom	47.63	83.62	0.93	
9	Netherlands	46.57	81.73	0.93	
10	Finland	45.96	80.64	0.92	
11	Belgium	45.58	79.98	0.91	
12	Denmark	45.13	79.17	0.90	
13	Australia (2014)	44.90	78.76	0.89	
14	France	44.56	78.15	0.88	
15	Russian Federation	44.35	77.77	0.87	●
16	Germany	44.19	77.49	0.86	
17	Estonia	43.99	77.14	0.85	
18	Canada (2014)	43.73	76.66	0.84	
19	New Zealand (2008)	42.92	75.22	0.83	
20	Lithuania	41.80	73.22	0.82	
21	Slovenia	41.66	72.97	0.81	
22	Latvia	41.18	72.13	0.80	
23	Austria	40.62	71.13	0.79	
24	Ireland	40.58	71.05	0.79	
25	Brunei Darussalam (2014)	40.53	70.96	0.78	●
26	Malta	39.78	69.63	0.77	
27	Hong Kong (China)	38.64	67.59	0.76	
28	United States of America (2013)	38.01	66.47	0.75	
29	Poland	37.63	65.78	0.74	
30	Ukraine	37.59	65.72	0.73	
31	Czech Republic	37.58	65.71	0.72	
32	Montenegro	37.39	65.36	0.71	
33	United Arab Emirates (2008)	36.08	63.02	0.70	
34	Belarus (2009)	35.90	62.70	0.69	
35	Italy	35.70	62.34	0.68	
36	Croatia	35.62	62.20	0.67	
37	Portugal	35.55	62.07	0.66	
38	Cyprus	35.20	61.45	0.65	
39	Hungary	34.87	60.86	0.64	
40	Egypt	33.93	59.19	0.64	●
41	Kazakhstan	33.34	58.13	0.63	
42	Spain	32.87	57.30	0.62	
43	Bulgaria	32.26	56.20	0.61	
44	Slovakia	31.93	55.62	0.60	
45	Lebanon (2007)	31.84	55.47	0.59	
46	Armenia	31.13	54.19	0.58	
47	Greece	29.85	51.92	0.57	
48	Serbia	28.87	50.16	0.56	
49	Trinidad and Tobago	28.41	49.34	0.55	
50	Moldova, Rep.	28.07	48.74	0.54	
51	TFYR of Macedonia	27.34	47.43	0.53	
52	Saudi Arabia	27.30	47.36	0.52	
53	Malaysia	25.50	44.16	0.51	
54	Chile	25.01	43.28	0.50	
55	Japan	24.78	42.87	0.50	
56	Mauritius	24.72	42.76	0.49	
57	Mongolia	24.67	42.68	0.48	
58	Philippines	24.03	41.54	0.47	
59	Panama (2014)	24.01	41.50	0.46	
60	Bosnia and Herzegovina	23.97	41.42	0.45	
61	Argentina (2014)	23.91	41.32	0.44	
62	Azerbaijan	23.42	40.44	0.43	
63	Romania	22.74	39.23	0.42	
64	South Africa	22.46	38.74	0.41	
65	Georgia (2007)	22.30	38.45	0.40	
66	Costa Rica	21.63	37.26	0.39	
67	Brazil (2014)	21.63	37.24	0.38	
68	Korea, Rep.	21.42	36.88	0.37	○
69	Uruguay (2014)	20.97	36.07	0.36	
70	Tunisia (2012)	20.97	36.07	0.36	
71	Bahrain (2008)	20.88	35.91	0.35	
72	Turkey	20.49	35.21	0.34	
73	Jamaica (2008)	20.12	34.56	0.33	
74	Bangladesh (2011)	20.01	34.36	0.32	
75	Pakistan (2008)	19.48	33.41	0.31	
76	Paraguay	19.00	32.55	0.30	
77	Mexico	18.85	32.29	0.29	
78	Kyrgyzstan	18.28	31.28	0.28	
79	Dominican Republic	17.94	30.67	0.27	
80	Botswana (2010)	17.79	30.40	0.26	
81	Iran, Islamic Rep.	17.65	30.16	0.25	
82	Sri Lanka (2014)	16.87	28.76	0.24	
83	Colombia (2010)	16.81	28.66	0.23	○
84	Qatar	16.08	27.34	0.22	
85	Albania (2009)	16.02	27.24	0.21	
86	Bolivia, Plurinational St. (2009)	15.25	25.86	0.21	
87	Yemen (2010)	15.03	25.48	0.20	
88	Ecuador	14.66	24.82	0.19	
89	Namibia (2013)	14.64	24.78	0.18	
90	Peru	14.61	24.72	0.17	○
91	Thailand (2014)	13.80	23.28	0.16	○
92	El Salvador (2013)	12.13	20.30	0.15	
93	Honduras	12.01	20.08	0.14	
94	Viet Nam	10.76	17.86	0.13	○
95	Algeria (2014)	10.00	16.50	0.12	
96	Indonesia	9.82	16.18	0.11	○
97	Guatemala	9.56	15.73	0.10	
98	Zambia (2010)	7.28	11.66	0.09	
99	Morocco (2008)	6.78	10.76	0.08	○
100	Zimbabwe (2014)	6.13	9.60	0.07	
101	Nepal (2008)	4.28	6.30	0.07	
102	Cambodia (2010)	4.12	6.01	0.06	○
103	Uganda (2013)	4.09	5.97	0.05	○
104	Ethiopia (2013)	3.77	5.39	0.04	
105	Rwanda (2012)	3.76	5.37	0.03	○
106	Madagascar	3.66	5.20	0.02	○
107	Tanzania, United Rep. (2014)	3.37	4.69	0.01	○
108	Guinea (2010)	0.75	0.00	0.00	○
n/a	Benin	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	China	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	India	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kenya	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Senegal	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	

SOURCE: International Labour Organization *ILOSTAT Database of Labour Statistics*

NOTE: ● indicates a strength; ○ a weakness

5.1.2 Firms offering formal training

Firms offering formal training (% of firms) | 2013

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	China (2012)	79.20	100.00	1.00	●
2	Sweden (2014)	70.30	88.26	0.99	●
3	Ecuador (2010)	65.90	82.45	0.98	●
4	Colombia (2010)	65.10	81.40	0.97	●
5	Argentina (2010)	63.60	79.42	0.96	●
6	Kyrgyzstan	62.70	78.23	0.95	●
7	Mongolia	60.90	75.86	0.93	●
8	Peru (2010)	60.10	74.80	0.92	●
9	Philippines (2015)	59.80	74.41	0.91	●
10	Chile (2010)	57.50	71.37	0.90	●
11	Bolivia, Plurinational St. (2010)	57.10	70.84	0.89	●
12	Dominican Republic (2010)	57.00	70.71	0.88	●
13	Rwanda (2011)	55.40	68.60	0.87	●
14	Czech Republic	55.10	68.21	0.86	
15	Paraguay (2010)	54.90	67.94	0.85	●
16	Costa Rica (2010)	54.70	67.68	0.84	●
17	El Salvador (2016)	53.80	66.49	0.82	●
18	Bosnia and Herzegovina	52.40	64.64	0.81	●
19	Botswana (2010)	51.90	63.98	0.79	●
19	Guatemala (2010)	51.90	63.98	0.79	●
21	Belarus	51.10	62.93	0.78	●
22	Mexico (2010)	50.80	62.53	0.77	
23	Croatia	49.30	60.55	0.76	
24	Uruguay (2010)	48.60	59.63	0.75	●
25	TFYR of Macedonia	46.90	57.39	0.74	
26	Russian Federation (2012)	46.20	56.46	0.73	
27	Slovakia	43.50	52.90	0.71	
28	Bulgaria	42.70	51.85	0.70	
29	Brazil (2009)	42.20	51.19	0.69	
30	Lithuania	42.00	50.92	0.68	
31	Slovenia	41.50	50.26	0.67	
32	Romania	40.70	49.21	0.66	
33	Kenya	40.60	49.08	0.65	
34	Serbia	37.80	45.38	0.64	
35	South Africa (2007)	36.80	44.06	0.63	
36	India (2014)	35.90	42.88	0.62	
37	Honduras (2010)	35.80	42.74	0.60	●
38	Estonia	35.20	41.95	0.59	
39	Uganda	34.70	41.29	0.58	●
40	Poland	34.60	41.16	0.57	
41	Tajikistan	33.10	39.18	0.56	●
42	Malawi (2014)	32.90	38.92	0.55	●
43	Moldova, Rep.	32.40	38.26	0.54	
44	Mali (2010)	32.10	37.86	0.52	●
44	Niger (2009)	32.10	37.86	0.52	
46	Burundi (2014)	32.00	37.73	0.49	
46	Pakistan	32.00	37.73	0.49	
48	Nepal	31.90	37.60	0.48	●
49	Zimbabwe (2011)	31.20	36.68	0.47	
50	Togo (2009)	31.00	36.41	0.46	●
51	Nigeria (2014)	30.70	36.02	0.44	●
51	Tanzania, United Rep.	30.70	36.02	0.44	
53	Tunisia	28.90	33.64	0.43	
54	Turkey	28.40	32.98	0.42	
55	Kazakhstan	28.30	32.85	0.41	
56	Zambia	28.20	32.72	0.40	
57	Trinidad and Tobago (2010)	28.00	32.45	0.38	
58	Lebanon	26.60	30.61	0.37	
59	Morocco	26.30	30.21	0.36	
60	Jamaica (2010)	25.90	29.68	0.35	
61	Mauritius (2009)	25.60	29.29	0.34	
62	Cameroon (2009)	25.50	29.16	0.33	
63	Namibia (2014)	25.40	29.02	0.32	
64	Latvia	25.20	28.76	0.31	○
65	Burkina Faso (2009)	24.80	28.23	0.30	
66	Albania	23.80	26.91	0.29	
67	Montenegro	23.70	26.78	0.27	
68	Ukraine	22.60	25.33	0.26	
69	Cambodia (2016)	22.20	24.80	0.24	
69	Viet Nam (2015)	22.20	24.80	0.24	
71	Mozambique (2007)	22.10	24.67	0.23	
72	Bangladesh	21.90	24.41	0.22	
73	Guinea (2006)	21.10	23.35	0.21	
74	Ethiopia (2015)	20.80	22.96	0.20	
75	Azerbaijan	20.20	22.16	0.19	
76	Benin (2016)	20.00	21.90	0.18	
77	Côte d'Ivoire (2009)	19.10	20.71	0.16	
78	Israel	18.60	20.05	0.15	○
79	Malaysia (2015)	18.50	19.92	0.14	○
80	Sri Lanka (2011)	18.40	19.79	0.13	○
81	Thailand (2016)	18.00	19.26	0.12	○
82	Senegal (2014)	17.40	18.47	0.11	
83	Algeria (2007)	17.30	18.34	0.10	
84	Armenia	16.20	16.89	0.09	○
85	Hungary	15.80	16.36	0.08	○
86	Yemen	14.30	14.38	0.07	
87	Madagascar	12.70	12.27	0.05	
88	Panama (2010)	11.00	10.03	0.04	○
89	Georgia	10.50	9.37	0.03	○
90	Indonesia (2015)	7.70	5.67	0.02	○
91	Egypt	5.20	2.37	0.01	○
92	Jordan	3.40	0.00	0.00	○
n/a	Australia	n/a	n/a	n/a	
n/a	Austria	n/a	n/a	n/a	
n/a	Bahrain	n/a	n/a	n/a	
n/a	Belgium	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Canada	n/a	n/a	n/a	
n/a	Cyprus	n/a	n/a	n/a	
n/a	Denmark	n/a	n/a	n/a	
n/a	Finland	n/a	n/a	n/a	
n/a	France	n/a	n/a	n/a	
n/a	Germany	n/a	n/a	n/a	
n/a	Greece	n/a	n/a	n/a	
n/a	Hong Kong (China)	n/a	n/a	n/a	
n/a	Iceland	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Ireland	n/a	n/a	n/a	
n/a	Italy	n/a	n/a	n/a	
n/a	Japan	n/a	n/a	n/a	
n/a	Korea, Rep.	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Luxembourg	n/a	n/a	n/a	
n/a	Malta	n/a	n/a	n/a	
n/a	Netherlands	n/a	n/a	n/a	
n/a	New Zealand	n/a	n/a	n/a	
n/a	Norway	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Portugal	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Singapore	n/a	n/a	n/a	
n/a	Spain	n/a	n/a	n/a	
n/a	Switzerland	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	United Kingdom	n/a	n/a	n/a	
n/a	United States of America	n/a	n/a	n/a	

SOURCE: World Bank, *Enterprise Surveys*

NOTE: ● indicates a strength; ○ a weakness

5.1.3 GERD performed by business enterprise

GERD: Performed by business enterprise (% of GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Israel	3.67	100.00	1.00	●
2	Korea, Rep.	3.28	89.37	0.99	●
3	Japan	2.74	74.69	0.98	●
4	Sweden	2.28	62.16	0.97	
5	Austria	2.19	59.74	0.96	●
6	Switzerland (2012)	2.05	55.97	0.94	
7	United States of America	2.00	54.59	0.93	
8	Finland	1.95	53.20	0.92	
9	Germany	1.95	53.17	0.91	
10	Denmark	1.93	52.62	0.90	
11	Belgium	1.77	48.22	0.89	
12	Slovenia	1.69	45.98	0.88	
13	China	1.61	43.80	0.87	
14	France	1.45	39.50	0.85	
15	Iceland	1.43	39.02	0.84	
16	Singapore (2014)	1.34	36.60	0.83	
17	Australia (2013)	1.24	33.68	0.82	
18	United Kingdom	1.12	30.58	0.81	
19	Netherlands	1.12	30.40	0.80	
20	Ireland (2014)	1.11	30.36	0.79	
21	Czech Republic	1.08	29.32	0.78	
22	Norway	1.04	28.46	0.76	
23	Hungary	1.02	27.79	0.75	
24	Canada (2014)	0.80	21.92	0.74	
25	Italy	0.74	20.15	0.73	
26	Bulgaria	0.72	19.57	0.72	
27	Estonia	0.68	18.56	0.71	
28	Russian Federation	0.67	18.25	0.70	
29	Luxembourg	0.66	17.90	0.69	
30	Spain	0.64	17.43	0.67	
31	Portugal	0.60	16.38	0.66	
32	Malaysia (2014)	0.58	15.70	0.65	
33	New Zealand (2013)	0.54	14.59	0.64	
34	Turkey (2014)	0.50	13.65	0.63	
35	Poland	0.47	12.80	0.62	
36	Thailand	0.44	11.96	0.61	
37	Croatia	0.44	11.91	0.60	
38	Malta (2014)	0.42	11.48	0.58	
39	United Arab Emirates	0.41	11.16	0.57	
40	Ukraine	0.38	10.42	0.56	
41	Belarus	0.34	9.24	0.55	
42	South Africa (2013)	0.33	9.08	0.54	
43	Slovakia	0.33	9.04	0.53	
44	Hong Kong (China) (2014)	0.33	8.97	0.52	
45	Greece	0.32	8.69	0.51	
46	India (2011)	0.29	8.03	0.49	
47	Lithuania	0.28	7.62	0.48	
48	Serbia	0.28	7.61	0.47	
49	Romania	0.21	5.84	0.46	
50	Morocco (2010)	0.21	5.83	0.45	
51	Costa Rica (2014)	0.21	5.80	0.44	
52	Viet Nam (2013)	0.19	5.26	0.43	
53	Ecuador (2014)	0.19	5.14	0.42	
54	Mexico	0.17	4.64	0.40	
55	Uganda (2010)	0.17	4.50	0.39	
56	Latvia	0.15	4.21	0.38	
57	Montenegro (2014)	0.14	3.81	0.37	
58	Chile	0.13	3.61	0.36	
59	Argentina (2014)	0.12	3.35	0.35	
60	Qatar (2012)	0.12	3.31	0.34	
61	Tunisia (2014)	0.12	3.30	0.33	
62	Botswana (2013)	0.10	2.60	0.31	
63	Colombia	0.08	2.13	0.30	
64	Moldova, Rep.	0.08	2.09	0.29	
65	Cyprus	0.08	2.08	0.28	○
66	Bosnia and Herzegovina	0.07	1.99	0.27	
67	Iran, Islamic Rep. (2008)	0.07	1.94	0.26	
68	Kenya (2010)	0.07	1.85	0.25	
69	Philippines (2013)	0.05	1.34	0.24	
70	Kazakhstan (2013)	0.05	1.33	0.22	
71	Sri Lanka (2013)	0.05	1.23	0.21	
72	Egypt	0.04	1.22	0.20	
73	Oman	0.04	1.17	0.19	
74	Namibia (2014)	0.04	1.05	0.18	
75	TFYR of Macedonia (2011)	0.03	0.94	0.17	○
76	Indonesia (2013)	0.02	0.59	0.16	
77	Azerbaijan (2014)	0.02	0.57	0.15	
78	Bahrain (2014)	0.02	0.55	0.13	
79	Kyrgyzstan	0.02	0.46	0.12	
80	Uruguay (2014)	0.02	0.42	0.11	○
81	Mongolia	0.01	0.31	0.10	○
82	Ethiopia (2013)	0.01	0.19	0.09	
83	Mali (2007)	0.01	0.17	0.08	
84	Zambia (2008)	0.01	0.15	0.07	
85	Senegal (2010)	0.00	0.05	0.06	○
86	Mozambique	0.00	0.04	0.04	
87	Trinidad and Tobago (2009)	0.00	0.03	0.03	○
88	Panama (2013)	0.00	0.03	0.02	○
89	Paraguay (2011)	0.00	0.01	0.01	○
90	Guatemala (2012)	0.00	0.00	0.00	○
n/a	Albania	n/a	n/a	n/a	
n/a	Algeria	n/a	n/a	n/a	
n/a	Armenia	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Brazil	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Georgia	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mauritius	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Peru	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*

NOTE: ● indicates a strength; ○ a weakness

5.1.4 GERD financed by business enterprise

GERD: Financed by business enterprise (% of total GERD) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Japan	77.97	100.00	1.00	●
2	China	74.73	95.83	0.99	●
3	Korea, Rep.	74.55	95.60	0.98	●
4	United Arab Emirates (2014)	74.29	95.27	0.97	●
5	Slovenia	69.21	88.75	0.96	●
6	Thailand	66.24	84.94	0.95	●
7	Germany (2014)	65.84	84.43	0.94	
8	United States of America	64.15	82.26	0.92	
9	Australia (2008)	61.91	79.38	0.91	
10	Belgium (2013)	61.32	78.62	0.90	
11	Sweden (2013)	60.96	78.15	0.89	
12	Switzerland (2012)	60.78	77.93	0.88	
13	Denmark	59.37	76.12	0.87	
14	France (2014)	55.65	71.35	0.86	
15	Finland	54.76	70.21	0.85	
16	Singapore (2014)	54.10	69.36	0.84	
17	Ireland (2014)	52.78	67.66	0.83	
18	Austria (2016)	52.50	67.30	0.82	
19	Turkey (2014)	50.87	65.20	0.81	●
20	Hungary	49.72	63.73	0.80	
21	Netherlands	48.70	62.42	0.78	
22	United Kingdom	48.39	62.02	0.77	
23	Croatia	46.64	59.78	0.76	
24	Spain (2014)	46.41	59.48	0.75	
25	Hong Kong (China) (2014)	46.39	59.46	0.74	
26	Italy (2014)	46.23	59.25	0.73	
27	Canada (2014)	45.39	58.16	0.72	
28	Malta	44.13	56.55	0.71	
29	Norway (2013)	43.14	55.29	0.70	
30	Portugal (2014)	41.80	53.56	0.69	
31	South Africa (2013)	41.37	53.01	0.68	
32	Belarus	41.31	52.93	0.67	
33	Estonia	41.00	52.54	0.66	
34	Sri Lanka (2013)	40.68	52.13	0.65	●
35	Ukraine	40.28	51.60	0.63	
36	Viet Nam (2013)	39.97	51.22	0.62	
37	New Zealand (2013)	39.78	50.96	0.61	
38	Poland	39.00	49.97	0.60	
39	Romania	37.29	47.77	0.59	
40	Israel (2013)	37.05	47.46	0.58	
41	Philippines (2013)	36.86	47.22	0.57	
42	Brazil (2014)	36.36	46.57	0.56	
43	Czech Republic	34.53	44.22	0.55	
44	Colombia	33.60	43.03	0.54	
45	Iceland	33.25	42.59	0.53	
46	Chile	32.78	41.98	0.52	
47	Greece	31.76	40.67	0.51	
48	Bosnia and Herzegovina	31.39	40.20	0.49	
49	Iran, Islamic Rep. (2008)	30.92	39.59	0.48	
50	Azerbaijan (2014)	30.53	39.10	0.47	
51	Morocco (2010)	29.94	38.33	0.46	
52	Kazakhstan (2013)	28.92	37.03	0.45	
53	Montenegro (2014)	28.53	36.52	0.44	
54	Lithuania	28.01	35.86	0.43	
55	Argentina (2008)	26.52	33.95	0.42	
56	Russian Federation	26.47	33.89	0.41	
57	Slovakia	25.06	32.07	0.40	
58	Qatar (2012)	24.18	30.95	0.39	
59	Bulgaria (2014)	22.25	28.47	0.38	○
60	Bahrain (2014)	21.77	27.85	0.37	
61	Oman	21.37	27.33	0.35	
62	Mexico	20.59	26.33	0.34	
63	Latvia	20.09	25.69	0.33	○
64	Tunisia (2014)	18.50	23.65	0.32	
65	Botswana (2013)	17.68	22.60	0.31	
66	Luxembourg (2013)	16.51	21.09	0.30	
67	Cyprus (2014)	13.72	17.51	0.29	○
68	Uganda (2010)	13.67	17.45	0.28	
69	Serbia	12.78	16.31	0.27	
70	Burkina Faso (2009)	11.93	15.22	0.26	
71	Namibia (2014)	11.10	14.15	0.25	
72	Panama (2013)	10.85	13.83	0.24	
73	Mali (2007)	10.10	12.87	0.23	
74	Mongolia	7.35	9.33	0.22	
75	Malaysia (2014)	6.91	8.77	0.20	○
76	Egypt	6.20	7.86	0.19	
77	Bolivia, Plurinational St. (2009)	5.20	6.58	0.18	
78	Uruguay (2014)	4.57	5.76	0.17	○
79	Kenya (2010)	4.34	5.47	0.16	
80	Senegal (2010)	4.10	5.16	0.15	
81	Albania (2008)	3.26	4.08	0.14	
82	Zambia (2008)	3.23	4.04	0.13	
83	Kyrgyzstan	2.24	2.78	0.12	
84	Tajikistan (2011)	1.65	2.02	0.11	
85	Costa Rica (2014)	1.49	1.81	0.10	○
86	Kuwait (2013)	1.41	1.71	0.09	○
87	Ethiopia (2013)	0.75	0.86	0.08	
88	El Salvador (2014)	0.66	0.74	0.06	○
89	Mozambique	0.47	0.50	0.05	
90	Paraguay	0.28	0.26	0.04	○
91	Mauritius (2012)	0.27	0.25	0.03	○
92	Nigeria (2007)	0.16	0.10	0.02	○
93	Ecuador (2014)	0.12	0.05	0.01	○
94	Tanzania, United Rep. (2010)	0.08	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Armenia	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	Georgia	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	India	n/a	n/a	n/a	
n/a	Indonesia	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Moldova, Rep.	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Peru	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*

NOTE: ● indicates a strength; ○ a weakness

5.1.5 Females employed with advanced degrees

Females employed with advanced degrees, % total employed (25+ years old) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Belarus (2009)	33.85	100.00	1.00	●
2	Russian Federation	33.24	98.19	0.99	●
3	Ukraine	29.71	87.75	0.98	●
4	Israel (2013)	28.39	83.85	0.97	●
5	Lithuania	27.15	80.18	0.95	●
6	Finland	26.56	78.41	0.94	
7	Estonia	25.84	76.30	0.93	
8	Ireland	24.90	73.52	0.92	
9	Norway	24.69	72.88	0.91	
10	Sweden	24.11	71.16	0.90	
11	Cyprus	24.02	70.92	0.89	
12	Latvia	23.58	69.60	0.87	
13	Singapore (2014)	23.34	68.89	0.86	
14	Belgium	23.33	68.85	0.85	
15	Iceland	22.73	67.08	0.84	
16	Australia (2013)	22.64	66.82	0.83	
17	United Kingdom	22.16	65.39	0.82	
18	Denmark	21.77	64.24	0.80	
19	Spain	21.74	64.17	0.79	
20	France	21.05	62.12	0.78	
21	Luxembourg	20.59	60.75	0.77	
22	Japan	20.34	60.02	0.76	
23	Slovenia	20.07	59.22	0.75	
24	Bulgaria	19.73	58.21	0.74	
25	New Zealand (2013)	19.55	57.67	0.72	
26	Poland	19.53	57.63	0.71	
27	Netherlands	18.74	55.30	0.70	
28	Switzerland	17.84	52.62	0.69	
29	Kazakhstan (2013)	17.55	51.76	0.68	
30	Canada (2016)	17.02	50.19	0.67	
31	Greece	16.85	49.70	0.66	
32	Mongolia (2014)	16.67	49.15	0.64	
33	Panama (2012)	16.58	48.90	0.63	
34	Argentina (2014)	16.44	48.49	0.62	
35	Korea, Rep.	16.24	47.88	0.61	
36	Austria	16.01	47.20	0.60	
37	Croatia	15.97	47.07	0.59	
38	Chile	15.89	46.84	0.57	
39	Georgia	15.45	45.55	0.56	
40	Portugal	15.31	45.15	0.55	
41	Hungary	15.17	44.72	0.54	
42	Armenia	14.52	42.81	0.53	
43	Moldova, Rep. (2013)	13.95	41.12	0.52	
44	Uruguay (2014)	13.70	40.36	0.51	
45	Peru	13.50	39.78	0.49	
46	Hong Kong (China)	13.38	39.42	0.48	
47	Philippines	12.98	38.24	0.47	
48	Costa Rica	12.97	38.21	0.46	
49	TFYR of Macedonia	12.94	38.12	0.45	
50	Azerbaijan (2013)	12.87	37.93	0.44	
51	Germany	12.75	37.55	0.43	○
52	Dominican Republic	12.73	37.51	0.41	
53	Slovakia	12.51	36.86	0.40	
54	Paraguay (2013)	12.44	36.66	0.39	
55	Malta	12.35	36.37	0.38	○
56	Serbia (2013)	12.23	36.03	0.37	
57	Malaysia	12.20	35.95	0.36	
58	Colombia (2014)	12.09	35.62	0.34	
59	Czech Republic	11.56	34.05	0.33	○
60	Italy	11.46	33.74	0.32	○
61	Kyrgyzstan (2013)	10.83	31.87	0.31	
62	Ecuador	10.63	31.29	0.30	
63	Romania	10.59	31.17	0.29	
64	South Africa (2014)	10.16	29.90	0.28	
65	Albania	9.25	27.20	0.26	
66	Brazil (2014)	9.14	26.88	0.25	
67	Botswana (2010)	9.09	26.74	0.24	
68	Sri Lanka (2014)	8.76	25.75	0.23	
69	Mexico (2013)	8.16	23.98	0.22	○
70	Turkey	7.97	23.42	0.21	○
71	Thailand (2013)	7.55	22.17	0.20	
72	Viet Nam	7.36	21.61	0.18	
73	Mauritius (2010)	7.35	21.59	0.17	○
74	Ethiopia (2012)	6.02	17.65	0.16	
75	Saudi Arabia (2014)	5.76	16.88	0.15	○
76	Egypt (2013)	5.51	16.16	0.14	
77	Indonesia	4.80	14.05	0.13	
78	Algeria (2014)	4.56	13.32	0.11	
79	Qatar (2013)	4.50	13.16	0.10	○
80	Guatemala (2013)	3.51	10.24	0.09	
81	Bosnia and Herzegovina	3.20	9.30	0.08	○
82	Uganda (2013)	2.71	7.86	0.07	
83	Madagascar (2012)	2.32	6.69	0.06	
84	Yemen (2010)	1.60	4.58	0.05	
85	Tanzania, United Rep. (2014)	1.35	3.82	0.03	
86	Senegal (2011)	0.73	2.01	0.02	○
87	Mozambique (2012)	0.51	1.36	0.01	○
88	El Salvador (2013)	0.05	0.00	0.00	○
n/a	Bahrain	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	China	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	India	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kenya	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Morocco	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Tunisia	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	United States of America	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: International Labour Organization, ILOSTAT *Annual Indicators*; and Statistics Canada, Table 282-0004; Labour Force Survey estimates (LFS) by educational attainment, sex and age group, annual, CANSIM, accessed 9 February 2017

NOTE: ● indicates a strength; ○ a weakness

5.2.1 University/industry research collaboration

Average answer to the survey question: In your country, to what extent do businesses and universities collaborate on research and development (R&D)? [1 = do not collaborate at all; 7 = collaborate extensively] | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Switzerland	5.80	80.00	1.00	●
2	Finland	5.72	78.62	0.99	●
3	Israel	5.60	76.67	0.98	●
4	United States of America	5.57	76.22	0.98	
5	Netherlands	5.50	75.00	0.97	●
6	United Kingdom	5.47	74.51	0.96	
7	Singapore	5.47	74.47	0.95	
8	Germany	5.35	72.52	0.94	
9	Belgium	5.26	71.00	0.93	●
10	Qatar	5.23	70.53	0.93	●
11	Malaysia	5.20	70.00	0.92	●
12	Sweden	5.16	69.33	0.91	
13	Ireland	5.11	68.52	0.90	
14	Denmark	4.84	63.99	0.89	
15	Austria	4.81	63.58	0.89	
16	Iceland	4.78	63.05	0.88	
17	Japan	4.75	62.54	0.87	
18	New Zealand	4.75	62.50	0.86	
19	Norway	4.74	62.37	0.85	
20	Luxembourg	4.65	60.83	0.84	
21	Hong Kong (China) (2015)	4.59	59.78	0.84	
22	Canada	4.58	59.63	0.83	
23	India	4.54	58.93	0.82	
24	United Arab Emirates	4.51	58.47	0.81	
25	Kenya	4.46	57.63	0.80	●
26	South Africa	4.44	57.36	0.80	●
27	Indonesia	4.42	57.03	0.79	●
28	Korea, Rep.	4.36	56.00	0.78	
29	China	4.32	55.27	0.77	
30	Tajikistan	4.31	55.19	0.76	●
31	France	4.29	54.79	0.75	
32	Australia	4.27	54.49	0.75	
33	Lithuania	4.12	51.93	0.74	
34	Estonia	4.08	51.37	0.73	
35	Portugal	4.03	50.46	0.72	
36	Malta	4.00	50.00	0.71	
37	Jordan	3.84	47.31	0.70	●
38	Ethiopia	3.83	47.19	0.70	●
39	Uganda	3.79	46.48	0.69	●
40	Thailand	3.77	46.15	0.68	
41	Slovenia	3.76	45.98	0.67	
42	Bahrain	3.73	45.44	0.66	
43	Italy	3.68	44.68	0.66	
44	Russian Federation	3.68	44.63	0.65	
45	Czech Republic	3.66	44.39	0.64	
46	Colombia	3.66	44.30	0.63	
47	Senegal	3.64	43.97	0.62	●
48	Lebanon	3.64	43.94	0.61	
49	Sri Lanka	3.63	43.83	0.61	
50	Mexico	3.63	43.75	0.60	
51	Oman	3.61	43.44	0.59	
52	Azerbaijan	3.56	42.67	0.58	
53	Tanzania, United Rep.	3.54	42.28	0.57	●
54	Saudi Arabia	3.51	41.86	0.57	
55	Spain	3.51	41.83	0.55	
55	Ukraine	3.51	41.83	0.55	
57	Guatemala	3.51	41.77	0.54	
58	Zambia	3.49	41.42	0.53	●
59	Philippines	3.48	41.35	0.52	
60	Turkey	3.47	41.15	0.52	
61	Chile	3.47	41.14	0.51	
62	Costa Rica	3.45	40.91	0.50	
63	Kazakhstan	3.45	40.86	0.49	
64	Jamaica	3.45	40.77	0.48	
65	Pakistan	3.44	40.70	0.48	
66	Uruguay	3.44	40.70	0.47	
67	TFYR of Macedonia	3.44	40.65	0.46	
68	Argentina	3.43	40.43	0.45	
69	Botswana	3.41	40.25	0.44	
70	Madagascar	3.40	40.00	0.43	
71	Bulgaria	3.38	39.71	0.43	
72	Panama	3.38	39.66	0.42	
73	Cyprus	3.35	39.23	0.41	
74	Latvia	3.35	39.17	0.40	
75	Rwanda	3.34	38.94	0.39	
76	Viet Nam	3.33	38.89	0.39	
77	Romania	3.33	38.83	0.38	
78	Slovakia	3.31	38.56	0.37	
79	Brunei Darussalam	3.30	38.41	0.36	
80	Poland	3.29	38.22	0.35	○
81	Côte d'Ivoire	3.29	38.19	0.34	
82	Mozambique	3.27	37.78	0.34	
83	Namibia	3.26	37.67	0.33	
84	Brazil	3.25	37.43	0.32	
85	Cameroon	3.23	37.23	0.31	
86	Armenia	3.21	36.89	0.30	
87	Mauritius	3.19	36.48	0.30	
88	Montenegro	3.18	36.40	0.29	
89	Serbia	3.15	35.86	0.28	
90	Mali	3.15	35.82	0.27	
91	Benin	3.14	35.61	0.26	
92	Honduras	3.12	35.37	0.25	
93	Morocco	3.12	35.35	0.25	
94	Ecuador	3.11	35.14	0.24	
95	Cambodia	3.08	34.70	0.23	
96	Albania	3.03	33.86	0.22	
97	Iran, Islamic Rep.	3.02	33.63	0.21	
98	Tunisia	2.97	32.79	0.20	
99	Hungary	2.92	32.03	0.20	○
100	Peru	2.91	31.78	0.19	○
101	Dominican Republic	2.91	31.78	0.18	
102	Trinidad and Tobago	2.90	31.67	0.17	
103	Croatia	2.87	31.10	0.16	○
104	Burundi	2.81	30.21	0.16	
105	Bosnia and Herzegovina	2.78	29.65	0.15	
106	El Salvador	2.78	29.59	0.14	
107	Georgia	2.72	28.68	0.13	○
108	Algeria	2.71	28.53	0.12	
109	Kyrgyzstan	2.71	28.52	0.11	
110	Malawi	2.71	28.48	0.11	
111	Nigeria	2.67	27.78	0.10	
112	Greece	2.65	27.56	0.09	○
113	Kuwait	2.64	27.30	0.08	○
114	Mongolia	2.59	26.58	0.07	○
115	Nepal	2.55	25.87	0.07	
116	Bangladesh	2.54	25.74	0.06	
117	Moldova, Rep.	2.52	25.34	0.05	○
118	Zimbabwe	2.50	25.00	0.04	
119	Paraguay	2.47	24.57	0.03	○
120	Bolivia, Plurinational St.	2.43	23.81	0.02	○
121	Egypt (2015)	2.43	23.78	0.02	○
122	Guinea (2015)	2.18	19.72	0.01	○
123	Yemen	1.89	14.76	0.00	○
n/a	Belarus	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	

SOURCE: World Economic Forum, *Executive Opinion Survey 2016–2017*
NOTE: ● indicates a strength; ○ a weakness

5.2.2 State of cluster development

Average answer to the survey question on the role of clusters in the economy: In your country, how widespread are well-developed and deep clusters (geographic concentrations of firms, suppliers, producers of related products and services, and specialized institutions in a particular field)? [1 = nonexistent; 7 = widespread in many fields] | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United States of America	5.56	75.99	1.00	●
2	United Arab Emirates	5.42	73.65	0.99	●
3	Germany	5.36	72.70	0.98	●
4	Italy	5.35	72.58	0.98	●
5	United Kingdom	5.34	72.27	0.97	
6	Netherlands	5.27	71.18	0.96	
7	Japan	5.22	70.32	0.95	
8	Norway	5.21	70.19	0.94	●
9	Qatar	5.20	69.98	0.93	●
10	Luxembourg	5.18	69.74	0.93	
11	Singapore	5.17	69.49	0.92	
12	Malaysia	5.17	69.45	0.91	●
13	Switzerland	5.14	68.93	0.90	
14	Hong Kong (China)	5.04	67.28	0.89	
15	Sweden	4.99	66.42	0.89	
16	Ireland	4.95	65.78	0.88	
17	Finland	4.89	64.88	0.87	
18	Austria	4.83	63.81	0.86	
19	Canada	4.72	61.93	0.85	
20	China	4.66	60.94	0.84	
21	Denmark	4.64	60.66	0.84	
22	Saudi Arabia	4.63	60.56	0.83	●
23	Bahrain	4.62	60.33	0.82	●
24	Belgium	4.61	60.09	0.81	
25	France	4.56	59.26	0.80	
26	India	4.52	58.73	0.80	
27	Korea, Rep.	4.51	58.56	0.79	
28	Indonesia	4.46	57.59	0.78	●
29	South Africa	4.38	56.38	0.77	
30	Jordan	4.28	54.65	0.76	●
31	Egypt	4.27	54.48	0.75	●
32	Spain	4.25	54.21	0.75	
33	Israel	4.23	53.82	0.74	
34	Mexico	4.23	53.79	0.73	
35	Malta	4.21	53.57	0.72	
36	Panama	4.20	53.27	0.71	
37	Portugal	4.16	52.61	0.70	
38	Kenya	4.16	52.61	0.70	
39	Mauritius	4.14	52.27	0.69	
40	Rwanda	4.13	52.15	0.68	●
41	Iceland	4.09	51.52	0.67	
42	Australia	3.97	49.56	0.66	
43	Brazil	3.96	49.33	0.66	
44	Cambodia	3.95	49.10	0.65	●
45	New Zealand	3.94	49.07	0.64	
46	Kuwait	3.94	49.05	0.63	
47	Brunei Darussalam	3.94	48.92	0.62	
48	Costa Rica	3.92	48.72	0.61	
49	Slovakia	3.91	48.48	0.61	
50	Viet Nam	3.85	47.53	0.60	
51	Guatemala	3.84	47.36	0.59	
52	TFYR of Macedonia	3.84	47.27	0.58	
53	Lebanon	3.83	47.19	0.57	
54	Turkey	3.82	47.00	0.57	
55	Cyprus	3.80	46.74	0.56	
56	Czech Republic	3.80	46.74	0.55	
57	Sri Lanka	3.78	46.28	0.54	
58	Thailand	3.77	46.18	0.53	
59	Estonia	3.76	46.00	0.52	
60	Dominican Republic	3.75	45.89	0.52	
61	Oman	3.74	45.73	0.51	
62	Philippines	3.74	45.70	0.50	
63	Honduras	3.73	45.53	0.49	
64	Zambia	3.72	45.34	0.48	●
65	Azerbaijan	3.71	45.20	0.48	
66	Poland	3.69	44.88	0.47	
67	Tanzania, United Rep.	3.69	44.80	0.46	
68	Namibia	3.67	44.54	0.45	
69	Senegal	3.66	44.40	0.44	
70	Jamaica	3.66	44.27	0.43	
71	Pakistan	3.65	44.25	0.43	
72	Bangladesh	3.64	44.05	0.42	
73	Bulgaria	3.63	43.79	0.41	○
74	Morocco	3.61	43.57	0.40	
75	Colombia	3.61	43.48	0.39	
76	Iran, Islamic Rep.	3.60	43.28	0.39	
77	Ethiopia	3.54	42.30	0.38	
78	Trinidad and Tobago	3.49	41.54	0.37	
79	Slovenia	3.49	41.53	0.36	○
80	Nigeria	3.49	41.49	0.35	
81	Uganda	3.48	41.33	0.34	
82	Latvia	3.47	41.21	0.34	○
83	Mali	3.45	40.81	0.33	
84	Botswana	3.44	40.62	0.32	
85	Chile	3.39	39.79	0.31	○
86	Russian Federation	3.36	39.36	0.30	
87	Hungary	3.36	39.34	0.30	
88	Lithuania	3.34	39.05	0.29	○
89	Armenia	3.33	38.86	0.28	
90	Benin	3.31	38.57	0.27	
91	Uruguay	3.27	37.91	0.26	
92	Ecuador	3.26	37.71	0.25	
93	Peru	3.24	37.38	0.25	
94	Argentina	3.23	37.20	0.24	
95	Romania	3.22	36.98	0.23	○
96	Cameroon	3.21	36.79	0.22	
97	Tunisia	3.18	36.25	0.21	
98	El Salvador	3.17	36.16	0.20	
99	Bosnia and Herzegovina	3.15	35.84	0.20	
100	Nepal	3.14	35.70	0.19	
101	Madagascar	3.14	35.60	0.18	
102	Serbia	3.10	35.05	0.17	○
103	Montenegro	3.09	34.77	0.16	○
104	Mozambique	3.07	34.54	0.16	
105	Algeria	3.05	34.19	0.15	
106	Guinea (2015)	3.02	33.75	0.14	
107	Greece	3.01	33.56	0.13	○
108	Tajikistan	3.01	33.55	0.12	
109	Kazakhstan	3.00	33.33	0.11	○
110	Albania	2.98	32.93	0.11	○
111	Georgia	2.97	32.89	0.10	○
112	Kyrgyzstan	2.96	32.72	0.09	
113	Croatia	2.96	32.70	0.08	○
114	Ukraine	2.95	32.54	0.07	○
115	Yemen	2.94	32.40	0.07	
116	Paraguay	2.91	31.88	0.06	○
117	Burundi	2.88	31.28	0.05	
118	Malawi	2.87	31.19	0.04	
119	Bolivia, Plurinational St.	2.85	30.83	0.03	○
120	Côte d'Ivoire	2.85	30.77	0.02	○
121	Mongolia	2.73	28.76	0.02	○
122	Zimbabwe	2.71	28.45	0.01	○
123	Moldova, Rep.	2.33	22.15	0.00	○
n/a	Belarus	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	

SOURCE: World Economic Forum, *Executive Opinion Survey 2016–2017*

NOTE: ● indicates a strength; ○ a weakness

5.2.3 GERD financed by abroad

GERD: Financed by abroad (% of total GERD) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Burkina Faso (2009)	59.61	100.00	1.00	●
2	Uganda (2010)	57.30	96.14	0.99	●
3	Bulgaria (2014)	50.88	85.36	0.98	●
4	Israel (2013)	49.25	82.62	0.97	●
5	Guatemala (2012)	49.01	82.22	0.96	●
6	Kenya (2010)	47.14	79.09	0.95	●
7	Latvia	44.98	75.46	0.94	●
8	Tanzania, United Rep. (2010)	42.00	70.47	0.93	●
9	Senegal (2010)	40.53	68.00	0.92	●
10	Burundi (2008)	39.92	66.97	0.91	●
11	Mozambique	39.88	66.91	0.90	●
12	Slovakia	39.43	66.15	0.89	●
13	Lithuania	34.58	58.02	0.88	●
14	Czech Republic	32.50	54.52	0.87	●
15	Luxembourg (2013)	32.34	54.26	0.86	
16	Iceland	26.35	44.21	0.85	
17	Cyprus (2014)	23.66	39.69	0.84	
18	Botswana (2013)	21.66	36.34	0.83	●
19	Malta	21.27	35.68	0.82	
20	Montenegro (2014)	20.70	34.73	0.81	●
21	Romania	19.23	32.26	0.80	●
22	Ireland (2014)	18.62	31.23	0.79	
23	Ukraine	18.18	30.50	0.78	
24	United Kingdom	17.59	29.51	0.77	
25	Bosnia and Herzegovina	16.90	28.35	0.76	●
26	El Salvador (2014)	16.88	28.32	0.74	●
27	Poland	16.74	28.09	0.73	
28	Austria (2016)	16.02	26.88	0.72	
29	Namibia (2014)	15.81	26.52	0.71	●
30	Netherlands	15.13	25.38	0.70	
31	Hungary	14.95	25.08	0.69	
32	Finland	14.52	24.36	0.68	
33	Croatia	14.48	24.28	0.67	
34	Georgia (2014)	14.27	23.94	0.66	
35	Belgium (2013)	13.17	22.09	0.65	
36	South Africa (2013)	12.92	21.67	0.64	
37	Chile	12.88	21.61	0.63	
38	Greece	12.85	21.55	0.62	
39	Belarus	12.72	21.34	0.61	
40	Serbia	12.55	21.06	0.60	
41	Bahrain (2014)	12.44	20.87	0.59	
42	Estonia	12.19	20.44	0.58	
43	Switzerland (2012)	12.07	20.26	0.57	
44	Moldova, Rep.	11.64	19.53	0.56	
45	Madagascar (2009)	10.58	17.75	0.55	●
46	Slovenia	10.56	17.71	0.54	
47	Paraguay	10.33	17.33	0.53	
48	Norway (2013)	9.47	15.88	0.52	
49	Italy (2014)	9.33	15.65	0.51	
50	Mali (2010)	8.81	14.78	0.50	
51	France (2014)	7.79	13.06	0.49	○
52	Spain (2014)	7.41	12.43	0.48	○
53	Uruguay (2014)	7.38	12.37	0.47	
54	Albania (2008)	7.37	12.36	0.46	
55	New Zealand (2013)	7.23	12.12	0.45	○
56	Hong Kong (China) (2014)	7.01	11.76	0.44	○
57	Singapore (2014)	6.85	11.48	0.43	○
58	Sweden (2013)	6.71	11.26	0.42	○
59	Denmark	6.52	10.94	0.41	○
60	Mauritius (2012)	6.43	10.79	0.40	
61	Canada (2014)	6.01	10.09	0.39	○
62	Portugal (2014)	5.61	9.42	0.38	○
63	Togo (2014)	5.54	9.30	0.37	
64	Sri Lanka (2013)	5.03	8.43	0.36	
65	Germany (2014)	4.99	8.38	0.35	○
66	United States of America	4.67	7.83	0.34	○
67	Tunisia (2014)	4.00	6.71	0.33	
68	Mongolia (2014)	2.85	4.78	0.32	
69	Pakistan	2.66	4.46	0.31	
70	Russian Federation	2.65	4.44	0.30	
71	Ecuador (2014)	2.46	4.13	0.29	
72	Colombia	2.42	4.07	0.28	
73	Qatar (2012)	2.42	4.06	0.27	
74	Armenia	2.28	3.82	0.26	
75	Ethiopia (2013)	2.15	3.61	0.24	
76	Bolivia, Plurinational St. (2009)	1.86	3.12	0.23	
77	Philippines (2013)	1.84	3.08	0.22	
78	Morocco (2010)	1.71	2.87	0.21	
79	Zambia (2008)	1.62	2.71	0.20	
80	Australia (2008)	1.61	2.70	0.19	○
81	Thailand	1.55	2.59	0.18	○
82	Viet Nam (2013)	1.51	2.53	0.17	
83	Costa Rica (2014)	1.42	2.38	0.16	○
84	Kuwait (2009)	1.18	1.97	0.15	
85	Turkey (2014)	1.08	1.81	0.14	○
86	Nigeria (2007)	1.04	1.74	0.13	
87	Kyrgyzstan	1.00	1.68	0.12	
88	Kazakhstan (2013)	0.76	1.27	0.11	○
89	Korea, Rep.	0.75	1.26	0.10	○
90	China	0.74	1.24	0.09	○
91	Argentina (2008)	0.60	1.00	0.08	○
92	Japan	0.48	0.80	0.07	○
93	Mexico	0.38	0.64	0.06	○
94	Panama (2013)	0.25	0.43	0.05	○
95	Tajikistan (2013)	0.21	0.35	0.04	
96	Malaysia (2014)	0.17	0.28	0.03	○
97	Azerbaijan (2014)	0.16	0.27	0.02	○
98	Egypt (2014)	0.12	0.20	0.01	○
99	Oman (2013)	0.00	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Brazil	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	India	n/a	n/a	n/a	
n/a	Indonesia	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Peru	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*
NOTE: ● indicates a strength; ○ a weakness

5.2.4 Joint venture/strategic alliance deals

Joint ventures/strategic alliances: Number of deals, fractional counting (per billion PPP$ GDP) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Hong Kong (China)	0.28	100.00	1.00	●
2	Bahrain	0.19	68.67	0.99	●
3	Estonia	0.18	62.63	0.98	●
4	Singapore	0.17	59.50	0.97	
5	Canada	0.16	56.16	0.96	●
6	Cyprus	0.15	54.42	0.95	●
7	Australia	0.15	53.87	0.95	
8	Luxembourg	0.15	52.68	0.94	
9	Sweden	0.14	48.51	0.93	
10	Switzerland	0.12	40.68	0.92	
11	Finland	0.12	40.53	0.91	
12	Israel	0.11	39.95	0.90	
13	United Kingdom	0.10	35.01	0.89	
14	New Zealand	0.10	33.70	0.88	
15	Denmark	0.09	30.87	0.87	
16	United Arab Emirates	0.09	30.42	0.86	
17	United States of America	0.08	29.45	0.85	
18	Malaysia	0.08	29.29	0.85	
19	Kyrgyzstan	0.07	24.73	0.84	●
20	Botswana	0.07	23.68	0.83	●
21	Rwanda	0.07	23.61	0.82	●
22	Norway	0.06	21.98	0.81	
23	Netherlands	0.06	21.23	0.80	
24	Malta	0.06	21.09	0.79	
25	Cambodia	0.06	20.41	0.78	●
26	Ireland	0.06	19.69	0.77	
27	Moldova, Rep.	0.05	18.45	0.76	
28	Zimbabwe	0.05	18.09	0.75	●
29	Belgium	0.05	17.19	0.75	
30	Tunisia	0.05	16.91	0.74	●
31	Sri Lanka	0.05	16.81	0.73	●
32	Jordan	0.05	15.73	0.72	●
33	Slovenia	0.05	15.36	0.71	
34	Jamaica	0.04	13.20	0.70	
35	Mali	0.04	13.20	0.69	●
36	South Africa	0.04	12.92	0.68	
37	Oman	0.04	12.89	0.67	●
38	Japan	0.04	12.41	0.66	
39	France	0.04	12.41	0.65	
40	Namibia	0.04	12.34	0.65	
41	Qatar	0.04	12.12	0.64	
42	Bulgaria	0.03	11.60	0.63	
43	Korea, Rep.	0.03	11.60	0.62	
44	Kenya	0.03	10.81	0.61	
45	China	0.03	10.73	0.60	
46	Germany	0.03	10.66	0.59	
47	Thailand	0.03	10.57	0.58	
48	Iceland	0.03	10.17	0.57	
49	India	0.03	9.08	0.56	
50	Philippines	0.03	9.05	0.55	
51	Greece	0.03	8.73	0.55	
52	Austria	0.03	8.61	0.54	○
53	Belarus	0.03	8.09	0.53	
54	Chile	0.02	7.96	0.52	
55	Kuwait	0.02	7.59	0.51	
56	Bosnia and Herzegovina	0.02	7.48	0.50	
57	Pakistan	0.02	7.46	0.49	
58	Paraguay	0.02	7.44	0.48	
59	Mongolia	0.02	7.20	0.47	
60	Spain	0.02	7.13	0.46	○
61	Italy	0.02	7.12	0.45	○
62	Russian Federation	0.02	7.00	0.45	
63	Hungary	0.02	6.91	0.44	
64	Mauritius (2015)	0.02	6.36	0.43	
65	Viet Nam	0.02	6.33	0.42	
66	Uruguay	0.02	6.32	0.41	
67	Azerbaijan	0.02	6.24	0.40	
68	Latvia	0.02	6.10	0.39	
69	Costa Rica	0.02	5.83	0.38	
70	Armenia	0.02	5.79	0.37	
71	Uganda	0.02	5.38	0.36	
72	Portugal	0.02	5.32	0.35	○
73	Tanzania, United Rep.	0.02	4.99	0.35	
74	Croatia	0.02	4.75	0.34	
75	Lebanon	0.02	4.65	0.33	
76	Ukraine	0.01	4.33	0.32	
77	Nepal	0.01	4.05	0.31	
78	Kazakhstan	0.01	3.97	0.30	
79	Turkey	0.01	3.87	0.29	
80	Saudi Arabia	0.01	3.83	0.28	
81	Georgia	0.01	3.83	0.27	
82	Madagascar	0.01	3.82	0.26	
83	Poland	0.01	3.72	0.25	○
84	Bangladesh	0.01	3.69	0.25	
85	Bolivia, Plurinational St.	0.01	3.61	0.24	
86	Senegal	0.01	3.55	0.23	
87	Mexico	0.01	2.96	0.22	○
88	Colombia	0.01	2.84	0.21	○
89	Morocco	0.01	2.83	0.20	
90	Brazil	0.01	2.77	0.19	○
91	Serbia (2015)	0.01	2.72	0.18	○
92	Czech Republic	0.01	2.61	0.17	○
93	Brunei Darussalam	0.01	2.57	0.16	○
94	Iran, Islamic Rep.	0.01	2.14	0.15	
95	Peru	0.01	1.65	0.15	○
96	Cameroon	0.01	1.34	0.14	
97	Indonesia	0.01	1.27	0.13	
98	Argentina	0.01	1.27	0.12	
99	Lithuania	0.01	1.11	0.11	○
100	Côte d'Ivoire	0.01	1.08	0.10	
101	Ethiopia	0.01	1.07	0.09	
102	Mozambique	0.01	1.05	0.08	
103	Egypt	0.01	1.02	0.07	
104	Panama	0.01	0.95	0.06	○
105	Zambia (2015)	0.01	0.87	0.05	○
106	Nigeria	0.01	0.83	0.05	
107	Algeria	0.00	0.79	0.04	
108	Romania	0.00	0.65	0.03	○
109	Dominican Republic	0.00	0.13	0.02	○
110	Slovakia	0.00	0.08	0.01	○
111	Ecuador	0.00	0.00	0.00	○
n/a	Albania	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	

SOURCE: Thomson Reuters, *Thomson One Banker Private Equity, SDC Platinum* database; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)

NOTE: ● indicates a strength; ○ a weakness

5.2.5 Patent families filed in two offices

Number of patent families filed by residents in at least two offices (per billion PPP$ GDP) | 2013

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Finland	9.39	100.00	0.97	●
1	Japan	15.53	100.00	0.97	●
1	Korea, Rep.	16.31	100.00	0.97	●
1	Switzerland	10.55	100.00	0.97	●
5	Sweden	8.81	93.74	0.97	
6	Malta	8.76	93.29	0.96	
7	Luxembourg	8.42	89.61	0.95	
8	Israel	8.02	85.39	0.94	
9	Denmark	7.96	84.74	0.93	
10	Germany	6.66	70.85	0.92	
11	Netherlands	6.17	65.70	0.92	
12	Iceland	5.10	54.28	0.91	
13	United States of America	4.95	52.70	0.90	
14	Austria	4.90	52.14	0.89	
15	New Zealand	4.73	50.38	0.88	
16	France	3.90	41.53	0.87	
17	Belgium	3.79	40.32	0.86	
18	Canada	2.90	30.85	0.86	
19	Singapore	2.79	29.73	0.85	
20	Ireland	2.55	27.15	0.84	
21	United Kingdom	2.52	26.81	0.83	
22	Cyprus	2.39	25.46	0.82	
23	Norway	2.22	23.64	0.81	
24	Slovenia	1.97	21.02	0.81	
25	Italy	1.77	18.82	0.80	
26	Hong Kong (China)	1.26	13.44	0.79	
27	Estonia	1.05	11.20	0.78	
28	Australia	1.05	11.13	0.77	
29	China	0.93	9.87	0.76	
30	Spain	0.79	8.40	0.75	
31	Czech Republic	0.74	7.86	0.75	
32	Portugal	0.73	7.76	0.74	
33	South Africa	0.69	7.31	0.73	
34	Ukraine	0.57	6.07	0.72	
35	Turkey	0.55	5.82	0.71	
36	Latvia	0.53	5.63	0.70	
37	Armenia	0.52	5.52	0.69	
38	Hungary	0.47	5.01	0.69	
39	Belarus	0.45	4.77	0.68	
40	Poland	0.44	4.68	0.67	
41	Greece	0.40	4.30	0.66	
42	Lithuania	0.39	4.17	0.65	
43	India	0.32	3.46	0.64	
44	Slovakia	0.31	3.32	0.64	
45	Malaysia	0.27	2.91	0.63	
46	Bulgaria	0.27	2.84	0.62	
47	Moldova, Rep.	0.24	2.55	0.61	
48	Montenegro (2012)	0.23	2.43	0.60	
49	Chile	0.22	2.34	0.59	
50	Russian Federation	0.21	2.26	0.58	
51	Saudi Arabia	0.20	2.11	0.58	
52	Niger	0.18	1.92	0.57	
53	Mauritius	0.18	1.91	0.56	
54	Burundi (2009)	0.17	1.82	0.55	●
55	Jamaica	0.17	1.80	0.54	
56	Bosnia and Herzegovina	0.16	1.68	0.53	
57	Kazakhstan	0.16	1.66	0.53	
58	Serbia	0.15	1.55	0.52	
59	Namibia	0.14	1.44	0.51	
60	Uruguay	0.13	1.41	0.50	
61	Brazil	0.13	1.37	0.49	
62	Croatia	0.13	1.34	0.48	
63	Brunei Darussalam	0.12	1.28	0.47	
64	Panama	0.11	1.13	0.47	
65	Jordan	0.10	1.12	0.46	
66	Colombia	0.10	1.11	0.45	
67	Argentina	0.10	1.05	0.44	
68	United Arab Emirates	0.10	1.04	0.43	
69	Tunisia	0.09	0.98	0.42	
70	Guinea (2009)	0.08	0.87	0.42	●
71	Zimbabwe (2012)	0.08	0.87	0.41	
72	Botswana (2008)	0.08	0.85	0.40	
73	Mexico	0.08	0.84	0.39	
74	Azerbaijan	0.08	0.80	0.38	
75	Romania	0.07	0.73	0.37	
76	Senegal (2012)	0.07	0.70	0.36	
77	Thailand	0.06	0.62	0.36	
78	Tajikistan (2011)	0.06	0.62	0.35	
79	Philippines	0.06	0.61	0.34	
80	Kyrgyzstan	0.05	0.58	0.33	
81	Lebanon	0.05	0.54	0.32	
82	Qatar	0.05	0.51	0.31	
83	Egypt	0.05	0.51	0.31	
84	Sri Lanka	0.05	0.48	0.30	
85	Trinidad and Tobago	0.05	0.48	0.29	
86	TFYR of Macedonia	0.04	0.40	0.28	
87	Mongolia (2012)	0.04	0.38	0.27	
88	Madagascar (2010)	0.03	0.37	0.26	
89	Bahrain	0.03	0.37	0.25	
90	Albania	0.03	0.35	0.25	
91	Kenya	0.03	0.34	0.24	
92	Georgia	0.03	0.33	0.23	
93	Cambodia (2008)	0.03	0.33	0.22	
94	Côte d'Ivoire	0.03	0.32	0.21	
95	Honduras (2011)	0.03	0.32	0.20	
96	Viet Nam	0.03	0.31	0.19	
97	Costa Rica	0.03	0.31	0.19	○
98	Zambia (2009)	0.03	0.27	0.18	
99	Morocco	0.02	0.26	0.17	○
100	Dominican Republic	0.02	0.25	0.16	
101	Algeria	0.02	0.24	0.15	
102	Kuwait	0.02	0.23	0.14	
103	Oman (2012)	0.02	0.22	0.14	
104	El Salvador	0.02	0.22	0.13	
105	Peru	0.02	0.21	0.12	○
106	Paraguay	0.02	0.19	0.11	
107	Cameroon (2012)	0.02	0.18	0.10	
108	Bolivia, Plurinational St. (2012)	0.02	0.18	0.09	
109	Pakistan	0.01	0.13	0.08	○
110	Yemen (2010)	0.01	0.10	0.08	
111	Iran, Islamic Rep.	0.01	0.10	0.07	○
112	Guatemala (2012)	0.01	0.10	0.06	
113	Tanzania, United Rep.	0.01	0.09	0.05	
114	Ecuador	0.01	0.06	0.04	○
115	Nigeria	0.00	0.04	0.03	○
116	Bangladesh	0.00	0.04	0.03	○
117	Indonesia	0.00	0.04	0.02	○
118	Mozambique	0.00	0.00	0.00	○
118	Uganda	0.00	0.00	0.00	○
n/a	Benin	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	

SOURCE: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)

NOTE: ● indicates a strength; ○ a weakness

5.3.1 Intellectual property payments

Charges for use of intellectual property n.i.e., payments (% of total trade) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Ireland	26.27	100.00	0.98	●
1	Netherlands	5.39	100.00	0.98	●
1	Singapore	3.62	100.00	0.98	●
4	Switzerland	3.28	90.57	0.97	
5	Malta	3.24	89.41	0.97	●
6	Luxembourg	2.60	71.82	0.96	
7	Argentina	2.57	71.03	0.95	●
8	Brazil	2.26	62.41	0.94	●
9	Japan	2.16	59.55	0.93	
10	Sweden	2.07	57.02	0.92	
11	Chile (2014)	1.83	50.51	0.91	●
12	Canada	1.83	50.49	0.90	
13	France	1.78	49.14	0.90	
14	South Africa	1.74	48.06	0.89	●
15	New Zealand	1.72	47.53	0.88	
16	Russian Federation	1.68	46.35	0.87	●
17	Korea, Rep.	1.66	45.73	0.86	
18	Thailand	1.63	45.12	0.85	●
19	United States of America	1.58	43.55	0.84	
20	Australia	1.41	38.94	0.83	
21	United Kingdom	1.33	36.59	0.83	
22	Hungary	1.33	36.57	0.82	
23	Guatemala	1.23	33.87	0.81	●
24	Croatia	1.22	33.75	0.80	●
25	Spain	1.19	32.85	0.79	
26	Iceland	1.17	32.23	0.78	
27	Costa Rica	1.10	30.44	0.77	
28	Romania	1.10	30.35	0.77	
29	India	1.10	30.26	0.76	
30	Poland	1.07	29.57	0.75	
31	TFYR of Macedonia	0.99	27.19	0.74	
32	China	0.99	27.19	0.73	
33	Finland	0.98	27.14	0.72	
34	Kenya (2014)	0.97	26.68	0.71	
35	Jamaica	0.95	26.27	0.70	●
36	Indonesia	0.93	25.69	0.70	
37	Serbia	0.91	24.99	0.69	
38	Belgium	0.90	24.75	0.68	
39	Italy	0.88	24.40	0.67	
40	Portugal	0.86	23.64	0.66	
41	Denmark	0.83	22.78	0.65	
42	Colombia	0.81	22.24	0.64	
43	El Salvador	0.80	22.14	0.63	●
44	Austria	0.78	21.65	0.63	
45	Philippines	0.77	21.13	0.62	
46	Ukraine	0.75	20.56	0.61	
47	Czech Republic	0.73	20.15	0.60	
48	Slovenia	0.69	19.16	0.59	
49	Peru	0.69	18.96	0.58	
50	Slovakia	0.66	18.17	0.57	
51	United Arab Emirates	0.63	17.51	0.57	
52	Malaysia	0.63	17.34	0.56	
53	Cyprus	0.62	17.18	0.55	
54	Albania	0.61	16.71	0.54	
55	Bulgaria	0.58	16.06	0.53	
56	Israel	0.58	15.94	0.52	
57	Bolivia, Plurinational St.	0.57	15.61	0.51	●
58	Honduras	0.55	15.06	0.50	
59	Madagascar (2013)	0.54	15.02	0.50	
60	Germany	0.54	14.99	0.49	○
61	Moldova, Rep.	0.52	14.41	0.48	
62	Greece	0.50	13.77	0.47	
63	Pakistan	0.49	13.63	0.46	
64	Norway	0.47	12.91	0.45	○
65	Dominican Republic (2014)	0.44	12.27	0.44	
66	Egypt (2014)	0.41	11.25	0.43	
67	Nigeria	0.41	11.24	0.43	●
68	Uruguay	0.40	11.15	0.42	
69	Belarus	0.40	11.01	0.41	
70	Panama	0.40	10.95	0.40	
71	Zimbabwe (2012)	0.33	9.23	0.39	
72	Turkey	0.33	8.98	0.38	
73	Ecuador	0.32	8.86	0.37	
74	Hong Kong (China) (2014)	0.31	8.59	0.37	○
75	Kazakhstan	0.31	8.51	0.36	
76	Mongolia	0.30	8.23	0.35	
77	Mauritius (2014)	0.27	7.45	0.34	
78	Mozambique (2014)	0.24	6.65	0.33	
79	Estonia	0.24	6.63	0.32	○
80	Uganda	0.22	6.18	0.31	
81	Algeria (2014)	0.22	5.93	0.30	
82	Mexico	0.21	5.80	0.30	
83	Latvia	0.21	5.73	0.29	○
84	Morocco (2013)	0.19	5.19	0.28	
85	Iran, Islamic Rep. (2014)	0.18	4.90	0.27	
86	Montenegro	0.17	4.57	0.26	○
87	Paraguay	0.17	4.55	0.25	
88	Lithuania	0.16	4.27	0.24	○
89	Lebanon (2014)	0.14	3.86	0.23	
90	Bosnia and Herzegovina	0.14	3.85	0.23	
91	Brunei Darussalam (2009)	0.13	3.60	0.22	
92	Malawi (2014)	0.13	3.56	0.21	
93	Namibia	0.11	3.07	0.20	
94	Niger (2009)	0.11	3.02	0.19	
95	Kyrgyzstan (2014)	0.11	2.95	0.18	
96	Togo (2010)	0.11	2.93	0.17	
97	Azerbaijan (2012)	0.10	2.88	0.17	
98	Senegal (2014)	0.10	2.86	0.16	
99	Botswana (2014)	0.10	2.71	0.15	
100	Cameroon (2013)	0.09	2.57	0.14	
101	Georgia	0.09	2.54	0.13	○
102	Cambodia	0.09	2.53	0.12	
103	Tunisia (2014)	0.08	2.23	0.11	○
104	Bangladesh (2014)	0.07	1.98	0.10	
105	Mali (2010)	0.07	1.81	0.10	
106	Benin (2014)	0.06	1.72	0.09	
107	Guinea (2013)	0.06	1.68	0.08	
108	Rwanda (2012)	0.05	1.41	0.07	○
109	Yemen (2014)	0.04	1.17	0.06	
110	Côte d'Ivoire (2013)	0.03	0.85	0.05	○
111	Ethiopia (2012)	0.02	0.67	0.04	
112	Zambia (2014)	0.02	0.48	0.03	○
113	Tanzania, United Rep. (2014)	0.01	0.26	0.03	
114	Burkina Faso (2014)	0.01	0.17	0.02	○
115	Burundi (2012)	0.00	0.08	0.01	○
116	Tajikistan (2013)	0.00	0.00	0.00	○
n/a	Armenia	n/a	n/a	n/a	
n/a	Bahrain	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Sri Lanka	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Viet Nam	n/a	n/a	n/a	

SOURCE: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments Manual* and *Balance of Payments* database

NOTE: ● indicates a strength; ○ a weakness

5.3.2 High-tech imports

High-tech net imports (% of total trade) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Hong Kong (China)	46.10	100.00	0.99	●
1	Malaysia	24.74	100.00	0.99	●
3	Viet Nam	22.58	90.27	0.98	●
4	Ethiopia	22.17	88.47	0.98	●
5	Singapore	21.41	85.05	0.97	
6	China	19.26	75.36	0.96	
7	Panama (2011)	18.82	73.42	0.95	●
8	Colombia	18.68	72.79	0.94	●
9	Mexico	18.43	71.65	0.94	●
10	Czech Republic	17.74	68.54	0.93	●
11	United States of America	17.70	68.39	0.92	
12	Thailand	15.65	59.15	0.91	●
13	Slovakia	15.62	59.01	0.90	●
14	Korea, Rep.	15.19	57.10	0.90	
15	Japan	14.87	55.65	0.89	
16	Hungary	13.81	50.91	0.88	●
17	Argentina	13.45	49.27	0.87	●
18	Paraguay	13.34	48.80	0.86	●
19	Netherlands	12.91	46.88	0.85	
20	Rwanda	12.78	46.29	0.85	●
21	United Kingdom	12.73	46.06	0.84	
22	Brazil	12.43	44.70	0.83	●
23	Estonia	12.21	43.72	0.82	
24	Costa Rica	11.80	41.89	0.81	
25	Algeria	11.68	41.34	0.81	●
26	Germany	11.61	41.03	0.80	
27	New Zealand	11.58	40.88	0.79	
28	Australia	11.49	40.47	0.78	
29	Israel	11.40	40.07	0.77	
30	Nepal	11.38	40.01	0.77	●
31	France	11.38	39.97	0.76	
32	Canada	11.12	38.82	0.75	
33	Peru	11.10	38.71	0.74	●
34	Latvia	10.87	37.70	0.73	
35	Burundi (2014)	10.84	37.55	0.73	●
36	Kenya (2013)	10.84	37.54	0.72	●
37	Poland	10.66	36.73	0.71	
38	Tunisia	10.47	35.91	0.70	●
39	Turkey	10.34	35.32	0.69	
40	Chile	10.33	35.26	0.69	
41	Pakistan	10.31	35.19	0.68	●
42	Belgium	10.29	35.11	0.67	
43	Romania	10.25	34.93	0.66	
44	South Africa	9.97	33.68	0.65	
45	Bolivia, Plurinational St.	9.97	33.67	0.65	●
46	El Salvador	9.93	33.48	0.64	●
47	Ecuador	9.72	32.52	0.63	●
48	Bangladesh (2011)	9.44	31.29	0.62	●
49	Guatemala	9.36	30.91	0.61	●
50	Austria	9.32	30.73	0.60	
51	Sweden	9.30	30.63	0.60	○
52	India	9.17	30.07	0.59	
53	Saudi Arabia	9.14	29.91	0.58	
54	Ireland	8.96	29.12	0.57	○
55	Mauritius	8.86	28.68	0.56	
56	Egypt	8.64	27.71	0.56	
57	Malawi	8.61	27.54	0.55	●
58	Indonesia	8.54	27.22	0.54	
59	Russian Federation	8.51	27.11	0.53	
60	Uruguay	8.42	26.71	0.52	
61	Zimbabwe (2014)	8.39	26.56	0.52	●
62	Finland	8.16	25.53	0.51	○
63	Switzerland	8.16	25.52	0.50	○
64	Italy	8.08	25.17	0.49	
65	Ukraine	7.98	24.70	0.48	
66	United Arab Emirates	7.97	24.69	0.48	
67	Moldova, Rep.	7.77	23.76	0.47	
68	Niger (2014)	7.62	23.10	0.46	
69	Kazakhstan	7.62	23.09	0.45	
70	Croatia	7.49	22.52	0.44	
71	Honduras (2014)	7.46	22.41	0.44	
72	Bulgaria	7.42	22.21	0.43	
73	Malta	7.41	22.15	0.42	
74	Spain	7.34	21.86	0.41	○
75	Morocco	7.34	21.83	0.40	
76	Tanzania, United Rep.	7.24	21.40	0.40	
77	Norway	7.02	20.39	0.39	○
78	Uganda	6.90	19.85	0.38	
79	Jordan	6.84	19.61	0.37	
80	Iceland	6.82	19.51	0.36	○
81	Serbia	6.76	19.22	0.35	
82	Lithuania	6.71	19.00	0.35	
83	Greece	6.65	18.76	0.34	
84	Bosnia and Herzegovina	6.52	18.18	0.33	
85	Kyrgyzstan	6.51	18.13	0.32	
86	Denmark	6.47	17.92	0.31	○
87	Portugal	6.45	17.86	0.31	○
88	Georgia	6.45	17.85	0.30	
89	TFYR of Macedonia	6.43	17.78	0.29	
90	Montenegro	6.41	17.65	0.28	
91	Burkina Faso	6.40	17.62	0.27	
92	Kuwait	6.38	17.53	0.27	
93	Jamaica	6.02	15.92	0.26	
94	Sri Lanka	6.01	15.89	0.25	
95	Namibia (2014)	5.99	15.78	0.24	
96	Brunei Darussalam	5.97	15.70	0.23	
97	Slovenia	5.95	15.62	0.23	○
98	Madagascar	5.88	15.30	0.22	
99	Dominican Republic	5.74	14.66	0.21	
100	Mozambique	5.70	14.48	0.20	
101	Côte d'Ivoire	5.60	14.05	0.19	
102	Senegal	5.55	13.79	0.19	
103	Mongolia	5.45	13.37	0.18	
104	Bahrain	5.35	12.90	0.17	
105	Belarus	5.21	12.26	0.16	○
106	Zambia	5.20	12.25	0.15	
107	Mali (2012)	5.12	11.87	0.15	
108	Cameroon	5.09	11.74	0.14	
109	Armenia	5.06	11.62	0.13	
110	Trinidad and Tobago (2010)	4.94	11.05	0.12	
111	Guinea (2014)	4.53	9.25	0.11	
112	Yemen (2014)	4.51	9.11	0.10	
113	Qatar	4.41	8.69	0.10	○
114	Albania	4.27	8.05	0.09	○
115	Iran, Islamic Rep. (2011)	4.00	6.83	0.08	○
116	Lebanon (2014)	3.84	6.14	0.07	○
117	Botswana	3.70	5.50	0.06	○
118	Cyprus	3.54	4.80	0.06	○
119	Nigeria (2014)	3.36	3.95	0.05	
120	Oman (2014)	3.14	2.98	0.04	○
121	Azerbaijan	3.11	2.83	0.03	○
122	Cambodia	2.94	2.08	0.02	○
123	Togo (2014)	2.69	0.95	0.02	○
124	Benin	2.61	0.60	0.01	○
125	Luxembourg	2.48	0.00	0.00	○
n/a	Philippines	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	

SOURCE: United Nations, *COMTRADE* database; Eurostat, *Annex 5: High-tech aggregation by SITC Rev. 4*, April 2009

NOTE: ● indicates a strength; ○ a weakness

5.3.3 ICT services imports

Telecommunications, computers, and information services imports (% of total trade) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Cyprus	7.73	100.00	0.99	●
1	Netherlands	5.53	100.00	0.99	●
3	Niger (2014)	4.98	90.08	0.98	●
4	Switzerland	3.67	66.29	0.98	
5	Finland	3.63	65.59	0.97	●
6	Sweden	3.27	58.91	0.96	
7	Mali (2014)	3.12	56.30	0.95	●
8	Madagascar (2013)	2.90	52.19	0.94	●
9	Luxembourg	2.84	51.16	0.94	
10	Senegal (2014)	2.64	47.55	0.93	●
11	Burundi (2014)	2.62	47.10	0.92	●
12	Moldova, Rep.	2.46	44.32	0.91	●
13	Denmark	2.41	43.44	0.90	
14	Burkina Faso (2014)	2.38	42.86	0.90	●
15	Montenegro	2.35	42.21	0.89	●
16	Belgium	2.26	40.70	0.88	
17	France	2.25	40.42	0.87	
18	Estonia	2.22	39.95	0.86	
19	Sri Lanka	2.15	38.59	0.86	●
20	Norway	2.12	38.19	0.85	
21	Iceland	2.11	37.92	0.84	
22	Israel	2.09	37.55	0.83	
23	Qatar	2.02	36.31	0.82	
24	Austria	1.93	34.66	0.82	
25	Slovenia	1.87	33.50	0.81	
26	Romania	1.80	32.40	0.80	●
27	United Kingdom	1.80	32.35	0.79	
28	Lebanon (2014)	1.75	31.46	0.78	●
29	Italy	1.75	31.34	0.78	
30	Germany	1.70	30.56	0.77	
31	Spain	1.68	30.06	0.76	
32	Nigeria	1.67	29.97	0.75	●
33	Singapore	1.66	29.83	0.74	
34	Ethiopia (2012)	1.65	29.55	0.74	●
35	Russian Federation	1.65	29.51	0.73	
36	Croatia	1.64	29.48	0.72	
37	TFYR of Macedonia	1.63	29.16	0.71	
38	Malaysia	1.62	29.13	0.70	
39	Serbia	1.57	28.07	0.70	
40	Mongolia	1.56	28.00	0.69	
41	Jamaica	1.51	26.97	0.68	
42	Albania	1.49	26.75	0.67	
43	Japan	1.48	26.43	0.66	
44	Guinea (2013)	1.45	26.01	0.66	●
45	Brazil	1.44	25.75	0.65	
46	Peru	1.44	25.72	0.64	
47	Argentina	1.43	25.68	0.63	
48	Yemen (2014)	1.41	25.30	0.62	●
49	Saudi Arabia	1.36	24.31	0.62	
50	New Zealand	1.35	24.16	0.61	
51	Hungary	1.34	24.03	0.60	
52	United States of America	1.34	23.90	0.59	
53	Latvia	1.34	23.90	0.58	
54	Mauritius (2014)	1.33	23.81	0.58	
55	Benin (2014)	1.32	23.62	0.57	●
56	Ukraine	1.30	23.30	0.56	
57	Uganda	1.30	23.16	0.55	
58	Portugal	1.23	22.05	0.54	
59	Malawi (2014)	1.21	21.63	0.54	●
60	Poland	1.19	21.23	0.53	
61	Pakistan	1.12	19.95	0.52	●
62	Czech Republic	1.11	19.84	0.51	
63	South Africa	1.07	19.05	0.50	
64	Greece	1.07	19.02	0.50	
65	Bulgaria	1.07	19.02	0.49	
66	Indonesia	1.03	18.34	0.48	
67	Malta	0.98	17.43	0.47	
68	Philippines	0.97	17.20	0.46	
69	Australia	0.96	17.15	0.46	○
70	Canada	0.95	16.87	0.45	○
71	Colombia	0.95	16.85	0.44	
72	Mozambique	0.95	16.85	0.43	
73	Armenia	0.92	16.38	0.42	
74	Slovakia	0.90	15.98	0.42	
75	Chile (2014)	0.84	14.99	0.41	
76	Honduras	0.84	14.87	0.40	
77	Togo (2014)	0.84	14.84	0.39	
78	India	0.83	14.69	0.38	
79	Bosnia and Herzegovina	0.77	13.67	0.38	
80	Bolivia, Plurinational St.	0.75	13.35	0.37	
81	Côte d'Ivoire (2013)	0.74	13.16	0.36	
82	Kazakhstan	0.72	12.79	0.35	
83	Azerbaijan	0.72	12.78	0.34	
84	Costa Rica	0.72	12.78	0.34	
85	Ireland	0.68	12.08	0.33	○
86	Egypt (2014)	0.66	11.58	0.32	
87	Cambodia	0.66	11.56	0.31	
88	Lithuania	0.65	11.40	0.30	○
89	Belarus	0.64	11.24	0.30	
90	Kuwait	0.62	10.95	0.29	
91	Kyrgyzstan	0.61	10.81	0.28	
92	United Arab Emirates	0.61	10.73	0.27	○
93	Iran, Islamic Rep. (2014)	0.61	10.65	0.26	
94	Nepal (2014)	0.58	10.26	0.26	
95	Rwanda (2014)	0.54	9.51	0.25	
96	Morocco (2013)	0.53	9.31	0.24	
97	Georgia	0.53	9.25	0.23	
98	Botswana (2014)	0.52	9.11	0.22	
99	China	0.51	8.92	0.22	○
100	Korea, Rep.	0.47	8.15	0.21	○
101	Tajikistan	0.46	7.98	0.20	
102	Cameroon (2013)	0.45	7.88	0.19	
103	Namibia	0.45	7.87	0.18	
104	El Salvador	0.44	7.72	0.18	
105	Uruguay	0.41	7.07	0.17	○
106	Tunisia (2014)	0.41	7.03	0.16	○
107	Guatemala	0.40	6.88	0.15	
108	Zambia (2014)	0.37	6.45	0.14	
109	Tanzania, United Rep. (2014)	0.35	6.04	0.14	
110	Algeria (2014)	0.31	5.26	0.13	
111	Hong Kong (China) (2014)	0.31	5.21	0.12	○
112	Bahrain (2014)	0.30	5.10	0.11	
113	Brunei Darussalam (2009)	0.27	4.58	0.10	○
114	Panama	0.27	4.50	0.10	
115	Dominican Republic (2014)	0.26	4.43	0.09	
116	Oman (2014)	0.24	4.08	0.08	○
117	Thailand	0.23	3.91	0.07	○
118	Zimbabwe (2012)	0.19	3.17	0.06	
119	Bangladesh (2014)	0.14	2.25	0.06	
120	Kenya (2014)	0.14	2.23	0.05	○
121	Turkey	0.10	1.40	0.04	○
122	Trinidad and Tobago (2011)	0.05	0.60	0.03	○
123	Viet Nam (2014)	0.05	0.58	0.02	○
124	Ecuador	0.04	0.41	0.02	○
125	Mexico	0.04	0.35	0.01	○
126	Paraguay	0.02	0.00	0.00	○
n/a	Jordan	n/a	n/a	n/a	

SOURCE: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments Manual* and *Balance of Payments* database

NOTE: ● indicates a strength; ○ a weakness

5.3.4 Foreign direct investment net inflows

Foreign direct investment (FDI), net inflows (% of GDP, three-year average) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Hong Kong (China)	43.65	100.00	1.00	●
2	Ireland	42.15	99.18	0.99	●
3	Mozambique	32.47	93.19	0.98	●
4	Luxembourg	28.68	90.42	0.98	●
5	Singapore	22.22	84.91	0.97	
6	Netherlands	21.01	83.73	0.96	●
7	Montenegro	12.79	73.99	0.95	●
8	Kyrgyzstan	10.26	70.09	0.94	●
9	Panama	10.13	69.88	0.94	●
10	Malta	9.51	68.81	0.93	
11	Cambodia	9.48	68.76	0.92	●
12	Georgia	9.26	68.37	0.91	●
13	Albania	9.07	68.03	0.90	●
14	Niger	8.90	67.72	0.90	●
15	Malawi	8.74	67.44	0.89	●
16	Chile	8.04	66.11	0.88	●
17	Trinidad and Tobago	7.97	65.99	0.87	●
18	Zambia	6.84	63.69	0.87	●
19	Mongolia	6.65	63.28	0.86	●
20	Namibia	6.36	62.66	0.85	●
21	Honduras	6.31	62.56	0.84	●
22	Costa Rica	5.97	61.78	0.83	●
23	Lebanon	5.81	61.41	0.83	●
24	Azerbaijan	5.69	61.15	0.82	●
25	Switzerland	5.61	60.95	0.81	
26	Viet Nam	5.41	60.48	0.80	●
27	Serbia	5.12	59.78	0.79	●
28	Jamaica	4.86	59.12	0.79	●
29	Jordan	4.79	58.97	0.78	●
30	Madagascar	4.65	58.59	0.77	●
31	Iceland	4.61	58.50	0.76	
32	Tanzania, United Rep.	4.42	57.99	0.75	●
33	Peru	4.23	57.49	0.75	●
34	Cyprus	4.22	57.49	0.74	
35	Colombia	4.20	57.42	0.73	
36	Uganda	4.01	56.92	0.72	●
37	Uruguay	4.00	56.89	0.71	●
38	Finland	3.95	56.74	0.71	
39	Moldova, Rep.	3.86	56.50	0.70	
40	Rwanda	3.70	56.05	0.69	●
41	Brazil	3.68	55.99	0.68	
42	Canada	3.68	55.99	0.67	
43	Kazakhstan	3.67	55.96	0.67	
44	Bulgaria	3.63	55.86	0.66	
45	Benin	3.62	55.83	0.65	●
46	Portugal	3.62	55.82	0.64	
47	Malaysia	3.45	55.32	0.63	
48	Israel	3.42	55.25	0.63	
49	Tajikistan	3.42	55.23	0.62	●
50	Morocco	3.20	54.59	0.61	
51	Latvia	3.19	54.55	0.60	
52	Dominican Republic	3.18	54.53	0.60	●
53	Australia	3.17	54.50	0.59	
54	Ethiopia	3.12	54.35	0.58	●
55	Bolivia, Plurinational St.	3.00	53.99	0.57	●
56	Brunei Darussalam	2.98	53.94	0.56	
57	Croatia	2.96	53.87	0.56	
58	Zimbabwe	2.95	53.85	0.55	●
59	Czech Republic	2.91	53.73	0.54	
60	Botswana	2.89	53.65	0.53	
61	Mexico	2.87	53.58	0.52	
62	Burkina Faso	2.86	53.57	0.52	●
63	Belarus	2.85	53.53	0.51	
64	Burundi	2.85	53.53	0.50	
65	Spain	2.84	53.50	0.49	
66	Armenia	2.76	53.26	0.48	
67	United Arab Emirates	2.70	53.06	0.48	
68	China	2.62	52.80	0.47	
69	Estonia	2.61	52.76	0.46	○
70	Indonesia	2.57	52.64	0.45	
71	Togo	2.50	52.44	0.44	●
72	Mauritius	2.49	52.39	0.44	
73	Thailand	2.43	52.21	0.43	
74	Senegal	2.42	52.18	0.42	
75	TFYR of Macedonia	2.40	52.10	0.41	
76	Poland	2.24	51.58	0.40	
77	Tunisia	2.23	51.53	0.40	
78	Ukraine	2.15	51.28	0.39	
79	Romania	2.13	51.18	0.38	
80	Bosnia and Herzegovina	2.12	51.17	0.37	
81	Guatemala	2.11	51.14	0.37	
82	Slovenia	2.07	50.99	0.36	○
83	United Kingdom	2.05	50.92	0.35	○
84	Cameroon	1.92	50.48	0.34	
85	Turkey	1.81	50.09	0.33	
86	Philippines	1.80	50.04	0.33	
87	India	1.77	49.94	0.32	
88	Egypt	1.71	49.74	0.31	
89	El Salvador	1.68	49.62	0.30	
90	United States of America	1.65	49.52	0.29	○
91	Bangladesh	1.65	49.50	0.29	
92	Lithuania	1.64	49.49	0.28	○
93	Argentina	1.59	49.32	0.27	
94	Russian Federation	1.55	49.17	0.26	○
95	Mali	1.54	49.13	0.25	
96	Kenya	1.49	48.95	0.25	
97	Guinea	1.49	48.93	0.24	●
98	South Africa	1.46	48.83	0.23	○
99	Hungary	1.36	48.46	0.22	○
100	Côte d'Ivoire	1.31	48.27	0.21	
101	Saudi Arabia	1.17	47.73	0.21	○
102	Germany	1.10	47.44	0.20	○
103	Sri Lanka	1.07	47.32	0.19	
104	Greece	0.99	47.00	0.18	○
105	Paraguay	0.97	46.93	0.17	
106	Ecuador	0.86	46.50	0.17	
107	Nigeria	0.85	46.46	0.16	
108	France	0.84	46.44	0.15	○
109	Italy	0.81	46.29	0.14	○
110	Sweden	0.67	45.71	0.13	○
111	Korea, Rep.	0.67	45.71	0.13	○
112	Slovakia	0.66	45.68	0.12	○
113	Pakistan	0.57	45.29	0.11	
114	Austria	0.55	45.20	0.10	○
115	Iran, Islamic Rep.	0.55	45.19	0.10	
116	New Zealand	0.51	45.05	0.09	○
117	Kuwait	0.46	44.82	0.08	○
118	Algeria	0.42	44.67	0.07	
119	Bahrain	0.40	44.58	0.06	○
120	Nepal	0.26	43.95	0.06	○
121	Qatar	0.24	43.88	0.05	○
122	Japan	0.20	43.66	0.04	○
123	Denmark	0.04	42.95	0.03	○
124	Oman	0.02	42.84	0.02	○
125	Norway	0.00	42.79	0.02	○
126	Yemen	–0.30	41.31	0.01	
127	Belgium	–4.55	0.00	0.00	○

SOURCE: International Monetary Fund, *International Financial Statistics* and *Balance of Payments* databases, World Bank, *International Debt Statistics,* and World Bank and OECD GDP estimates; extracted from the World Bank's *World Development Indicators* database

NOTE: ● indicates a strength; ○ a weakness

5.3.5 Research talent in business enterprise

Researchers in business enterprise, per thousand population (%) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Israel (2012)	83.68	100.00	1.00	●
2	Korea, Rep.	79.71	95.25	0.99	●
3	Japan	73.44	87.74	0.98	●
4	United States of America (2014)	71.01	84.84	0.96	
5	Costa Rica (2011)	69.18	82.65	0.95	●
6	Sweden	68.56	81.91	0.94	
7	Austria	63.70	76.10	0.93	●
8	Philippines (2013)	63.21	75.51	0.92	●
9	China	62.67	74.86	0.90	
10	United Arab Emirates	60.88	72.72	0.89	
11	France (2014)	60.52	72.29	0.88	
12	Hungary	59.35	70.90	0.87	●
13	Netherlands	59.08	70.57	0.86	
14	Malta	58.02	69.30	0.85	
15	Denmark	58.02	69.30	0.83	
16	Finland	56.77	67.80	0.82	
17	Germany	56.51	67.49	0.81	
18	Canada (2013)	56.01	66.90	0.80	
19	Ireland	53.82	64.27	0.79	
20	Slovenia	53.05	63.36	0.77	
21	Thailand	50.89	60.77	0.76	
22	Uganda (2010)	50.61	60.43	0.75	●
23	Singapore (2014)	50.51	60.32	0.74	
24	Czech Republic	50.32	60.09	0.73	
25	Norway	49.44	59.03	0.71	
26	Mali (2010)	49.04	58.56	0.70	●
27	Belgium	48.28	57.65	0.69	
28	Turkey (2014)	46.67	55.73	0.68	
29	Russian Federation	46.44	55.45	0.67	
30	Switzerland (2012)	46.16	55.12	0.65	
31	Iceland	41.81	49.91	0.64	
32	Hong Kong (China) (2014)	40.86	48.78	0.63	
33	India (2010)	38.73	46.22	0.62	
34	Italy	38.62	46.10	0.61	
35	Bulgaria	38.60	46.07	0.60	
36	United Kingdom	38.16	45.55	0.58	○
37	Spain	36.88	44.01	0.57	
38	Luxembourg	36.01	42.97	0.56	
39	Indonesia (2009)	35.54	42.41	0.55	
40	Poland	34.80	41.53	0.54	
41	New Zealand (2013)	34.08	40.66	0.52	
42	Ukraine	32.52	38.79	0.51	
43	Sri Lanka (2013)	30.67	36.58	0.50	
44	Portugal	28.96	34.54	0.49	
45	Qatar (2012)	27.97	33.35	0.48	
46	Australia (2010)	27.87	33.24	0.46	○
47	Estonia	27.52	32.82	0.45	○
48	Chile	27.37	32.64	0.44	
49	Brazil (2010)	25.94	30.93	0.43	
50	Mexico (2013)	24.48	29.18	0.42	
51	Romania	24.25	28.91	0.40	
52	Lithuania	22.71	27.06	0.39	
53	Cyprus	21.51	25.63	0.38	
54	Viet Nam (2013)	21.06	25.09	0.37	
55	South Africa (2013)	19.40	23.11	0.36	
56	Slovakia	19.36	23.06	0.35	
57	Montenegro (2014)	19.00	22.63	0.33	
58	Croatia	16.73	19.91	0.32	
59	Latvia	16.72	19.90	0.31	○
60	Iran, Islamic Rep. (2008)	14.96	17.80	0.30	
61	Ecuador (2008)	14.95	17.78	0.29	
62	Greece	14.34	17.05	0.27	○
63	TFYR of Macedonia (2014)	11.70	13.89	0.26	
64	Kenya (2010)	11.41	13.55	0.25	
65	Oman	10.58	12.56	0.24	
66	Malaysia (2014)	10.25	12.16	0.23	○
67	Serbia	9.59	11.37	0.21	
68	Moldova, Rep.	7.65	9.04	0.20	
69	Morocco (2014)	7.52	8.89	0.19	○
70	Namibia (2014)	6.95	8.21	0.18	
71	Bosnia and Herzegovina	6.51	7.68	0.17	
72	Argentina (2014)	6.20	7.32	0.15	
73	Egypt	5.44	6.40	0.14	
74	Zambia (2008)	4.85	5.70	0.13	
75	Tunisia	4.01	4.70	0.12	○
76	Malawi (2007)	1.73	1.96	0.11	
77	Botswana (2013)	1.05	1.15	0.10	○
78	Uruguay	0.94	1.03	0.08	○
79	Panama (2008)	0.86	0.93	0.07	○
80	Colombia (2014)	0.63	0.65	0.06	○
81	Ethiopia (2013)	0.48	0.48	0.05	
82	Bahrain (2014)	0.41	0.38	0.04	○
83	Bolivia, Plurinational St. (2010)	0.36	0.33	0.02	○
84	Mozambique	0.30	0.26	0.01	○
85	Senegal (2010)	0.09	0.00	0.00	○
n/a	Albania	n/a	n/a	n/a	
n/a	Algeria	n/a	n/a	n/a	
n/a	Armenia	n/a	n/a	n/a	
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Belarus	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Georgia	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kazakhstan	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Kyrgyzstan	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Mauritius	n/a	n/a	n/a	
n/a	Mongolia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Peru	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*

NOTE: ● indicates a strength; ○ a weakness

6.1.1 Patent applications by origin

Number of resident patent applications filed at a given national or regional patent office (per billion PPP$ GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	China	49.16	100.00	0.98	●
1	Germany	18.71	100.00	0.98	●
1	Japan	53.44	100.00	0.98	●
1	Korea, Rep.	90.26	100.00	0.98	●
5	Switzerland	17.74	94.85	0.97	
6	United States of America	15.99	85.44	0.96	
7	Finland	14.63	78.20	0.95	
8	Denmark	13.09	69.97	0.94	
9	Sweden	12.37	66.11	0.93	
10	Netherlands	11.06	59.12	0.93	
11	Austria	10.37	55.41	0.92	●
12	Iran, Islamic Rep. (2014)	10.07	53.81	0.91	●
13	Luxembourg	9.68	51.70	0.90	
14	France	9.41	50.28	0.89	
15	Russian Federation	7.94	42.41	0.89	●
16	United Kingdom	7.37	39.35	0.88	
17	New Zealand	7.05	37.66	0.87	
18	Ukraine	6.68	35.66	0.86	●
19	Kyrgyzstan	6.36	33.96	0.85	●
20	Belgium	6.04	32.25	0.85	
21	Malta	6.01	32.10	0.84	
22	Iceland	5.60	29.89	0.83	
23	Poland	5.21	27.84	0.82	●
24	Norway	4.66	24.90	0.81	
25	Armenia	4.53	24.18	0.80	●
26	Israel	4.50	24.05	0.80	
27	Belarus	4.23	22.59	0.79	●
28	Portugal	3.66	19.54	0.78	
29	Turkey	3.63	19.39	0.77	
30	Moldova, Rep.	3.57	19.04	0.76	
31	Latvia	3.37	17.98	0.76	
32	Czech Republic	3.23	17.25	0.75	
33	Singapore	3.11	16.58	0.74	
34	Mongolia	3.01	16.08	0.73	
35	Kazakhstan	2.89	15.40	0.72	
36	Georgia	2.77	14.80	0.72	
37	Ireland	2.74	14.60	0.71	
38	Spain	2.67	14.24	0.70	
39	Canada	2.62	13.96	0.69	
40	Hungary	2.58	13.75	0.68	
41	Romania	2.43	12.96	0.67	
42	Montenegro	2.31	12.30	0.67	
43	Bulgaria	2.28	12.17	0.66	
44	Greece	2.23	11.90	0.65	
45	Australia	2.01	10.70	0.64	
46	Croatia	1.95	10.39	0.63	
47	Serbia	1.86	9.92	0.63	
48	Slovenia	1.85	9.85	0.62	
49	Italy	1.83	9.76	0.61	
50	Slovakia	1.72	9.14	0.60	
51	Lithuania	1.70	9.03	0.59	
52	Estonia	1.65	8.77	0.59	
53	India	1.57	8.37	0.58	
54	Malaysia	1.56	8.28	0.57	
55	Cyprus	1.53	8.14	0.56	
56	Brazil	1.45	7.72	0.55	
57	Tunisia	1.41	7.53	0.54	
58	Lebanon	1.32	7.03	0.54	
59	Azerbaijan	1.30	6.92	0.53	
60	South Africa	1.22	6.51	0.52	
61	Viet Nam	1.05	5.58	0.51	
62	Bosnia and Herzegovina (2014)	1.05	5.57	0.50	
63	Chile	1.05	5.56	0.50	
64	Sri Lanka	0.98	5.18	0.49	
65	Kenya	0.96	5.11	0.48	
66	Thailand (2014)	0.94	5.00	0.47	
67	Morocco	0.82	4.33	0.46	
68	Brunei Darussalam (2014)	0.79	4.17	0.46	
69	Egypt (2014)	0.75	3.99	0.45	
70	Mozambique	0.72	3.81	0.44	●
71	Argentina	0.62	3.26	0.43	
72	Mexico	0.61	3.23	0.42	
73	Hong Kong (China)	0.57	3.03	0.41	○
74	Saudi Arabia	0.54	2.86	0.41	
75	Philippines	0.50	2.66	0.40	
76	Jordan	0.50	2.61	0.39	
77	Colombia	0.48	2.54	0.38	
78	Albania	0.43	2.25	0.37	
79	Senegal	0.41	2.14	0.37	
80	Paraguay (2010)	0.41	2.13	0.36	
81	Indonesia	0.37	1.95	0.35	
82	Cameroon	0.37	1.95	0.34	
83	Uruguay	0.36	1.87	0.33	
84	Zimbabwe	0.32	1.68	0.33	
85	Niger	0.32	1.65	0.32	
86	Côte d'Ivoire	0.30	1.57	0.31	
87	Malawi	0.29	1.53	0.30	
88	Togo (2014)	0.29	1.53	0.29	
89	Jamaica	0.28	1.48	0.28	
90	Mali (2014)	0.27	1.41	0.28	
91	Rwanda	0.24	1.27	0.27	
92	Zambia (2014)	0.23	1.21	0.26	
93	Costa Rica	0.23	1.17	0.25	
94	Burkina Faso	0.23	1.17	0.24	
95	Pakistan	0.22	1.16	0.24	
96	Benin	0.22	1.13	0.23	
97	Peru	0.17	0.88	0.22	
98	Panama	0.16	0.82	0.21	
99	Nepal	0.16	0.80	0.20	
100	Bahrain	0.16	0.79	0.20	
101	Algeria	0.15	0.78	0.19	
102	Dominican Republic	0.14	0.71	0.18	
103	El Salvador	0.13	0.67	0.17	
104	Bolivia, Plurinational St. (2014)	0.13	0.65	0.16	
105	Botswana (2014)	0.12	0.58	0.15	
106	Uganda	0.11	0.56	0.15	
107	Honduras	0.10	0.48	0.14	
108	Madagascar	0.08	0.41	0.13	
109	Tajikistan	0.08	0.41	0.12	
110	Bangladesh	0.07	0.34	0.11	
111	Trinidad and Tobago	0.07	0.32	0.11	
112	Yemen	0.07	0.31	0.10	
113	Guinea	0.07	0.31	0.09	
114	United Arab Emirates	0.06	0.30	0.08	○
115	Guatemala	0.06	0.26	0.07	
116	Nigeria (2013)	0.05	0.24	0.07	
117	Mauritius	0.04	0.18	0.06	○
118	Cambodia (2014)	0.04	0.17	0.05	○
119	TFYR of Macedonia (2014)	0.04	0.15	0.04	○
120	Qatar	0.03	0.13	0.03	○
121	Ecuador (2010)	0.03	0.12	0.02	○
122	Oman	0.02	0.09	0.02	○
123	Kuwait	0.02	0.05	0.01	○
124	Tanzania, United Rep.	0.01	0.00	0.00	○
n/a	Burundi	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	

SOURCE: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)
NOTE: ● indicates a strength; ○ a weakness

6.1.2 PCT international applications by origin

Number of international patent applications filed by residents at the Patent Cooperation Treaty (per billion PPP$ GDP) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Japan	9.17	100.00	0.97	●
1	Korea, Rep.	8.07	100.00	0.97	●
1	Sweden	7.47	100.00	0.97	●
1	Switzerland	8.83	100.00	0.97	●
5	Luxembourg	7.34	98.25	0.96	
6	Finland	6.63	88.74	0.95	
7	Israel	6.19	82.85	0.94	
8	Netherlands	5.40	72.34	0.93	
9	Malta	5.33	71.38	0.92	
10	Denmark	5.11	68.34	0.91	
11	Germany	4.60	61.62	0.90	
12	Iceland	3.47	46.42	0.89	
13	Austria	3.42	45.75	0.88	
14	United States of America	3.05	40.80	0.87	
15	France	3.00	40.13	0.86	
16	Belgium	2.40	32.09	0.85	
17	China	2.03	27.14	0.84	
18	United Kingdom	1.97	26.36	0.83	
19	Singapore	1.81	24.14	0.83	
20	Norway	1.79	23.94	0.82	
21	New Zealand	1.76	23.47	0.81	
22	Australia	1.54	20.63	0.80	
23	Italy	1.51	20.21	0.79	
24	Canada	1.39	18.62	0.78	
25	Ireland	1.35	18.09	0.77	
26	Cyprus	1.23	16.44	0.76	
27	Slovenia	1.04	13.93	0.75	
28	Spain	0.89	11.88	0.74	
29	Trinidad and Tobago	0.87	11.64	0.73	●
30	Hungary	0.67	8.86	0.72	
31	Panama	0.64	8.58	0.71	
32	Turkey	0.64	8.52	0.70	
33	Estonia	0.62	8.26	0.69	
34	Portugal	0.62	8.25	0.68	
35	Czech Republic	0.57	7.55	0.67	
36	Moldova, Rep.	0.54	7.18	0.66	
37	Ukraine	0.47	6.19	0.65	
38	Latvia	0.45	6.01	0.64	
39	Chile	0.45	6.00	0.63	
40	Bulgaria	0.44	5.85	0.62	
41	Croatia	0.41	5.50	0.61	
42	South Africa	0.39	5.17	0.60	
43	Greece	0.38	5.07	0.59	
44	Georgia	0.35	4.61	0.58	
45	Armenia	0.34	4.49	0.57	
46	Lithuania	0.33	4.32	0.56	
47	Poland	0.33	4.32	0.55	
48	Slovakia	0.33	4.31	0.54	
49	Russian Federation	0.23	3.00	0.53	
50	Malaysia	0.22	2.90	0.52	
51	Montenegro	0.19	2.48	0.51	
52	Brazil	0.18	2.38	0.50	
53	Senegal	0.18	2.31	0.50	
54	India	0.18	2.30	0.49	
55	Saudi Arabia	0.17	2.24	0.48	
56	Brunei Darussalam	0.15	1.94	0.47	
57	Serbia	0.15	1.93	0.46	
58	Colombia	0.14	1.87	0.45	
59	Morocco	0.14	1.80	0.44	
60	Thailand	0.13	1.74	0.43	
61	Mexico	0.12	1.62	0.42	
62	United Arab Emirates	0.12	1.58	0.41	
63	Belarus	0.10	1.33	0.40	
64	TFYR of Macedonia	0.10	1.28	0.39	
65	Romania	0.10	1.23	0.38	
66	Bosnia and Herzegovina	0.09	1.21	0.37	
67	Bahrain	0.09	1.16	0.36	
68	Namibia	0.07	0.94	0.35	
69	Zimbabwe	0.07	0.90	0.34	
70	Sri Lanka	0.07	0.85	0.33	
71	Dominican Republic	0.06	0.78	0.32	
72	Albania (2015)	0.06	0.77	0.31	
73	Madagascar (2014)	0.06	0.74	0.30	
74	Uganda (2014)	0.05	0.66	0.29	
75	Niger (2015)	0.05	0.66	0.28	
76	Kazakhstan	0.05	0.65	0.27	
77	Costa Rica	0.05	0.63	0.26	
78	Ecuador	0.05	0.61	0.25	
79	Kyrgyzstan (2015)	0.05	0.61	0.24	
80	Rwanda (2015)	0.05	0.61	0.23	
81	Peru	0.05	0.60	0.22	
82	Malawi	0.05	0.58	0.21	
83	Benin (2014)	0.05	0.57	0.20	
84	Tunisia	0.05	0.57	0.19	
85	Iran, Islamic Rep.	0.04	0.53	0.18	
86	Qatar	0.04	0.51	0.17	
87	Oman	0.04	0.49	0.17	
88	Egypt	0.04	0.47	0.16	
89	Philippines	0.04	0.44	0.15	
90	Mozambique	0.03	0.33	0.14	
91	Botswana	0.03	0.32	0.13	
92	Mongolia	0.03	0.32	0.12	
93	Kenya	0.03	0.30	0.11	○
94	Cameroon	0.03	0.30	0.10	
95	Honduras	0.02	0.26	0.09	○
96	Côte d'Ivoire	0.02	0.26	0.08	
97	Algeria	0.02	0.21	0.07	
98	El Salvador	0.02	0.20	0.06	○
99	Azerbaijan	0.02	0.19	0.05	○
100	Viet Nam	0.02	0.18	0.04	○
101	Guatemala	0.02	0.15	0.03	○
102	Tanzania, United Rep. (2015)	0.01	0.14	0.02	
103	Indonesia	0.00	0.02	0.01	○
104	Nigeria	0.00	0.00	0.00	○
n/a	Argentina	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Hong Kong (China)	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Mauritius	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Uruguay	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	

SOURCE: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)

NOTE: ● indicates a strength; ○ a weakness

6.1.3 Utility model applications by origin

Number of utility model applications filed by residents at the national patent office (per billion PPP$ GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	China	56.85	100.00	0.95	●
1	Korea, Rep.	4.48	100.00	0.95	●
1	Moldova, Rep.	9.25	100.00	0.95	●
1	Ukraine	24.95	100.00	0.95	●
5	Mongolia	4.12	92.03	0.94	●
6	Czech Republic	4.04	90.12	0.92	●
7	Tajikistan	3.74	83.60	0.90	●
8	Russian Federation	3.06	68.27	0.89	●
9	Germany	2.68	59.78	0.87	
10	Slovakia	2.31	51.45	0.85	●
11	Belarus	2.26	50.38	0.84	●
12	Turkey	2.16	48.09	0.82	●
13	Armenia	2.13	47.29	0.81	●
14	Estonia	2.02	44.90	0.79	
15	Bulgaria	1.92	42.61	0.77	
16	Thailand	1.87	41.59	0.76	
17	Finland	1.82	40.37	0.74	
18	Georgia	1.71	37.93	0.73	
19	Austria	1.40	30.98	0.71	
20	Spain	1.38	30.45	0.69	
21	Italy (2014)	1.10	24.24	0.68	
22	Japan	1.08	23.72	0.66	
23	Philippines	1.06	23.37	0.65	
24	Hong Kong (China)	1.06	23.26	0.63	
25	Poland	0.99	21.72	0.61	
26	Kazakhstan	0.97	21.41	0.60	
27	Australia	0.97	21.37	0.58	
28	Hungary	0.84	18.46	0.56	
29	Brazil	0.81	17.85	0.55	
30	Kenya	0.80	17.55	0.53	
31	Croatia	0.80	17.52	0.52	
32	Kyrgyzstan	0.69	15.05	0.50	
33	Serbia	0.59	12.89	0.48	
34	Uruguay	0.56	12.19	0.47	
35	Viet Nam	0.56	12.14	0.45	
36	Peru	0.51	10.91	0.44	
37	Denmark	0.46	9.97	0.42	○
38	Portugal	0.40	8.61	0.40	○
39	Colombia	0.29	6.06	0.39	
40	Mexico	0.26	5.37	0.37	
41	Rwanda	0.24	5.05	0.35	
42	Chile	0.20	4.02	0.34	
43	Slovenia (2010)	0.16	3.09	0.32	○
44	Bolivia, Plurinational St. (2014)	0.16	3.08	0.31	
45	Argentina	0.15	2.92	0.29	
46	Azerbaijan (2014)	0.14	2.81	0.27	
47	Burkina Faso (2010)	0.14	2.66	0.26	
48	Romania	0.14	2.65	0.24	○
49	El Salvador (2014)	0.14	2.65	0.23	
50	Ecuador (2010)	0.13	2.52	0.21	
51	Malaysia	0.13	2.40	0.19	○
52	Costa Rica	0.11	1.96	0.18	○
53	Indonesia	0.10	1.85	0.16	
54	Guatemala	0.09	1.52	0.15	
55	France	0.08	1.29	0.13	○
56	Honduras	0.07	1.21	0.11	
57	Dominican Republic	0.07	1.07	0.10	
58	Panama	0.06	0.85	0.08	
59	Greece	0.03	0.35	0.06	○
60	Albania (2014)	0.03	0.28	0.05	○
61	Botswana (2014)	0.03	0.22	0.03	○
62	Trinidad and Tobago (2014)	0.02	0.07	0.02	○
63	Yemen (2014)	0.02	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Bahrain	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Belgium	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Bosnia and Herzegovina	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	Canada	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Cyprus	n/a	n/a	n/a	
n/a	Egypt	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Iceland	n/a	n/a	n/a	
n/a	India	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Ireland	n/a	n/a	n/a	
n/a	Israel	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Latvia	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Lithuania	n/a	n/a	n/a	
n/a	Luxembourg	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Malta	n/a	n/a	n/a	
n/a	Mauritius	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Morocco	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Netherlands	n/a	n/a	n/a	
n/a	New Zealand	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Norway	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Senegal	n/a	n/a	n/a	
n/a	Singapore	n/a	n/a	n/a	
n/a	South Africa	n/a	n/a	n/a	
n/a	Sri Lanka	n/a	n/a	n/a	
n/a	Sweden	n/a	n/a	n/a	
n/a	Switzerland	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Tunisia	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	United Kingdom	n/a	n/a	n/a	
n/a	United States of America	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)
NOTE: ● indicates a strength; ○ a weakness

6.1.4 Scientific and technical publications

Number of scientific and technical journal articles (per billion PPP$ GDP) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Iceland	71.10	100.00	1.00	●
2	Denmark	66.80	93.91	0.99	●
3	Switzerland	58.07	81.54	0.98	●
4	Slovenia	55.45	77.83	0.98	●
5	Finland	55.04	77.24	0.97	●
6	Sweden	52.85	74.14	0.96	
7	New Zealand	50.85	71.31	0.95	
8	Serbia	49.19	68.96	0.94	●
9	Australia	48.75	68.33	0.94	
10	Estonia	47.57	66.66	0.93	
11	Israel	45.82	64.17	0.92	
12	Portugal	45.49	63.71	0.91	●
13	Netherlands	42.90	60.04	0.90	
14	United Kingdom	41.63	58.24	0.90	
15	Cyprus	40.98	57.32	0.89	
16	Belgium	40.13	56.12	0.88	
17	Canada	37.24	52.02	0.87	
18	Austria	36.09	50.39	0.86	
19	Croatia	35.24	49.19	0.86	●
20	Norway	34.97	48.80	0.85	
21	Czech Republic	34.67	48.37	0.84	
22	Greece	33.39	46.57	0.83	●
23	Spain	32.10	44.74	0.82	
24	Tunisia	31.83	44.36	0.82	●
25	Korea, Rep.	29.19	40.61	0.81	
26	Armenia	28.95	40.28	0.80	●
27	Italy	27.61	38.37	0.79	
28	Singapore	26.06	36.18	0.78	
29	Germany	25.66	35.61	0.78	
30	France	25.34	35.16	0.77	
31	Hungary	25.30	35.11	0.76	
32	Poland	25.09	34.81	0.75	
33	Lithuania	24.79	34.38	0.74	
34	Ireland	23.26	32.21	0.74	
35	Iran, Islamic Rep.	21.54	29.77	0.73	●
36	Montenegro	21.48	29.69	0.72	
37	Malawi	20.73	28.62	0.71	●
38	United States of America	19.84	27.36	0.70	
39	Slovakia	19.58	27.00	0.70	
40	Luxembourg	18.73	25.79	0.69	
41	Chile	18.45	25.40	0.68	
42	Malta	17.90	24.61	0.67	
43	Turkey	17.47	24.01	0.66	
44	South Africa	17.15	23.56	0.66	
45	Romania	16.49	22.62	0.65	
46	Jordan	16.03	21.97	0.64	
47	Georgia	16.02	21.96	0.63	
48	Lebanon	15.72	21.53	0.62	
49	Zimbabwe	15.64	21.41	0.62	●
50	Bulgaria	15.28	20.90	0.61	
51	Japan	15.14	20.70	0.60	
52	Latvia	14.90	20.37	0.59	
53	TFYR of Macedonia	14.24	19.43	0.58	
54	China	14.09	19.22	0.58	
55	Brazil	13.55	18.45	0.57	
56	Uruguay	13.24	18.02	0.56	
57	Moldova, Rep.	13.16	17.90	0.55	
58	Malaysia	12.32	16.71	0.54	
59	Ukraine	12.23	16.57	0.54	
60	Uganda	12.05	16.32	0.53	
61	Kenya	11.58	15.65	0.52	
62	Benin	11.31	15.28	0.51	
63	Burkina Faso	10.61	14.29	0.50	●
64	Cameroon	10.60	14.28	0.50	●
65	Senegal	10.30	13.84	0.49	
66	Bosnia and Herzegovina	10.23	13.74	0.48	
67	Egypt	9.75	13.06	0.47	
68	Argentina	9.60	12.85	0.46	
69	Rwanda	9.51	12.73	0.46	
70	Russian Federation	8.84	11.78	0.45	
71	Pakistan	8.73	11.62	0.44	
72	Nepal	8.54	11.36	0.43	●
73	Botswana	8.22	10.90	0.42	
74	Saudi Arabia	7.96	10.53	0.42	
75	Costa Rica	7.46	9.82	0.41	
76	Mozambique	7.45	9.80	0.40	
77	Ethiopia	7.06	9.25	0.39	
78	Morocco	6.97	9.13	0.38	
79	India	6.90	9.02	0.38	
80	Togo	6.72	8.77	0.37	
81	Namibia	6.66	8.69	0.36	
82	Jamaica	6.62	8.63	0.35	
83	Mongolia	6.55	8.53	0.34	
84	Thailand	6.51	8.48	0.34	
85	Belarus	6.47	8.42	0.33	
86	Qatar	6.33	8.23	0.32	
87	Tanzania, United Rep.	6.20	8.04	0.31	
88	Brunei Darussalam	6.14	7.95	0.30	
89	Ecuador	6.03	7.80	0.30	
90	Niger	6.02	7.78	0.29	
91	Colombia	6.00	7.75	0.28	
92	Madagascar	5.84	7.53	0.27	
93	Mexico	5.84	7.52	0.26	
94	Viet Nam	5.63	7.23	0.26	
95	Kyrgyzstan	5.57	7.14	0.25	
96	Zambia	5.43	6.95	0.24	
97	Algeria	5.36	6.85	0.23	
98	Albania	5.20	6.62	0.22	
99	Cambodia	5.02	6.37	0.22	
100	Mauritius	4.64	5.83	0.21	
101	Mali	4.62	5.80	0.20	
102	Panama	4.53	5.67	0.19	
103	Oman	4.24	5.25	0.18	
104	Burundi	3.93	4.82	0.18	
105	Sri Lanka	3.53	4.26	0.17	
106	United Arab Emirates	3.51	4.23	0.16	○
107	Trinidad and Tobago	3.28	3.90	0.15	
108	Azerbaijan	3.23	3.83	0.14	
109	Bolivia, Plurinational St.	3.17	3.74	0.14	
110	Bangladesh	2.89	3.35	0.13	
111	Côte d'Ivoire	2.86	3.30	0.12	
112	Yemen	2.82	3.24	0.11	
113	Peru	2.71	3.10	0.10	○
114	Bahrain	2.68	3.05	0.10	○
115	Kuwait	2.64	3.00	0.09	○
116	Tajikistan	2.56	2.87	0.08	
117	Nigeria	2.34	2.57	0.07	
118	Kazakhstan	1.84	1.86	0.06	○
119	Paraguay	1.64	1.57	0.06	○
120	Philippines	1.58	1.49	0.05	○
121	Guatemala	1.25	1.03	0.04	○
122	Honduras	1.18	0.92	0.03	○
123	El Salvador	1.11	0.83	0.02	○
124	Indonesia	0.69	0.23	0.02	○
125	Guinea	0.68	0.22	0.01	○
126	Dominican Republic	0.53	0.00	0.00	○
n/a	Hong Kong (China)	n/a	n/a	n/a	

SOURCE: *Clarivate Analytics,* special tabulations from Thomson Reuters, Web of Science, Science Citation Index (SCI) and Social Sciences Citation Index (SSCI); International Monetary Fund, *World Economic Outlook Database*, October 2016

NOTE: ● indicates a strength; ○ a weakness

6.1.5 Citable documents H index

The H index is the economy's number of published articles (H) that have received at least H citations | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United Kingdom	1,099.00	100.00	0.99	●
1	United States of America	1,783.00	100.00	0.99	●
3	Germany	961.00	87.10	0.98	●
4	France	878.00	79.35	0.98	●
5	Canada	862.00	77.85	0.97	●
6	Japan	797.00	71.78	0.96	
7	Italy	766.00	68.88	0.95	●
8	Netherlands	752.00	67.57	0.94	
9	Switzerland	744.00	66.82	0.94	
10	Australia	709.00	63.55	0.93	
11	Sweden	666.00	59.53	0.92	
12	Spain	648.00	57.85	0.91	●
13	Belgium	593.00	52.71	0.90	
14	China	563.00	49.91	0.90	
15	Denmark	558.00	49.44	0.89	
16	Israel	536.00	47.38	0.88	
17	Austria	487.00	42.80	0.87	
18	Finland	479.00	42.06	0.87	
19	Korea, Rep.	476.00	41.78	0.86	
20	Norway	439.00	38.32	0.85	
21	India	426.00	37.10	0.84	●
22	Russian Federation	421.00	36.64	0.83	●
23	Brazil	412.00	35.79	0.83	●
24	Poland	401.00	34.77	0.82	●
25	Hong Kong (China)	392.00	33.93	0.80	
25	Singapore	392.00	33.93	0.80	
27	New Zealand	387.00	33.46	0.79	
28	Ireland	364.00	31.31	0.79	
29	Greece	354.00	30.37	0.78	
30	Portugal	334.00	28.50	0.77	
31	Hungary	329.00	28.04	0.76	
32	Czech Republic	322.00	27.38	0.75	
33	South Africa	320.00	27.20	0.75	
34	Mexico	316.00	26.82	0.74	
35	Argentina	300.00	25.33	0.73	●
36	Turkey	296.00	24.95	0.72	
37	Chile	257.00	21.31	0.71	
38	Thailand	236.00	19.35	0.71	
39	Iceland	218.00	17.66	0.70	
40	Slovenia	204.00	16.36	0.69	
41	Iran, Islamic Rep.	199.00	15.89	0.68	●
42	Saudi Arabia	195.00	15.51	0.67	
42	Slovakia	195.00	15.51	0.67	
44	Croatia	194.00	15.42	0.66	
45	Malaysia	190.00	15.05	0.65	
46	Ukraine	188.00	14.86	0.64	
47	Romania	187.00	14.77	0.63	
48	Colombia	186.00	14.67	0.63	
49	Estonia	185.00	14.58	0.62	
50	Bulgaria	184.00	14.49	0.60	
50	Egypt	184.00	14.49	0.60	
52	Kenya	179.00	14.02	0.60	
53	Pakistan	166.00	12.80	0.59	●
54	Philippines	163.00	12.52	0.58	
55	Indonesia	155.00	11.78	0.57	
56	Peru	154.00	11.68	0.56	
57	Lithuania	144.00	10.75	0.56	
58	Panama	142.00	10.56	0.54	
58	Viet Nam	142.00	10.56	0.54	
60	Lebanon	138.00	10.19	0.53	
61	Costa Rica	137.00	10.09	0.52	
62	Armenia	135.00	9.91	0.52	
63	Bangladesh	134.00	9.81	0.51	●
64	Belarus	133.00	9.72	0.50	
65	Uruguay	132.00	9.63	0.49	
66	Nigeria	131.00	9.53	0.48	●
67	United Arab Emirates	130.00	9.44	0.48	
68	Morocco	129.00	9.35	0.47	
69	Uganda	128.00	9.25	0.46	
70	Cyprus	127.00	9.16	0.45	
71	Tunisia	123.00	8.79	0.44	
72	Tanzania, United Rep.	122.00	8.69	0.44	
73	Sri Lanka	120.00	8.50	0.43	
74	Serbia	118.00	8.32	0.42	
75	Georgia	114.00	7.94	0.40	
75	Luxembourg	114.00	7.94	0.40	
77	Jordan	112.00	7.76	0.39	
77	Latvia	112.00	7.76	0.39	
79	Ecuador	111.00	7.66	0.38	
80	Kuwait	108.00	7.38	0.37	
81	Algeria	106.00	7.20	0.37	
82	Malawi	104.00	7.01	0.36	
83	Ethiopia	101.00	6.73	0.35	
84	Zimbabwe	99.00	6.54	0.34	
85	Senegal	95.00	6.17	0.33	
86	Cameroon	94.00	6.07	0.32	
86	Nepal	94.00	6.07	0.32	
88	Zambia	92.00	5.89	0.31	
89	Oman	91.00	5.79	0.30	
90	Côte d'Ivoire	89.00	5.61	0.29	
91	Bolivia, Plurinational St.	88.00	5.51	0.29	
92	Qatar	86.00	5.33	0.28	
93	Malta	83.00	5.05	0.27	○
94	Burkina Faso	82.00	4.95	0.26	
95	TFYR of Macedonia	81.00	4.86	0.25	○
96	Moldova, Rep.	80.00	4.77	0.25	
97	Botswana	79.00	4.67	0.24	
98	Trinidad and Tobago	76.00	4.39	0.23	
99	Jamaica	75.00	4.30	0.21	
99	Mali	75.00	4.30	0.21	
101	Madagascar	74.00	4.21	0.21	
102	Mozambique	73.00	4.11	0.20	
103	Cambodia	72.00	4.02	0.17	
103	Mongolia	72.00	4.02	0.17	
103	Namibia	72.00	4.02	0.17	
106	Guatemala	69.00	3.74	0.17	
107	Kazakhstan	68.00	3.64	0.16	
108	Benin	65.00	3.36	0.15	
109	Azerbaijan	64.00	3.27	0.14	
110	Bosnia and Herzegovina	61.00	2.99	0.13	○
111	Paraguay	60.00	2.90	0.13	
112	Niger	59.00	2.80	0.12	
113	Bahrain	55.00	2.43	0.11	
114	Mauritius	54.00	2.34	0.10	○
114	Rwanda	54.00	2.34	0.10	
116	Brunei Darussalam	52.00	2.15	0.09	○
117	Dominican Republic	51.00	2.06	0.07	○
117	Honduras	51.00	2.06	0.07	○
119	Yemen	50.00	1.96	0.06	
120	Albania	48.00	1.78	0.06	○
121	Guinea	46.00	1.59	0.05	
122	Kyrgyzstan	45.00	1.50	0.04	○
123	El Salvador	44.00	1.40	0.03	○
124	Togo	39.00	0.93	0.02	○
125	Burundi	32.00	0.28	0.01	○
125	Montenegro	32.00	0.28	0.01	○
127	Tajikistan	29.00	0.00	0.00	○

SOURCE: SCImago (2017) SJR—SCImago Journal & Country Rank. Retrieved February 2017

NOTE: ● indicates a strength; ○ a weakness

6.2.1 Growth rate of GDP per person engaged

Growth rate of GDP per person engaged (constant 1990 PPP$) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Viet Nam	6.90	100.00	1.00	●
2	China	6.63	97.65	0.99	●
3	Ethiopia	5.56	88.46	0.98	●
4	Côte d'Ivoire	5.43	87.39	0.97	●
5	India	5.20	85.45	0.96	●
6	Ireland	5.05	84.12	0.95	●
7	Cambodia	4.99	83.60	0.95	●
8	Romania	4.68	80.93	0.94	●
9	Indonesia	4.62	80.44	0.93	●
10	Mozambique	4.42	78.71	0.92	●
11	Sri Lanka	4.33	77.98	0.91	●
12	Zambia	4.31	77.77	0.90	●
13	Dominican Republic	4.29	77.64	0.89	●
14	Tanzania, United Rep.	4.07	75.75	0.88	●
15	Philippines	4.03	75.40	0.87	●
16	Bangladesh	3.85	73.82	0.86	●
17	Tajikistan	3.77	73.10	0.85	●
18	Iran, Islamic Rep.	3.57	71.46	0.85	●
19	Thailand	2.98	66.41	0.84	●
20	Czech Republic	2.97	66.26	0.83	
21	Niger	2.87	65.40	0.82	●
22	Kenya	2.83	65.06	0.81	●
23	Bolivia, Plurinational St.	2.82	65.03	0.80	●
24	Mali	2.75	64.36	0.79	●
25	Malta	2.73	64.25	0.78	
26	Morocco	2.71	64.08	0.77	●
27	Bulgaria	2.61	63.19	0.76	
28	Sweden	2.57	62.85	0.75	
29	Kyrgyzstan	2.55	62.71	0.75	●
30	Pakistan	2.52	62.44	0.74	●
31	Armenia	2.40	61.37	0.73	
32	Georgia	2.38	61.24	0.72	
33	Cameroon	2.37	61.14	0.71	●
34	Luxembourg	2.27	60.30	0.70	
35	Poland	2.20	59.70	0.69	
36	Uganda	2.19	59.56	0.68	●
37	Algeria	2.01	58.05	0.67	●
38	Burkina Faso	1.90	57.10	0.66	●
39	Peru	1.83	56.50	0.65	
40	Malawi	1.76	55.88	0.65	●
41	Slovakia	1.59	54.42	0.64	
42	Slovenia	1.43	53.04	0.63	
43	Turkey	1.42	52.98	0.62	
44	Latvia	1.37	52.55	0.61	
45	TFYR of Macedonia	1.34	52.35	0.60	
46	Bosnia and Herzegovina	1.30	51.98	0.59	
47	United Arab Emirates	1.29	51.85	0.58	
48	Korea, Rep.	1.28	51.79	0.57	
49	Senegal	1.28	51.79	0.56	
50	Uruguay	1.24	51.47	0.55	
51	Madagascar	1.13	50.53	0.55	
52	Netherlands	1.08	50.05	0.54	○
53	Saudi Arabia	1.04	49.70	0.53	
54	Norway	1.01	49.50	0.52	○
55	Hong Kong (China)	1.00	49.37	0.51	
56	Guatemala	1.00	49.36	0.50	
57	Kazakhstan	0.99	49.33	0.49	
58	Malaysia	0.92	48.70	0.48	
59	New Zealand	0.91	48.59	0.47	○
60	Finland	0.90	48.51	0.46	○
61	Germany	0.85	48.14	0.45	○
62	Australia	0.85	48.07	0.45	○
63	France	0.81	47.73	0.44	○
64	Bahrain	0.80	47.67	0.43	
65	United Kingdom	0.79	47.56	0.42	○
66	Cyprus	0.72	46.95	0.41	
67	United States of America	0.71	46.91	0.40	○
68	Colombia	0.68	46.63	0.39	
69	Egypt	0.68	46.62	0.38	
70	Qatar	0.60	45.98	0.37	
71	Belgium	0.46	44.73	0.36	○
72	Jordan	0.44	44.61	0.35	
73	Montenegro	0.41	44.31	0.35	
74	Serbia	0.41	44.31	0.34	
75	Canada	0.32	43.54	0.33	○
76	Lithuania	0.31	43.43	0.32	
77	Chile	0.29	43.27	0.31	○
78	Spain	0.27	43.11	0.30	○
79	Austria	0.23	42.78	0.29	○
80	Italy	0.20	42.56	0.28	○
81	Iceland	0.18	42.33	0.27	○
82	Israel	0.15	42.12	0.26	○
83	Mexico	0.12	41.87	0.25	
84	Hungary	0.10	41.69	0.25	○
85	Japan	0.07	41.43	0.24	○
86	Portugal	0.07	41.39	0.23	○
87	Denmark	0.06	41.30	0.22	○
88	Costa Rica	–0.02	40.64	0.21	
89	Croatia	–0.04	40.43	0.20	○
90	Argentina	–0.16	39.40	0.19	
91	Singapore	–0.21	39.01	0.18	○
92	Tunisia	–0.43	37.08	0.17	○
93	Jamaica	–0.46	36.89	0.16	
94	Switzerland	–0.63	35.44	0.15	○
95	Azerbaijan	–0.66	35.12	0.15	
96	Oman	–0.74	34.47	0.14	
97	Ukraine	–0.93	32.80	0.13	○
98	Trinidad and Tobago	–0.98	32.40	0.12	
99	Ecuador	–1.10	31.42	0.11	
100	Kuwait	–1.28	29.82	0.10	○
101	Estonia	–1.76	25.76	0.09	○
102	Greece	–2.11	22.71	0.08	○
103	Zimbabwe	–2.42	20.08	0.07	
104	Belarus	–2.43	19.95	0.06	○
105	South Africa	–2.54	19.04	0.05	○
106	Albania	–2.68	17.82	0.05	○
107	Nigeria	–2.69	17.73	0.04	○
108	Moldova, Rep.	–3.52	10.60	0.03	○
109	Brazil	–4.07	5.91	0.02	○
110	Russian Federation	–4.76	0.00	0.00	○
110	Yemen	–31.13	0.00	0.00	○
n/a	Benin	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Mauritius	n/a	n/a	n/a	
n/a	Mongolia	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Panama	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	

SOURCE: The Conference Board Total Economy Database™ Output, Labor and Labor Productivity, 1950–2016, May 2016

NOTE: ● indicates a strength; ○ a weakness

6.2.2 New business density

New business density (new registrations per thousand population 15–64 years old) | 2014

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Hong Kong (China)	31.30	100.00	0.99	●
1	Malta	17.26	100.00	0.99	●
3	New Zealand	16.63	96.35	0.98	●
4	Estonia	16.05	92.99	0.97	●
5	Australia	14.91	86.38	0.96	●
6	Panama (2012)	14.10	81.69	0.95	●
7	Cyprus	13.70	79.37	0.94	●
8	Botswana	13.11	75.95	0.93	●
9	United Kingdom (2012)	12.90	74.73	0.92	
10	Latvia	10.61	61.46	0.91	●
11	Singapore	9.51	55.09	0.90	
12	Iceland	9.48	54.92	0.89	
13	Bulgaria	8.86	51.32	0.88	●
14	Chile	8.03	46.51	0.88	●
15	Norway	7.72	44.72	0.87	
16	Sweden	6.87	39.79	0.86	
17	Montenegro	6.85	39.68	0.85	●
18	South Africa (2012)	6.54	37.86	0.84	●
19	Mongolia	6.31	36.55	0.83	●
20	Luxembourg (2012)	6.10	35.33	0.82	
21	Ireland	5.78	33.48	0.81	
22	Georgia	5.65	32.72	0.80	
23	Netherlands	5.34	30.93	0.79	
24	Mauritius	5.14	29.77	0.78	●
25	Croatia	4.63	26.81	0.77	
26	Portugal	4.62	26.75	0.76	
27	Slovenia	4.44	25.71	0.75	
28	Denmark	4.36	25.25	0.74	
29	Russian Federation	4.20	24.32	0.73	
30	Lithuania	4.19	24.26	0.72	
31	Romania	4.07	23.57	0.71	
32	TFYR of Macedonia	3.70	21.42	0.70	
33	Hungary	3.66	21.19	0.69	
34	Finland	3.43	19.86	0.68	
35	Czech Republic	3.42	19.80	0.67	
36	Israel	3.11	18.00	0.66	
37	Slovakia	3.10	17.94	0.65	
38	Spain	2.97	17.19	0.64	
39	Brazil	2.88	16.67	0.63	
40	Switzerland (2012)	2.53	14.64	0.63	
41	Uruguay (2012)	2.49	14.41	0.62	
42	Peru	2.44	14.12	0.61	
43	Malaysia	2.37	13.71	0.60	
44	Italy	2.32	13.42	0.59	
45	Korea, Rep.	2.30	13.31	0.58	
46	France	2.26	13.08	0.57	○
47	Belgium (2013)	2.05	11.86	0.56	
48	Colombia (2012)	2.00	11.57	0.55	
49	Kenya	1.80	10.41	0.54	
50	Kazakhstan (2012)	1.71	9.89	0.53	
51	Qatar	1.70	9.83	0.52	
52	Moldova, Rep. (2009)	1.63	9.43	0.51	
53	Serbia	1.62	9.37	0.50	
54	Morocco	1.54	8.91	0.49	
55	Armenia	1.52	8.79	0.47	
55	Tunisia (2013)	1.52	8.79	0.47	
57	Rwanda	1.49	8.62	0.46	
58	United Arab Emirates (2012)	1.38	7.98	0.45	
59	Zambia	1.33	7.69	0.44	●
60	Germany (2013)	1.29	7.46	0.43	○
61	Canada	1.28	7.40	0.42	○
62	Dominican Republic	1.20	6.93	0.41	
63	Uganda (2012)	1.17	6.76	0.40	
64	Turkey	1.13	6.53	0.39	
65	Albania (2013)	1.11	6.41	0.38	
66	Costa Rica	1.10	6.36	0.38	
67	Kyrgyzstan	1.08	6.24	0.37	
68	Belarus	1.05	6.07	0.36	
69	Oman (2013)	1.02	5.89	0.35	
70	Jamaica	1.00	5.78	0.34	
71	Azerbaijan	0.99	5.72	0.32	
71	Jordan	0.99	5.72	0.32	
73	Mexico	0.94	5.43	0.31	
74	Ukraine (2012)	0.92	5.31	0.30	
75	Thailand	0.90	5.20	0.29	
76	Namibia (2012)	0.85	4.91	0.28	
77	Bosnia and Herzegovina	0.83	4.79	0.27	
78	Greece (2010)	0.77	4.42	0.26	○
79	Nigeria	0.76	4.39	0.25	
80	Austria	0.73	4.21	0.24	○
81	Madagascar	0.70	4.04	0.23	
82	Nepal	0.69	3.98	0.22	
83	Algeria	0.58	3.34	0.21	
84	Bolivia, Plurinational St.	0.57	3.28	0.20	
85	Poland (2009)	0.53	3.05	0.19	○
86	El Salvador	0.52	2.99	0.17	
86	Guatemala (2012)	0.52	2.99	0.17	
88	Sri Lanka (2012)	0.51	2.94	0.16	
89	Argentina	0.43	2.47	0.15	
90	Senegal	0.30	1.72	0.14	
91	Indonesia (2012)	0.29	1.66	0.13	
92	Philippines (2012)	0.27	1.55	0.13	○
93	Tajikistan (2012)	0.26	1.49	0.11	
93	Togo	0.26	1.49	0.11	
95	Cambodia (2009)	0.22	1.24	0.10	
96	Burkina Faso (2012)	0.15	0.85	0.08	
96	Japan	0.15	0.85	0.08	○
98	Guinea	0.13	0.73	0.07	
99	Egypt (2009)	0.13	0.72	0.06	○
100	India	0.12	0.68	0.05	○
101	Bangladesh (2012)	0.09	0.50	0.04	○
102	Malawi (2009)	0.08	0.44	0.03	○
103	Pakistan	0.04	0.21	0.02	○
104	Ethiopia (2009)	0.03	0.15	0.01	○
105	Niger (2009)	0.00	0.00	0.00	○
n/a	Bahrain	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	China	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Ecuador	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	United States of America	n/a	n/a	n/a	
n/a	Viet Nam	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: World Bank, *Doing Business 2016, Entrepreneurship*

NOTE: ● indicates a strength; ○ a weakness

6.2.3 Total computer software spending

Total computer software spending (% of GDP) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United States of America	1.09	100.00	1.00	●
2	Ireland	0.83	75.82	0.99	●
3	Canada	0.80	72.98	0.98	●
4	United Kingdom	0.77	70.23	0.98	●
5	Switzerland	0.74	67.71	0.97	
6	Ukraine	0.70	63.48	0.96	●
7	Spain	0.66	59.88	0.95	●
8	Belgium	0.65	59.24	0.94	●
9	Norway	0.64	58.20	0.94	
10	Netherlands	0.63	57.77	0.93	
11	Portugal	0.62	56.77	0.92	●
12	Denmark	0.62	56.35	0.91	
13	France	0.60	54.54	0.90	
14	Austria	0.59	54.12	0.90	
15	Italy	0.58	53.07	0.89	●
16	Sweden	0.58	52.80	0.88	
17	Greece	0.58	52.41	0.87	●
18	Turkey	0.55	49.68	0.86	●
19	Finland	0.55	49.67	0.85	
20	Germany	0.55	49.65	0.85	
21	Kuwait	0.44	40.24	0.84	●
22	Montenegro	0.43	38.54	0.83	●
23	Saudi Arabia	0.41	37.25	0.82	●
24	Zimbabwe	0.41	36.75	0.81	●
25	Malta	0.40	36.40	0.81	
26	China	0.40	36.39	0.80	
27	Bahrain	0.39	35.74	0.79	
28	Hong Kong (China)	0.38	34.46	0.78	
29	Malaysia	0.37	33.91	0.77	
30	South Africa	0.37	33.45	0.77	
31	Qatar	0.35	31.68	0.76	
32	Iceland	0.34	31.07	0.75	
33	Sri Lanka	0.34	30.48	0.74	●
34	Singapore	0.34	30.46	0.73	
35	Russian Federation	0.33	30.06	0.73	
36	Indonesia	0.33	29.80	0.72	●
37	United Arab Emirates	0.33	29.42	0.71	
38	Jamaica	0.32	28.59	0.70	●
39	Viet Nam	0.32	28.57	0.69	
40	Tunisia	0.31	28.05	0.69	●
41	Czech Republic	0.31	27.93	0.68	
42	Hungary	0.31	27.75	0.67	
43	Slovakia	0.30	27.24	0.66	
44	Poland	0.30	26.96	0.65	
45	Romania	0.30	26.76	0.65	
46	Egypt	0.30	26.63	0.64	●
47	Thailand	0.29	26.05	0.63	
48	Bulgaria	0.28	25.57	0.62	
49	Chile	0.28	25.39	0.61	
50	Korea, Rep.	0.28	25.37	0.60	
51	Australia	0.28	25.20	0.60	
52	Costa Rica	0.28	24.97	0.59	
53	Israel	0.28	24.92	0.58	
54	Jordan	0.28	24.88	0.57	
55	Honduras	0.27	24.45	0.56	●
56	Senegal	0.27	24.44	0.56	
57	Mexico	0.26	23.66	0.55	
58	New Zealand	0.26	23.61	0.54	
59	Pakistan	0.26	23.60	0.53	●
60	Japan	0.26	23.11	0.52	
61	Philippines	0.25	22.83	0.52	
62	Morocco	0.25	22.47	0.51	
63	Ecuador	0.25	22.39	0.50	
64	Peru	0.24	21.79	0.49	
65	Uruguay	0.24	21.47	0.48	
66	India	0.24	21.33	0.48	
67	Iran, Islamic Rep.	0.24	21.20	0.47	
68	Argentina	0.23	20.45	0.46	
69	Colombia	0.21	18.80	0.45	
70	Panama	0.21	18.51	0.44	
71	Bolivia, Plurinational St.	0.21	18.31	0.44	
72	Brazil	0.20	18.17	0.43	
73	Luxembourg	0.19	16.74	0.42	
74	Kenya	0.17	15.45	0.41	
75	Mauritius	0.17	15.44	0.40	
76	Cameroon	0.17	15.12	0.40	
77	Bangladesh	0.17	14.95	0.39	
78	Cyprus	0.17	14.80	0.38	
79	Estonia	0.16	13.73	0.37	○
80	TFYR of Macedonia	0.15	12.97	0.36	
81	Nigeria	0.13	11.19	0.35	
82	Mongolia	0.13	11.16	0.35	
83	Moldova, Rep.	0.12	10.88	0.34	
84	Namibia	0.12	10.38	0.33	
85	Botswana	0.12	10.23	0.32	
86	Albania	0.12	10.13	0.31	
87	Latvia	0.11	9.90	0.31	○
88	Armenia	0.11	9.26	0.30	
89	Bosnia and Herzegovina	0.10	8.81	0.29	
90	Kyrgyzstan	0.10	8.28	0.28	
91	Georgia	0.10	8.16	0.27	
92	Slovenia	0.09	8.07	0.27	○
93	Togo	0.08	7.14	0.26	
94	Burundi	0.08	6.95	0.25	
95	Tajikistan	0.08	6.47	0.24	
96	Lithuania	0.08	6.45	0.23	○
97	Azerbaijan	0.06	4.98	0.23	
98	Croatia	0.06	4.64	0.22	○
99	Oman	0.05	4.21	0.21	
100	Rwanda	0.05	4.12	0.20	
101	Benin	0.05	4.07	0.19	
102	Malawi	0.05	4.03	0.19	
103	Serbia	0.05	3.62	0.18	○
104	Lebanon	0.05	3.57	0.17	
105	El Salvador	0.05	3.56	0.16	
106	Paraguay	0.04	3.50	0.15	
107	Guinea	0.04	3.49	0.15	
108	Belarus	0.04	3.11	0.14	○
109	Niger	0.04	2.82	0.13	
110	Burkina Faso	0.03	2.56	0.12	
111	Mali	0.03	2.56	0.11	
112	Cambodia	0.03	2.51	0.10	
113	Mozambique	0.03	2.31	0.10	
114	Zambia	0.03	2.24	0.09	
115	Madagascar	0.03	2.12	0.08	
116	Nepal	0.02	1.59	0.07	
117	Dominican Republic	0.02	1.56	0.06	○
118	Yemen	0.02	1.55	0.06	
119	Kazakhstan	0.02	1.39	0.05	○
120	Côte d'Ivoire	0.02	1.24	0.04	○
121	Guatemala	0.02	1.01	0.03	○
122	Uganda	0.02	0.83	0.02	○
123	Tanzania, United Rep.	0.01	0.44	0.02	○
124	Algeria	0.01	0.41	0.01	○
125	Ethiopia	0.01	0.00	0.00	○
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	

SOURCE: IHS Global Insight, *Information and Communication Technology Database*
NOTE: ● indicates a strength; ○ a weakness

6.2.4 ISO 9001 quality certificates

ISO 9001 Quality management systems—Requirements: Number of certificates issued (per billion PPP$ GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Italy	61.08	100.00	1.00	●
2	Romania	49.49	81.02	0.99	●
3	Bulgaria	39.68	64.96	0.98	●
4	Slovakia	35.23	57.67	0.98	●
5	Malta	32.76	53.64	0.97	●
6	Israel	31.85	52.14	0.96	
7	Czech Republic	31.50	51.57	0.95	●
8	Estonia	30.06	49.21	0.94	●
9	Cyprus	29.25	47.88	0.94	●
10	Croatia	27.71	45.36	0.93	●
11	Portugal	25.83	42.28	0.92	●
12	Serbia	25.71	42.09	0.91	●
13	Switzerland	25.29	41.40	0.90	
14	Slovenia	23.22	38.02	0.90	●
15	Latvia	22.77	37.28	0.89	
16	Hungary	22.35	36.60	0.88	●
17	Belarus	21.73	35.58	0.87	●
18	Greece	21.59	35.35	0.87	●
19	Spain	20.22	33.11	0.86	
20	Bosnia and Herzegovina	19.38	31.74	0.85	●
21	Colombia	18.48	30.25	0.84	●
22	Uruguay	18.04	29.53	0.83	●
23	Lithuania	15.00	24.56	0.83	●
24	United Kingdom	14.86	24.33	0.82	
25	China	14.85	24.32	0.81	
26	Malaysia	14.63	23.96	0.80	
27	Germany	13.73	22.48	0.79	
28	Chile	12.48	20.43	0.79	
29	TFYR of Macedonia	12.48	20.43	0.78	●
30	Netherlands	12.35	20.22	0.77	
31	Singapore	12.24	20.04	0.76	
32	Australia	11.95	19.57	0.75	
33	Finland	11.54	18.89	0.75	
34	Austria	11.04	18.07	0.74	
35	Poland	10.61	17.36	0.73	
36	France	10.44	17.10	0.72	
37	Japan	9.73	15.92	0.71	
38	Mauritius	9.70	15.88	0.71	
39	Sweden	9.09	14.88	0.70	
40	Albania	8.54	13.99	0.69	●
41	Montenegro	8.43	13.80	0.68	
42	Argentina	8.04	13.17	0.67	
43	Tunisia	7.84	12.84	0.67	
44	Thailand	7.82	12.81	0.66	
45	United Arab Emirates	7.68	12.57	0.65	
46	Ireland	7.62	12.47	0.64	
47	Lebanon	7.58	12.41	0.63	
48	Viet Nam	7.50	12.27	0.63	
49	Moldova, Rep.	7.25	11.86	0.62	
50	Denmark	7.21	11.80	0.61	
51	Belgium	7.20	11.78	0.60	
52	New Zealand	7.16	11.73	0.60	
53	Norway	6.91	11.31	0.59	
54	Ecuador	6.89	11.29	0.58	●
55	Korea, Rep.	6.47	10.59	0.57	
56	Hong Kong (China)	6.06	9.92	0.56	
57	South Africa	5.99	9.80	0.56	
58	Bahrain	5.84	9.57	0.55	
59	Paraguay	5.51	9.02	0.54	●
60	Brazil	5.48	8.97	0.53	
61	Turkey	5.35	8.76	0.52	
62	Iceland	4.94	8.09	0.52	
63	Zimbabwe	4.64	7.59	0.51	●
64	Kenya	4.61	7.55	0.50	
65	India	4.54	7.43	0.49	
66	Luxembourg	4.50	7.37	0.48	
67	Honduras	4.18	6.84	0.48	
68	El Salvador	4.17	6.82	0.47	
69	Jordan	4.09	6.70	0.46	
70	Canada	3.93	6.43	0.45	○
71	Costa Rica	3.74	6.13	0.44	
72	Sri Lanka	3.58	5.87	0.44	
73	Morocco	3.54	5.79	0.43	
74	Mexico	3.33	5.45	0.42	
75	Peru	3.31	5.42	0.41	
76	Oman	3.21	5.25	0.40	
77	Bolivia, Plurinational St.	3.10	5.07	0.40	
78	Ukraine	3.09	5.06	0.39	
79	Brunei Darussalam	3.07	5.03	0.38	
80	Indonesia	3.02	4.95	0.37	
81	Philippines	2.96	4.84	0.37	
82	Madagascar	2.70	4.42	0.36	
83	Pakistan	2.67	4.37	0.35	
84	Trinidad and Tobago	2.65	4.33	0.34	
85	Russian Federation	2.44	3.99	0.33	
86	Georgia	2.38	3.90	0.33	
87	Egypt	2.36	3.87	0.32	
88	Panama	2.25	3.69	0.31	
89	Benin	2.18	3.57	0.30	
90	Qatar	2.12	3.47	0.29	
91	Côte d'Ivoire	2.03	3.33	0.29	
92	Togo	2.02	3.31	0.28	
93	Iran, Islamic Rep.	1.91	3.13	0.27	
94	United States of America	1.84	3.00	0.26	○
95	Saudi Arabia	1.79	2.93	0.25	
96	Guatemala	1.78	2.92	0.25	
97	Namibia	1.76	2.88	0.24	
98	Mozambique	1.71	2.80	0.23	
99	Senegal	1.66	2.72	0.22	
100	Burkina Faso	1.62	2.65	0.21	
101	Azerbaijan	1.43	2.34	0.21	
102	Nepal	1.40	2.29	0.20	
103	Dominican Republic	1.29	2.11	0.19	
104	Kuwait	1.19	1.94	0.18	
105	Uganda	1.10	1.80	0.17	
106	Kazakhstan	1.07	1.75	0.17	
107	Armenia	1.06	1.74	0.16	
108	Jamaica	1.05	1.72	0.15	
109	Algeria	0.98	1.60	0.14	
110	Cameroon	0.95	1.55	0.13	
111	Malawi	0.83	1.36	0.13	
112	Zambia	0.80	1.31	0.12	
113	Tanzania, United Rep.	0.79	1.29	0.11	
114	Bangladesh	0.78	1.28	0.10	
115	Cambodia	0.74	1.20	0.10	
116	Ethiopia	0.61	1.00	0.09	
117	Guinea	0.59	0.96	0.08	
118	Mongolia	0.50	0.81	0.07	○
119	Botswana	0.43	0.70	0.06	○
120	Niger	0.42	0.69	0.06	
121	Yemen	0.29	0.48	0.05	
122	Nigeria	0.18	0.30	0.04	○
123	Mali	0.17	0.28	0.03	○
124	Tajikistan	0.17	0.27	0.02	○
125	Rwanda	0.15	0.24	0.02	○
126	Kyrgyzstan	0.05	0.08	0.01	○
127	Burundi	0.00	0.00	0.00	○

SOURCE: International Organization for Standardization, *The ISO Survey 2015*; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)
NOTE: ● indicates a strength; ○ a weakness

6.2.5 High-tech and medium-high-tech output

High-tech and medium-high-tech output (% of total manufactures output) | 2014

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Switzerland	0.65	100.00	1.00	●
2	Singapore	0.65	99.72	0.99	●
3	Hungary	0.58	88.97	0.98	●
4	Slovakia	0.58	88.38	0.97	●
5	Ireland (2013)	0.55	84.74	0.96	●
6	Germany	0.54	83.01	0.95	
7	Czech Republic	0.52	79.97	0.94	●
8	Korea, Rep.	0.52	79.79	0.93	
9	Japan (2012)	0.50	76.49	0.92	
10	Slovenia	0.47	71.88	0.91	●
11	Sweden	0.46	69.58	0.90	
12	Qatar (2013)	0.44	66.55	0.89	●
13	United States of America (2008)	0.43	65.58	0.88	
14	China (2011)	0.43	65.36	0.87	
15	Austria	0.43	65.07	0.86	
16	Mexico (2013)	0.42	63.52	0.85	●
17	Denmark	0.42	62.85	0.84	
18	Philippines (2012)	0.41	61.98	0.83	●
19	Thailand (2011)	0.41	61.60	0.82	
20	Netherlands	0.39	58.47	0.81	
21	Brazil (2013)	0.38	57.40	0.80	●
22	Finland	0.38	56.54	0.79	
23	France	0.37	55.87	0.78	
24	Oman	0.37	55.05	0.77	●
25	United Kingdom	0.36	54.58	0.76	
26	Italy	0.36	54.41	0.75	
27	Romania (2013)	0.36	54.14	0.74	
28	Malaysia (2012)	0.36	53.58	0.73	
29	Saudi Arabia (2009)	0.36	53.41	0.72	
30	Estonia	0.35	52.82	0.71	
31	Belgium	0.35	51.90	0.70	
32	Norway	0.34	51.45	0.69	
33	Spain	0.33	49.71	0.68	
34	Tunisia (2007)	0.32	47.75	0.67	
35	Poland	0.32	47.19	0.66	
36	Iran, Islamic Rep.	0.31	45.50	0.65	●
37	Israel	0.30	44.06	0.64	
38	Canada	0.29	43.52	0.63	
39	Algeria (2010)	0.29	42.91	0.62	●
40	India	0.29	42.82	0.61	
41	Belarus	0.29	42.02	0.60	
42	Morocco (2013)	0.28	41.86	0.59	
43	Indonesia (2013)	0.28	41.69	0.58	
44	South Africa (2010)	0.27	40.07	0.57	
45	Serbia	0.27	38.87	0.56	
46	Viet Nam (2012)	0.26	38.22	0.55	
47	Portugal	0.26	37.95	0.54	
48	Turkey	0.25	36.70	0.53	
49	Australia (2013)	0.25	36.59	0.52	
50	Malta (2010)	0.24	35.60	0.51	
51	Russian Federation	0.24	35.52	0.50	
52	Pakistan (2006)	0.24	34.36	0.50	
53	Hong Kong (China)	0.23	32.67	0.49	
54	Lebanon (2007)	0.22	31.63	0.48	
55	Jordan (2013)	0.21	30.81	0.47	
56	Ukraine	0.20	29.23	0.46	
57	Bulgaria	0.20	28.58	0.45	
58	Colombia (2012)	0.20	28.49	0.44	
59	TFYR of Macedonia (2011)	0.20	27.77	0.43	
60	Egypt (2012)	0.19	27.45	0.42	
61	Lithuania	0.19	26.21	0.41	
62	Luxembourg	0.18	25.40	0.40	
63	Chile (2013)	0.17	23.85	0.39	
64	Senegal (2012)	0.16	21.60	0.38	
65	Latvia (2013)	0.16	21.59	0.37	
66	Cyprus	0.15	20.36	0.36	
67	Kazakhstan (2013)	0.15	19.68	0.35	
68	Uruguay (2011)	0.14	19.62	0.34	
69	Kuwait (2013)	0.14	18.94	0.33	
70	Ecuador (2008)	0.14	18.80	0.32	
71	Ethiopia	0.14	18.11	0.31	
72	Paraguay (2010)	0.13	17.83	0.30	
73	New Zealand (2012)	0.13	17.50	0.29	○
74	Azerbaijan (2013)	0.13	17.19	0.28	
75	Greece	0.13	17.13	0.27	○
76	Georgia (2013)	0.13	16.82	0.26	
77	Costa Rica (2013)	0.12	15.67	0.25	
78	Kenya (2013)	0.11	14.24	0.24	
79	Bosnia and Herzegovina (2011)	0.11	14.16	0.23	
80	Moldova, Rep. (2013)	0.10	12.77	0.22	
81	Bahrain (2013)	0.10	12.75	0.21	
82	Tanzania, United Rep. (2010)	0.10	12.46	0.20	
83	Peru (2011)	0.09	11.27	0.19	○
84	Bangladesh (2011)	0.09	10.98	0.18	
85	Bolivia, Plurinational St. (2010)	0.09	10.45	0.17	
86	Malawi (2012)	0.09	10.28	0.16	
87	Mauritius (2012)	0.08	9.54	0.15	○
88	Albania (2013)	0.08	8.98	0.14	
89	Panama (2013)	0.08	8.81	0.13	
90	Iceland (2006)	0.07	7.90	0.12	○
91	Nepal (2011)	0.07	7.23	0.11	
92	Sri Lanka (2012)	0.06	6.35	0.10	○
93	Mongolia (2011)	0.06	5.34	0.09	○
94	Namibia (2013)	0.05	4.01	0.08	○
95	Kyrgyzstan (2013)	0.04	3.39	0.07	
96	Cameroon (2008)	0.04	3.37	0.06	○
97	Armenia (2013)	0.04	2.94	0.05	○
98	Burundi (2012)	0.04	2.52	0.04	
99	Brunei Darussalam (2010)	0.03	0.82	0.03	○
100	Tajikistan (2013)	0.02	0.49	0.02	○
101	Madagascar (2006)	0.02	0.37	0.01	○
102	Yemen (2012)	0.02	0.00	0.00	○
n/a	Argentina	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Croatia	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: United Nations Industrial Development Organization (UNIDO), *Industrial Statistics Database*, 3- and 4-digit level of International Standard Industrial Classification ISIC Revision 3 (INDSTAT4 2016); OECD, Directorate for Science, Technology and Industry, Economic Analysis and Statistics Division, 'ISIC REV. 3 Technology Intensity Definition: Classification of Manufacturing Industries into Categories Based on R&D Intensities', 7 July 2011

NOTE: ● indicates a strength; ○ a weakness

6.3.1 Intellectual property receipts

Charges for use of intellectual property n.i.e., receipts (% of total trade) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United States of America	5.09	100.00	1.00	●
2	Japan	4.71	96.20	0.99	●
3	Sweden	4.21	90.88	0.98	●
4	Switzerland	3.82	86.32	0.97	
5	Netherlands	3.71	84.98	0.96	●
6	Finland	2.90	74.02	0.95	
7	Iceland	2.82	72.79	0.94	
8	Ireland	2.39	65.92	0.93	
9	Malta	2.13	61.41	0.93	
10	United Kingdom	1.98	58.58	0.92	
11	France	1.88	56.50	0.91	
12	Denmark	1.41	46.66	0.90	
13	Hungary	1.41	46.56	0.89	●
14	Korea, Rep.	1.04	37.47	0.88	
15	Luxembourg	0.98	35.71	0.87	
16	Germany	0.94	34.54	0.86	
17	Israel	0.87	32.65	0.85	
18	Canada	0.83	31.30	0.84	
19	Belgium	0.78	30.02	0.83	
20	Singapore	0.69	27.18	0.82	
21	New Zealand	0.63	25.29	0.81	
22	Italy	0.58	23.39	0.80	
23	United Arab Emirates	0.50	20.92	0.79	
24	Madagascar (2013)	0.46	19.17	0.79	●
25	Austria	0.45	18.86	0.78	
26	Spain	0.43	18.12	0.77	
27	Yemen (2009)	0.40	17.00	0.76	●
28	Kenya (2014)	0.39	16.80	0.75	●
29	Norway	0.38	16.48	0.74	
30	El Salvador	0.33	14.61	0.73	●
31	Australia	0.32	13.89	0.72	
32	Czech Republic	0.31	13.69	0.71	
33	Egypt (2007)	0.25	11.36	0.70	●
34	Brazil	0.25	11.26	0.69	
35	Argentina	0.24	10.64	0.68	
36	Bolivia, Plurinational St.	0.23	10.46	0.67	●
37	Russian Federation	0.22	9.86	0.66	
38	Croatia	0.20	9.13	0.65	
39	Serbia	0.20	9.03	0.64	
40	Slovenia	0.19	8.62	0.64	
41	Poland	0.18	8.47	0.63	
42	Bosnia and Herzegovina	0.18	8.35	0.62	
43	Ukraine	0.18	8.17	0.61	
44	TFYR of Macedonia	0.16	7.45	0.60	
45	Bulgaria	0.13	6.32	0.59	
46	Moldova, Rep.	0.13	6.15	0.58	
47	Romania	0.12	5.75	0.57	
48	Tunisia (2014)	0.12	5.52	0.56	
49	Portugal	0.11	5.01	0.55	
50	South Africa	0.11	4.98	0.54	
51	Jamaica	0.10	4.91	0.53	
52	Chile (2014)	0.10	4.85	0.52	
53	India	0.10	4.82	0.51	
54	Hong Kong (China) (2014)	0.10	4.75	0.50	
55	Guatemala	0.10	4.74	0.50	
56	Colombia	0.10	4.63	0.49	
57	Greece	0.09	4.32	0.48	
58	Mexico	0.07	3.56	0.47	
59	Lebanon (2014)	0.07	3.56	0.46	
60	Thailand	0.07	3.45	0.45	
61	Belarus	0.07	3.40	0.44	
62	Lithuania	0.07	3.38	0.43	
63	Senegal (2014)	0.07	3.28	0.42	
64	Uganda	0.07	3.20	0.41	
65	Estonia	0.07	3.16	0.40	○
66	Peru	0.05	2.48	0.39	
67	China	0.05	2.35	0.38	
68	Mongolia	0.05	2.30	0.37	
69	Albania	0.05	2.29	0.36	
70	Latvia	0.04	2.01	0.36	
71	Pakistan	0.04	2.00	0.35	
72	Mauritius (2014)	0.04	1.99	0.34	
73	Malaysia	0.04	1.98	0.33	
74	Montenegro	0.04	1.80	0.32	
75	Slovakia	0.03	1.61	0.31	○
76	Indonesia	0.03	1.57	0.30	
77	Kyrgyzstan (2014)	0.03	1.48	0.29	
78	Zimbabwe (2012)	0.03	1.28	0.28	
79	Costa Rica (2014)	0.02	1.19	0.27	
80	Burkina Faso (2014)	0.02	1.10	0.26	
81	Panama	0.02	1.07	0.25	
82	Iran, Islamic Rep. (2014)	0.01	0.72	0.24	
83	Rwanda (2009)	0.01	0.71	0.23	
84	Philippines	0.01	0.69	0.22	
85	Honduras	0.01	0.53	0.21	
86	Cyprus (2014)	0.01	0.48	0.21	○
87	Burundi (2013)	0.01	0.44	0.20	
88	Georgia	0.01	0.37	0.19	
89	Tajikistan (2013)	0.01	0.35	0.18	
90	Guinea (2008)	0.01	0.31	0.17	
91	Côte d'Ivoire (2013)	0.01	0.28	0.16	
92	Cambodia	0.00	0.20	0.15	
93	Ethiopia (2010)	0.00	0.17	0.14	
94	Mali (2012)	0.00	0.16	0.13	
95	Morocco (2013)	0.00	0.13	0.12	○
96	Cameroon (2013)	0.00	0.12	0.11	
97	Uruguay	0.00	0.11	0.10	○
98	Bangladesh (2014)	0.00	0.11	0.09	
99	Botswana (2014)	0.00	0.10	0.08	○
100	Namibia (2014)	0.00	0.10	0.07	○
101	Kazakhstan	0.00	0.09	0.07	○
102	Mozambique (2012)	0.00	0.07	0.06	
103	Togo (2010)	0.00	0.04	0.05	
104	Algeria (2014)	0.00	0.03	0.04	
105	Benin (2014)	0.00	0.01	0.03	○
106	Niger (2007)	0.00	0.01	0.02	
107	Azerbaijan (2012)	0.00	0.01	0.01	○
108	Tanzania, United Rep. (2007)	0.00	0.00	0.00	○
n/a	Armenia	n/a	n/a	n/a	
n/a	Bahrain	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	Ecuador	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Sri Lanka	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Turkey	n/a	n/a	n/a	
n/a	Viet Nam	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	

SOURCE: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments Manual* and *Balance of Payments* database

NOTE: ● indicates a strength; ○ a weakness

6.3.2 High-tech exports

High-tech net exports (% of total trade) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	China	29.38	100.00	0.99	●
1	Malaysia	32.31	100.00	0.99	●
3	Singapore	29.08	98.97	0.98	●
4	Viet Nam	26.83	91.32	0.98	●
5	Korea, Rep.	24.79	84.36	0.97	
6	Panama (2011)	17.12	58.25	0.96	●
7	Czech Republic	16.72	56.90	0.95	●
8	Israel	15.76	53.62	0.94	
9	Thailand	15.23	51.82	0.94	●
10	Mexico	14.79	50.32	0.93	●
11	France	14.45	49.17	0.92	●
12	Switzerland	14.43	49.11	0.91	
13	Germany	13.93	47.41	0.90	
14	Hungary	13.89	47.28	0.90	●
15	Netherlands	13.00	44.22	0.89	
16	Japan	12.82	43.62	0.88	
17	Estonia	11.66	39.68	0.87	
18	Ireland	11.66	39.66	0.86	
19	Belgium	11.07	37.68	0.85	
20	Slovakia	9.32	31.72	0.85	●
21	United Kingdom	9.23	31.39	0.84	
22	Austria	9.18	31.22	0.83	
23	Sweden	9.04	30.75	0.82	
24	Latvia	8.05	27.37	0.81	
25	Poland	7.25	24.67	0.81	
26	United States of America	7.10	24.16	0.80	
27	Denmark	6.83	23.25	0.79	
28	Lithuania	6.10	20.75	0.78	
29	Romania	6.04	20.53	0.77	
30	Kazakhstan	5.91	20.12	0.77	●
31	Italy	5.65	19.22	0.76	
32	Canada	5.63	19.15	0.75	
33	Costa Rica	5.12	17.42	0.74	
34	Finland	5.03	17.11	0.73	
35	Slovenia	4.97	16.91	0.73	
36	Malta	4.71	16.01	0.72	
37	Tunisia	4.34	14.76	0.71	●
38	Brazil	4.06	13.81	0.70	
39	Spain	3.98	13.52	0.69	
40	Croatia	3.86	13.11	0.69	
41	Norway	3.85	13.11	0.68	
42	Bulgaria	3.70	12.57	0.67	
43	Indonesia	3.49	11.87	0.66	
44	Russian Federation	3.41	11.60	0.65	
45	India	3.19	10.86	0.65	
46	Ukraine	3.11	10.57	0.64	
47	Niger (2014)	2.95	10.02	0.63	
48	Portugal	2.62	8.89	0.62	
49	El Salvador	2.40	8.16	0.61	●
50	Uruguay	2.28	7.76	0.60	
51	Greece	2.27	7.72	0.60	
52	South Africa	2.27	7.70	0.59	
53	Serbia	2.19	7.44	0.58	
54	TFYR of Macedonia	2.16	7.33	0.57	
55	Australia	2.04	6.93	0.56	
56	Argentina	2.03	6.91	0.56	
57	Belarus	1.76	5.98	0.55	
58	Namibia (2014)	1.61	5.46	0.54	
59	Morocco	1.53	5.19	0.53	
60	Colombia	1.52	5.15	0.52	
61	Guatemala	1.52	5.14	0.52	
62	Brunei Darussalam	1.39	4.72	0.51	
63	Bosnia and Herzegovina	1.38	4.70	0.50	
64	New Zealand	1.37	4.66	0.49	
65	Iceland	1.34	4.55	0.48	
66	Turkey	1.32	4.48	0.48	
67	Kyrgyzstan	1.20	4.07	0.47	
68	Dominican Republic	1.13	3.82	0.46	
69	Cambodia	0.93	3.15	0.45	
70	Chile	0.81	2.73	0.44	
71	Pakistan	0.73	2.47	0.44	
72	Luxembourg	0.68	2.31	0.43	
73	Jordan	0.67	2.27	0.42	
74	Moldova, Rep.	0.62	2.08	0.41	
75	Zambia	0.61	2.06	0.40	
76	Côte d'Ivoire	0.58	1.95	0.40	
77	Montenegro	0.57	1.93	0.39	
78	Senegal	0.56	1.90	0.38	
79	Kenya (2013)	0.56	1.88	0.37	
80	Honduras (2014)	0.53	1.79	0.36	
81	Iran, Islamic Rep. (2011)	0.53	1.78	0.35	
82	Botswana	0.51	1.73	0.35	
83	Georgia	0.51	1.72	0.34	
84	Peru	0.51	1.72	0.33	
85	Oman (2014)	0.49	1.65	0.32	
86	Cyprus	0.48	1.61	0.31	
87	Ecuador	0.46	1.54	0.31	
88	Paraguay	0.45	1.53	0.30	
89	Rwanda	0.45	1.52	0.29	
90	Mozambique	0.42	1.40	0.28	
91	Albania	0.41	1.38	0.27	
92	Sri Lanka	0.32	1.07	0.27	
93	Armenia	0.32	1.07	0.26	
94	Qatar	0.27	0.91	0.25	
95	United Arab Emirates	0.27	0.90	0.24	○
96	Kuwait	0.27	0.89	0.23	
97	Bolivia, Plurinational St.	0.24	0.79	0.23	
98	Zimbabwe (2014)	0.22	0.72	0.22	
99	Malawi	0.19	0.64	0.21	
100	Lebanon (2014)	0.19	0.62	0.20	
101	Burkina Faso	0.17	0.58	0.19	
102	Cameroon	0.17	0.57	0.19	
103	Nigeria (2014)	0.17	0.55	0.18	
104	Egypt	0.16	0.54	0.17	
105	Uganda	0.16	0.52	0.16	
106	Guinea (2014)	0.15	0.48	0.15	
107	Bangladesh (2011)	0.14	0.45	0.15	
108	Ethiopia	0.13	0.43	0.14	
109	Saudi Arabia	0.13	0.42	0.13	○
110	Bahrain	0.12	0.40	0.12	
111	Mali (2012)	0.11	0.36	0.11	
112	Tanzania, United Rep.	0.09	0.27	0.10	
113	Hong Kong (China)	0.08	0.26	0.10	○
114	Burundi (2014)	0.07	0.23	0.09	
115	Azerbaijan	0.07	0.23	0.08	○
116	Mongolia	0.07	0.22	0.07	○
117	Nepal	0.06	0.18	0.06	○
118	Benin	0.05	0.16	0.06	
119	Madagascar	0.05	0.14	0.05	
120	Trinidad and Tobago (2010)	0.03	0.10	0.04	○
121	Togo (2014)	0.02	0.06	0.03	○
122	Mauritius	0.02	0.06	0.02	○
123	Yemen (2014)	0.01	0.02	0.02	
124	Jamaica	0.01	0.02	0.01	○
125	Algeria	0.01	0.00	0.00	○
n/a	Philippines	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	

SOURCE: United Nations, *COMTRADE* database; Eurostat, *Annex 5: High-tech aggregation by SITC Rev. 4*, April 2009

NOTE: ● indicates a strength; ○ a weakness

6.3.3 ICT services exports

Telecommunications, computers, and information services exports (% of total trade) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Costa Rica	14.62	100.00	0.98	●
1	India	12.63	100.00	0.98	●
1	Ireland	24.01	100.00	0.98	●
1	Israel	10.63	100.00	0.98	●
5	Finland	9.88	93.00	0.97	●
6	Cyprus (2014)	9.59	90.18	0.96	●
7	Netherlands	7.15	67.22	0.95	
8	Sweden	7.10	66.70	0.94	
9	Nepal (2014)	6.61	62.04	0.94	●
10	Niger (2014)	6.00	56.34	0.93	●
11	Senegal (2014)	5.23	49.03	0.92	●
12	Kuwait	4.86	45.53	0.91	●
13	Moldova, Rep.	4.74	44.40	0.90	●
14	Mali (2014)	4.69	43.91	0.90	●
15	Ukraine	4.38	41.03	0.89	●
16	Philippines	4.33	40.50	0.88	●
17	Kenya (2014)	4.27	39.96	0.87	●
18	Romania	4.09	38.31	0.86	●
19	Sri Lanka	4.02	37.63	0.86	●
20	Luxembourg	3.90	36.44	0.85	
21	Switzerland	3.68	34.39	0.84	
22	Armenia	3.51	32.78	0.83	●
23	Serbia	3.38	31.54	0.82	●
24	United Kingdom	3.34	31.19	0.82	
25	Bahrain (2014)	3.34	31.18	0.81	●
26	Montenegro	3.18	29.72	0.80	
27	Burundi (2014)	3.18	29.68	0.79	●
28	Estonia	3.18	29.65	0.78	
29	Belarus	3.08	28.73	0.78	●
30	Belgium	2.96	27.63	0.77	
31	Morocco (2013)	2.91	27.14	0.76	●
32	Austria	2.91	27.13	0.75	
33	Guatemala	2.90	27.07	0.74	●
34	Honduras	2.87	26.79	0.74	●
35	Spain	2.86	26.63	0.73	
36	Lebanon (2014)	2.79	25.96	0.72	●
37	Albania	2.77	25.78	0.71	●
38	Iceland	2.76	25.69	0.70	
39	Bulgaria	2.69	25.06	0.70	
40	Guinea (2013)	2.68	24.98	0.69	●
41	Mauritius (2014)	2.64	24.54	0.68	
42	Uruguay	2.57	23.95	0.67	
43	TFYR of Macedonia	2.52	23.48	0.66	
44	Latvia	2.50	23.23	0.66	
45	Croatia	2.50	23.21	0.65	
46	Denmark	2.48	23.03	0.64	
47	Jamaica	2.29	21.28	0.63	
48	Argentina	2.29	21.27	0.62	
49	France	2.18	20.23	0.62	
50	Pakistan	2.16	20.02	0.61	●
51	El Salvador	2.10	19.46	0.60	
52	Germany	1.99	18.44	0.59	
53	Yemen (2014)	1.95	18.06	0.58	●
54	Poland	1.91	17.66	0.58	
55	Benin (2014)	1.84	16.97	0.57	●
56	Slovenia	1.82	16.82	0.56	
57	Czech Republic	1.76	16.30	0.55	
58	Hungary	1.74	16.08	0.54	
59	Egypt (2014)	1.71	15.79	0.54	
60	Bosnia and Herzegovina	1.66	15.32	0.53	
61	United Arab Emirates	1.66	15.31	0.52	
62	Madagascar (2013)	1.65	15.26	0.51	
63	Ethiopia (2012)	1.65	15.22	0.50	●
64	Tunisia (2014)	1.57	14.48	0.50	
65	Norway	1.55	14.30	0.49	○
66	Greece	1.53	14.09	0.48	
67	Italy	1.49	13.74	0.47	
68	United States of America	1.49	13.72	0.46	
69	Canada	1.47	13.54	0.46	
70	Portugal	1.40	12.85	0.45	○
71	Malaysia	1.34	12.28	0.44	
72	Burkina Faso (2014)	1.32	12.13	0.43	
73	Togo (2014)	1.31	12.05	0.42	●
74	Cameroon (2013)	1.25	11.47	0.42	●
75	New Zealand	1.24	11.33	0.41	○
76	Russian Federation	1.18	10.82	0.40	
77	China	1.10	10.01	0.39	
78	Bangladesh (2014)	1.09	9.96	0.38	
79	Panama	1.09	9.94	0.38	
80	Slovakia	1.07	9.71	0.37	
81	Dominican Republic (2014)	1.05	9.59	0.36	
82	Malta	1.03	9.37	0.35	○
83	Uganda	1.03	9.34	0.34	
84	Singapore	1.01	9.20	0.34	○
85	Bolivia, Plurinational St.	0.96	8.71	0.33	
86	Rwanda (2014)	0.92	8.36	0.32	
87	Malawi (2014)	0.92	8.32	0.31	
88	Lithuania	0.85	7.64	0.30	○
89	Australia	0.81	7.25	0.30	○
90	Côte d'Ivoire (2013)	0.74	6.58	0.29	
91	Qatar	0.73	6.55	0.28	
92	Brazil	0.68	6.03	0.27	
93	Kyrgyzstan	0.65	5.82	0.26	
94	Korea, Rep.	0.61	5.44	0.26	○
95	Indonesia	0.61	5.36	0.25	
96	Georgia	0.60	5.27	0.24	
97	South Africa	0.58	5.14	0.23	○
98	Tajikistan	0.57	5.04	0.22	
99	Chile (2014)	0.54	4.73	0.22	○
100	Colombia	0.53	4.60	0.21	○
101	Hong Kong (China) (2014)	0.45	3.92	0.20	○
102	Azerbaijan	0.45	3.91	0.19	
103	Cambodia	0.44	3.78	0.18	
104	Tanzania, United Rep. (2014)	0.43	3.66	0.18	
105	Japan	0.42	3.59	0.17	○
106	Ecuador	0.39	3.34	0.16	
107	Brunei Darussalam (2009)	0.37	3.17	0.15	○
108	Peru	0.34	2.83	0.14	○
109	Kazakhstan	0.30	2.48	0.14	○
110	Zambia (2014)	0.29	2.40	0.13	
111	Botswana (2014)	0.29	2.34	0.12	○
112	Algeria (2014)	0.29	2.33	0.11	
113	Mongolia	0.22	1.70	0.10	
114	Mozambique	0.22	1.69	0.10	
115	Oman (2014)	0.20	1.56	0.09	○
116	Iran, Islamic Rep. (2014)	0.19	1.40	0.08	○
117	Thailand	0.18	1.32	0.07	○
118	Paraguay	0.14	0.93	0.06	○
119	Nigeria	0.12	0.81	0.06	
120	Saudi Arabia	0.12	0.75	0.05	○
121	Turkey	0.10	0.58	0.04	○
122	Viet Nam (2014)	0.09	0.48	0.03	○
123	Trinidad and Tobago (2011)	0.08	0.42	0.02	○
124	Namibia (2014)	0.05	0.10	0.02	○
125	Zimbabwe (2012)	0.05	0.07	0.01	○
126	Mexico	0.04	0.00	0.00	○
n/a	Jordan	n/a	n/a	n/a	

SOURCE: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments Manual* and *Balance of Payments* database

NOTE: ● indicates a strength; ○ a weakness

6.3.4 Foreign direct investment net outflows

Foreign direct investment (FDI), net outflows (% of GDP, three-year average) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Cyprus	17.24	100.00	0.95	●
1	Hong Kong (China)	32.79	100.00	0.95	●
1	Ireland	39.57	100.00	0.95	●
1	Kuwait	7.46	100.00	0.95	●
1	Luxembourg	48.39	100.00	0.95	●
1	Netherlands	23.13	100.00	0.95	●
1	Singapore	12.69	100.00	0.95	●
8	Switzerland	7.01	95.76	0.94	
9	Trinidad and Tobago	5.57	82.14	0.94	●
10	Chile	5.04	77.08	0.93	●
11	Togo	4.11	68.36	0.92	●
12	Malaysia	4.08	68.02	0.91	●
13	Canada	3.85	65.85	0.90	
14	Norway	3.66	64.04	0.90	
15	Brunei Darussalam	3.64	63.83	0.89	●
16	Azerbaijan	3.57	63.19	0.88	●
17	Spain	3.37	61.33	0.87	
18	Sweden	3.35	61.14	0.86	
19	Qatar	3.25	60.20	0.85	
20	Denmark	3.00	57.82	0.85	
21	Japan	2.94	57.23	0.84	
22	Germany	2.87	56.63	0.83	
23	Lebanon	2.80	55.94	0.82	●
24	Russian Federation	2.77	55.69	0.81	
25	Czech Republic	2.53	53.35	0.81	
26	United Arab Emirates	2.34	51.58	0.80	
27	Portugal	2.31	51.33	0.79	
28	Israel	2.12	49.52	0.78	
29	United States of America	2.09	49.23	0.77	
30	Korea, Rep.	2.05	48.89	0.77	
31	Iceland	2.04	48.79	0.76	
32	Estonia	1.93	47.76	0.75	
33	Philippines	1.89	47.31	0.74	●
34	South Africa	1.86	47.09	0.73	
35	Thailand	1.86	47.02	0.73	
36	Georgia	1.84	46.84	0.72	
37	Panama	1.82	46.66	0.71	
38	Austria	1.81	46.60	0.70	
39	Bahrain	1.53	43.95	0.69	
40	Colombia	1.50	43.61	0.69	
41	Latvia	1.33	42.04	0.68	
42	Mozambique	1.28	41.58	0.67	●
43	France	1.22	40.98	0.66	
44	Kyrgyzstan	1.22	40.97	0.65	
45	China	1.21	40.94	0.65	
46	Kazakhstan	1.21	40.87	0.64	
47	Croatia	1.19	40.72	0.63	
48	Indonesia	1.16	40.43	0.62	
49	Oman	1.09	39.80	0.61	
50	Costa Rica	1.09	39.79	0.60	
51	Niger	1.04	39.30	0.60	
52	Slovakia	0.99	38.83	0.59	
53	Mexico	0.89	37.90	0.58	
54	Italy	0.89	37.90	0.57	
55	Mauritius	0.85	37.52	0.56	
56	Serbia	0.82	37.19	0.56	
57	Brazil	0.81	37.17	0.55	
58	Lithuania	0.79	36.93	0.54	
59	Viet Nam	0.78	36.81	0.53	
60	Honduras	0.77	36.78	0.52	
61	Bulgaria	0.77	36.75	0.52	
62	Saudi Arabia	0.74	36.51	0.51	
63	Greece	0.69	36.03	0.50	
64	Turkey	0.68	35.88	0.49	
65	Botswana	0.62	35.33	0.48	
66	Albania	0.50	34.16	0.48	
67	Poland	0.50	34.16	0.47	
68	Morocco	0.49	34.08	0.46	
69	El Salvador	0.47	33.91	0.45	
70	Mongolia	0.44	33.63	0.44	
71	Burkina Faso	0.44	33.62	0.44	
72	Montenegro	0.44	33.61	0.43	
73	Slovenia	0.41	33.32	0.42	
74	Benin	0.38	33.05	0.41	
75	Moldova, Rep.	0.35	32.83	0.40	
76	India	0.34	32.71	0.40	
77	Zimbabwe	0.29	32.18	0.39	
78	Nigeria	0.27	32.07	0.38	
79	Bosnia and Herzegovina	0.27	32.04	0.37	
80	Cambodia	0.25	31.85	0.36	
81	Ukraine	0.23	31.64	0.35	
82	Romania	0.23	31.62	0.35	
83	Argentina	0.22	31.60	0.34	
84	Belarus	0.22	31.52	0.33	
85	Senegal	0.20	31.37	0.32	
86	Paraguay	0.19	31.31	0.31	
87	Uruguay	0.19	31.30	0.31	
88	Armenia	0.16	30.98	0.30	
89	Namibia	0.16	30.96	0.29	
90	Bangladesh	0.14	30.78	0.28	
91	Australia	0.12	30.64	0.27	○
92	Jordan	0.09	30.36	0.27	
93	Rwanda	0.09	30.32	0.26	
94	Egypt	0.08	30.24	0.25	
95	Sri Lanka	0.08	30.22	0.24	
96	Madagascar	0.07	30.17	0.23	
97	Ecuador	0.07	30.11	0.23	
98	Peru	0.06	30.05	0.22	
99	Tunisia	0.06	30.01	0.21	
100	Pakistan	0.05	29.95	0.20	
101	Iran, Islamic Rep.	0.03	29.73	0.19	
102	Yemen	0.02	29.67	0.19	
103	Côte d'Ivoire	0.02	29.64	0.18	
104	Mali	0.01	29.59	0.17	
105	Guinea	0.01	29.55	0.16	
106	Guatemala	0.01	29.54	0.15	
107	New Zealand	0.01	29.53	0.15	○
108	Burundi	0.00	29.51	0.14	
109	Bolivia, Plurinational St.	0.00	29.48	0.12	
109	Tanzania, United Rep.	0.00	29.48	0.12	
111	Kenya	–0.01	29.37	0.11	○
112	Algeria	–0.03	29.22	0.10	
113	Uganda	–0.03	29.19	0.10	
114	Hungary	–0.05	29.01	0.09	○
115	TFYR of Macedonia	–0.07	28.80	0.08	○
116	Malawi	–0.08	28.73	0.07	
117	Dominican Republic	–0.11	28.45	0.06	○
118	Jamaica	–0.20	27.63	0.06	○
119	Cameroon	–0.41	25.59	0.05	○
120	Finland	–0.99	20.14	0.04	○
121	Zambia	–1.16	18.54	0.03	○
122	United Kingdom	–1.51	15.23	0.02	○
123	Tajikistan	–1.87	11.81	0.02	○
124	Belgium	–3.12	0.00	0.00	○
124	Malta	–81.54	0.00	0.00	○
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	

SOURCE: International Monetary Fund, Balance of Payments database, supplemented by data from the United Nations Conference on Trade and Development and official national sources; extracted from the World Bank's *World Development Indicators* database

NOTE: ● indicates a strength; ○ a weakness

7.1.1 Trademark application class count by origin

Number of trademark applications issued to residents at a given national or regional office (per billion PPP$ GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Mongolia	194.51	100.00	0.99	●
1	Paraguay (2010)	296.27	100.00	0.99	●
3	Moldova, Rep.	149.83	76.91	0.98	●
4	China	134.99	69.24	0.97	●
5	Luxembourg	131.62	67.50	0.97	●
6	Jamaica	126.41	64.81	0.96	●
7	Turkey	122.04	62.55	0.95	●
8	Bulgaria	113.56	58.17	0.94	●
9	Slovenia (2010)	111.20	56.95	0.93	●
10	France	108.98	55.80	0.92	●
11	Armenia	107.42	55.00	0.91	●
12	Ukraine	106.83	54.69	0.90	●
13	Malta	104.63	53.55	0.90	
14	Korea, Rep.	103.32	52.88	0.89	
15	Portugal	95.36	48.77	0.88	●
16	New Zealand	93.90	48.01	0.87	
17	Iceland	87.72	44.81	0.86	
18	El Salvador	83.68	42.73	0.85	●
19	Estonia	82.92	42.34	0.84	
20	Viet Nam	81.73	41.72	0.83	●
21	Switzerland	79.82	40.73	0.83	
22	Costa Rica	79.76	40.70	0.82	●
23	Cyprus	75.36	38.43	0.81	
24	Latvia	72.77	37.09	0.80	
25	Australia	70.83	36.09	0.79	
26	Hong Kong (China)	69.53	35.42	0.78	
27	Chile	68.28	34.77	0.77	
28	Germany	66.92	34.06	0.77	
29	Czech Republic	66.17	33.68	0.76	
30	Slovakia	65.95	33.57	0.75	
31	Ecuador (2010)	63.94	32.53	0.74	●
32	Namibia	62.93	32.00	0.73	●
33	Netherlands	61.08	31.05	0.72	
34	Austria	61.06	31.04	0.71	
35	Japan	59.93	30.45	0.70	
36	Spain	59.20	30.08	0.70	
37	Argentina	59.05	30.00	0.69	
38	Madagascar	56.99	28.93	0.68	●
39	Panama	56.36	28.61	0.67	
40	Sweden	55.75	28.29	0.66	○
41	Georgia	53.67	27.22	0.65	
42	Romania	52.73	26.73	0.64	
43	United Kingdom	52.69	26.71	0.63	○
44	Finland	51.52	26.11	0.63	
45	Canada	51.11	25.90	0.62	
46	Peru	51.05	25.87	0.61	
47	Croatia	50.65	25.66	0.60	
48	Lithuania	50.63	25.65	0.59	
49	Uruguay	50.14	25.39	0.58	
50	Italy (2014)	49.87	25.25	0.57	
51	Honduras	49.65	25.14	0.57	●
52	Morocco	49.38	25.00	0.56	
53	Belgium	49.34	24.98	0.55	○
54	Dominican Republic	45.63	23.07	0.54	
55	Poland	45.03	22.75	0.53	
56	Russian Federation	43.41	21.92	0.52	
57	Brazil	40.86	20.60	0.51	
58	Mexico	40.66	20.50	0.50	
59	Mauritius	40.21	20.26	0.50	
60	Guatemala (2010)	39.25	19.77	0.49	
61	Denmark	36.59	18.39	0.48	○
62	Colombia	36.16	18.17	0.47	
63	Hungary	35.79	17.98	0.46	
64	Nepal	35.10	17.62	0.45	●
65	Bolivia, Plurinational St. (2014)	35.06	17.60	0.44	
66	Mozambique	34.69	17.41	0.43	●
67	Kenya	32.93	16.50	0.43	
68	Jordan	32.91	16.49	0.42	
69	Norway	32.04	16.04	0.41	○
70	Serbia	32.01	16.02	0.40	
71	India	31.33	15.67	0.39	
72	Thailand	30.03	15.00	0.38	
73	South Africa	29.68	14.82	0.37	
74	Philippines	28.22	14.07	0.37	
75	Sri Lanka	26.77	13.32	0.36	
76	Belarus	26.68	13.27	0.35	
77	Albania	26.52	13.19	0.34	
78	Pakistan	25.27	12.54	0.33	
79	Algeria	24.94	12.37	0.32	
80	Cambodia (2014)	23.52	11.64	0.31	
81	United States of America	21.52	10.60	0.30	○
82	Malawi	20.98	10.33	0.30	
83	Nigeria (2013)	19.84	9.74	0.29	
84	Malaysia	19.50	9.56	0.28	○
85	Singapore	17.90	8.73	0.27	○
86	Yemen	17.48	8.52	0.26	●
87	Trinidad and Tobago	17.34	8.45	0.25	
88	Bosnia and Herzegovina	16.91	8.22	0.24	
89	Kyrgyzstan	16.81	8.17	0.23	
90	Kazakhstan (2013)	16.70	8.11	0.23	
91	Azerbaijan	16.50	8.01	0.22	
92	Bangladesh	16.07	7.79	0.21	
93	Lebanon	15.06	7.26	0.20	
94	Guinea	13.80	6.62	0.19	
95	Indonesia	13.22	6.32	0.18	
96	Uganda	13.10	6.25	0.17	
97	Israel	13.00	6.20	0.17	○
98	Rwanda	12.03	5.70	0.16	
99	Egypt	11.73	5.55	0.15	
100	Senegal	11.48	5.42	0.14	
101	United Arab Emirates (2014)	11.41	5.38	0.13	○
102	Botswana (2014)	10.36	4.84	0.12	○
103	Zimbabwe	10.16	4.74	0.11	
104	Côte d'Ivoire	9.47	4.38	0.10	
105	Tajikistan	9.15	4.21	0.10	
106	Zambia (2014)	8.79	4.02	0.09	
107	Togo	8.73	4.00	0.08	
108	Benin	7.50	3.36	0.07	
109	Cameroon	7.26	3.23	0.06	○
110	Bahrain	5.92	2.54	0.05	○
111	Mali	5.43	2.29	0.04	
112	Qatar (2014)	4.58	1.85	0.03	○
113	Saudi Arabia	4.40	1.76	0.03	○
114	Burkina Faso	3.17	1.12	0.02	○
115	Brunei Darussalam (2012)	2.55	0.80	0.01	○
116	Niger	1.00	0.00	0.00	○
n/a	Burundi	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Greece	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Ireland	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	TFYR of Macedonia	n/a	n/a	n/a	
n/a	Tunisia	n/a	n/a	n/a	

SOURCE: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)

NOTE: ● indicates a strength; ○ a weakness

7.1.2 Industrial designs by origin

Number of designs contained in industrial design applications filed at a given national or regional office (per billion PPP$ GDP) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	China	28.00	100.00	0.96	●
1	Italy (2014)	18.51	100.00	0.96	●
1	Korea, Rep.	35.56	100.00	0.96	●
1	Moldova, Rep.	67.28	100.00	0.96	●
1	Turkey	24.26	100.00	0.96	●
6	Germany	16.48	89.00	0.96	●
7	Luxembourg	13.82	74.60	0.95	
8	Morocco	13.60	73.44	0.94	●
9	Malta (2014)	12.97	70.00	0.93	
10	Spain	12.79	69.04	0.92	●
11	Ukraine	12.61	68.06	0.91	●
12	Bulgaria	10.84	58.47	0.90	●
13	Switzerland	10.06	54.25	0.89	
14	Portugal	9.66	52.10	0.88	●
15	Austria	7.91	42.62	0.88	
16	Denmark	7.61	41.01	0.87	
17	France	7.46	40.21	0.86	
18	Mongolia (2014)	7.35	39.62	0.85	●
19	Iran, Islamic Rep. (2014)	6.46	34.77	0.84	●
20	Madagascar	5.77	31.05	0.83	●
21	Croatia	5.53	29.77	0.82	●
22	Cyprus	5.41	29.10	0.81	
23	Finland	5.33	28.68	0.80	
24	Japan	5.12	27.57	0.79	
25	Czech Republic	5.12	27.53	0.79	
26	Sweden	5.03	27.03	0.78	
27	Georgia	4.90	26.38	0.77	
28	Guinea	4.64	24.97	0.76	●
29	Estonia	4.25	22.85	0.75	
30	Greece	4.21	22.63	0.74	
31	Latvia	3.90	20.95	0.73	
32	Israel	3.68	19.74	0.72	
33	Viet Nam	3.32	17.82	0.71	
34	Hungary	3.26	17.49	0.71	
35	Hong Kong (China)	3.21	17.21	0.70	
36	Netherlands	3.13	16.76	0.69	
37	Thailand	3.05	16.32	0.68	
38	Belgium	2.91	15.57	0.67	
39	Jamaica	2.63	14.09	0.66	
40	Romania	2.52	13.47	0.65	
41	Australia	2.47	13.22	0.64	
42	Bangladesh	2.21	11.82	0.63	●
43	Slovakia	2.09	11.14	0.63	
44	New Zealand	2.05	10.95	0.62	
45	Lithuania	1.95	10.39	0.61	
46	Sri Lanka	1.74	9.28	0.60	
47	Norway	1.72	9.16	0.59	
48	Singapore	1.68	8.93	0.58	○
49	TFYR of Macedonia	1.65	8.77	0.57	
50	Côte d'Ivoire	1.64	8.74	0.56	●
51	Egypt	1.55	8.21	0.55	
52	Algeria (2014)	1.49	7.91	0.54	●
53	Ireland	1.32	7.01	0.54	○
54	United States of America	1.25	6.63	0.53	
55	Serbia	1.25	6.60	0.52	
56	Armenia	1.22	6.44	0.51	
57	Belarus	1.20	6.33	0.50	
58	Argentina	1.15	6.06	0.49	
59	Iceland	1.05	5.54	0.48	
60	Kyrgyzstan	1.04	5.44	0.47	
61	Brazil	1.03	5.40	0.46	
62	Tunisia	1.01	5.33	0.46	
63	South Africa	1.00	5.23	0.45	
64	Indonesia	0.93	4.88	0.44	
65	Mozambique	0.90	4.71	0.43	
66	India	0.85	4.46	0.42	
67	Nigeria (2013)	0.85	4.44	0.41	
68	Montenegro	0.80	4.18	0.40	
69	Mexico	0.78	4.03	0.39	
70	Malaysia	0.77	3.99	0.38	
71	Philippines	0.72	3.76	0.38	
72	Russian Federation	0.70	3.64	0.37	
73	Jordan	0.66	3.43	0.36	
74	Senegal	0.63	3.22	0.35	
75	Bosnia and Herzegovina	0.59	3.03	0.34	
76	Colombia	0.54	2.74	0.33	
77	Mali	0.53	2.72	0.32	
78	Kenya	0.51	2.62	0.31	
79	Canada	0.49	2.48	0.30	○
80	Zambia (2014)	0.48	2.45	0.29	
81	Mauritius (2013)	0.45	2.26	0.29	
82	Albania (2014)	0.45	2.25	0.28	
83	Trinidad and Tobago	0.41	2.04	0.27	
84	Pakistan	0.39	1.95	0.26	
85	Bolivia, Plurinational St. (2014)	0.37	1.84	0.25	
86	Togo	0.37	1.83	0.24	
87	Cameroon	0.36	1.77	0.23	
88	Benin	0.35	1.73	0.22	
89	Botswana (2014)	0.35	1.71	0.21	
90	Peru	0.34	1.66	0.21	
91	Dominican Republic	0.32	1.57	0.20	
92	Rwanda	0.24	1.16	0.19	
93	Nepal	0.23	1.07	0.18	
94	Panama	0.22	1.02	0.17	
95	El Salvador	0.21	0.97	0.16	
96	Kazakhstan	0.21	0.95	0.15	
97	Saudi Arabia	0.19	0.87	0.14	○
98	Honduras	0.17	0.76	0.13	
99	Cambodia	0.17	0.73	0.13	
100	Burkina Faso	0.16	0.71	0.12	
101	Guatemala	0.16	0.70	0.11	
102	United Arab Emirates (2014)	0.15	0.64	0.10	○
103	Costa Rica	0.13	0.56	0.09	○
104	Brunei Darussalam (2014)	0.12	0.49	0.08	○
105	Uruguay	0.11	0.43	0.07	○
106	Chile	0.10	0.39	0.06	○
107	Azerbaijan	0.06	0.19	0.05	○
108	Niger (2014)	0.06	0.14	0.04	
109	Yemen	0.05	0.12	0.04	
110	Tajikistan (2013)	0.05	0.10	0.03	○
111	Bahrain	0.05	0.09	0.02	○
112	Namibia	0.04	0.05	0.01	○
113	Oman	0.03	0.00	0.00	○
n/a	Burundi	n/a	n/a	n/a	
n/a	Ecuador	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Lebanon	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Poland	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Slovenia	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	
n/a	United Kingdom	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: World Intellectual Property Organization, *Intellectual Property Statistics*; International Monetary Fund, *World Economic Outlook Database*, October 2016 (PPP$ GDP)
NOTE: ● indicates a strength; ○ a weakness

7.1.3 ICTs and business model creation

Average answer to the question: In your country, to what extent do ICTs enable new business models? [1 = not at all; 7 = to a great extent] | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United Kingdom	6.03	83.79	1.00	●
2	Switzerland	6.00	83.28	0.99	●
3	Netherlands	5.99	83.17	0.98	●
4	Finland	5.98	83.07	0.98	●
5	Sweden	5.98	83.03	0.97	
6	Luxembourg	5.96	82.72	0.96	
7	Singapore	5.89	81.47	0.95	
8	Israel	5.85	80.87	0.94	
9	Ireland	5.83	80.44	0.93	
10	United Arab Emirates	5.79	79.92	0.93	●
11	Qatar	5.77	79.45	0.92	●
12	United States of America	5.75	79.20	0.91	
13	Norway	5.75	79.14	0.90	
14	Iceland	5.72	78.62	0.89	
15	Germany	5.64	77.31	0.89	
16	Portugal	5.61	76.79	0.88	●
17	France	5.60	76.73	0.87	
18	Korea, Rep.	5.60	76.68	0.86	
19	Belgium	5.59	76.42	0.85	
20	Malaysia	5.57	76.19	0.84	
21	New Zealand	5.57	76.10	0.84	
22	Estonia	5.55	75.91	0.83	
23	Canada	5.55	75.79	0.82	
24	Denmark	5.52	75.31	0.81	
25	Spain	5.42	73.68	0.80	
26	Austria	5.37	72.86	0.80	
27	Panama	5.31	71.78	0.79	●
28	Chile	5.29	71.49	0.78	
29	Japan	5.28	71.34	0.77	
30	Lithuania	5.25	70.89	0.76	
31	Hong Kong (China)	5.24	70.69	0.75	
32	Malta	5.19	69.90	0.75	
33	Saudi Arabia	5.13	68.83	0.74	
34	Czech Republic	5.12	68.66	0.73	
35	Australia	5.11	68.54	0.72	
36	Rwanda	5.08	68.02	0.71	●
37	Kenya	5.07	67.80	0.70	
38	Uruguay	5.06	67.59	0.70	
39	Thailand	5.03	67.11	0.69	
40	Slovakia	5.02	67.06	0.68	
41	Costa Rica	5.02	66.95	0.67	
42	Bahrain	5.01	66.84	0.66	
43	Mexico	4.99	66.57	0.66	
44	Dominican Republic	4.93	65.56	0.65	●
45	South Africa	4.93	65.46	0.64	
46	China	4.92	65.36	0.63	
47	Guatemala	4.91	65.25	0.62	●
48	Jordan	4.87	64.58	0.61	
49	Hungary	4.83	63.79	0.61	
50	Azerbaijan	4.83	63.78	0.60	
51	Turkey	4.79	63.16	0.59	
52	Indonesia	4.77	62.91	0.58	
53	Morocco	4.74	62.30	0.57	
54	Slovenia	4.73	62.11	0.57	
55	Jamaica	4.72	62.05	0.56	
56	Bulgaria	4.72	62.02	0.55	
57	Italy	4.70	61.65	0.54	
58	Colombia	4.69	61.50	0.53	
59	Poland	4.66	61.00	0.52	
60	Philippines	4.65	60.88	0.52	
61	Cambodia	4.64	60.73	0.51	
62	Sri Lanka	4.64	60.62	0.50	
63	Latvia	4.63	60.45	0.49	
64	Mauritius	4.60	59.96	0.48	
65	Peru	4.59	59.79	0.48	
66	Senegal	4.58	59.71	0.47	
67	Honduras	4.57	59.44	0.46	
68	Armenia	4.54	59.00	0.45	
69	Tunisia	4.53	58.86	0.44	
70	Iran, Islamic Rep.	4.53	58.78	0.43	
71	Brazil	4.49	58.19	0.43	
72	Namibia	4.48	58.02	0.42	
73	TFYR of Macedonia	4.48	57.93	0.41	
74	Croatia	4.47	57.76	0.40	
75	Nigeria	4.45	57.47	0.39	
76	Ecuador	4.44	57.37	0.39	
77	Romania	4.43	57.15	0.38	
78	Viet Nam	4.42	57.05	0.37	
79	Montenegro	4.40	56.71	0.36	
80	India	4.39	56.57	0.35	
81	Côte d'Ivoire	4.38	56.27	0.34	
82	Mongolia	4.35	55.82	0.34	
83	Oman	4.32	55.30	0.33	
84	Uganda	4.28	54.69	0.32	
85	Kazakhstan	4.26	54.39	0.31	
86	Cyprus	4.26	54.29	0.30	
87	Greece	4.25	54.17	0.30	
88	Madagascar	4.20	53.37	0.29	
89	Kuwait	4.20	53.36	0.28	
90	Trinidad and Tobago	4.19	53.15	0.27	
91	Russian Federation	4.16	52.67	0.26	
92	Botswana	4.15	52.51	0.25	
93	Brunei Darussalam	4.11	51.85	0.25	
94	Tanzania, United Rep.	4.11	51.84	0.24	
95	Cameroon	4.08	51.35	0.23	
96	Pakistan	4.08	51.27	0.22	
97	Egypt	4.02	50.30	0.21	
98	Benin	4.01	50.14	0.20	
99	Georgia	4.00	50.00	0.20	
100	Paraguay	4.00	49.93	0.19	
101	Serbia	3.98	49.65	0.18	○
102	Albania	3.97	49.58	0.17	
103	Bangladesh	3.97	49.55	0.16	
104	Moldova, Rep.	3.97	49.46	0.16	○
105	Mozambique	3.96	49.30	0.15	
106	El Salvador	3.94	49.07	0.14	
107	Mali	3.93	48.77	0.13	
108	Zambia	3.92	48.61	0.12	
109	Lebanon	3.91	48.48	0.11	○
110	Bolivia, Plurinational St.	3.85	47.44	0.11	
111	Tajikistan	3.84	47.29	0.10	
112	Ukraine	3.82	46.97	0.09	○
113	Zimbabwe	3.80	46.60	0.08	
114	Argentina	3.79	46.57	0.07	○
115	Algeria	3.71	45.23	0.07	
116	Bosnia and Herzegovina	3.68	44.73	0.06	○
117	Ethiopia	3.66	44.36	0.05	
118	Kyrgyzstan	3.47	41.12	0.04	○
119	Nepal	3.47	41.09	0.03	○
120	Malawi	3.36	39.41	0.02	○
121	Guinea (2015)	3.15	35.86	0.02	○
122	Burundi	2.91	31.90	0.01	○
123	Yemen	2.79	29.90	0.00	○
n/a	Belarus	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	

SOURCE: World Economic Forum, *Executive Opinion Survey 2016–2017*
NOTE: ● indicates a strength; ○ a weakness

7.1.4 ICTs and organizational model creation

Average answer to the question: In your country, to what extent do ICTs enable new organizational models (e.g., virtual teams, remote working, telecommuting) within companies? [1 = not at all; 7 = to a great extent] | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United States of America	5.94	82.31	1.00	●
2	United Kingdom	5.88	81.30	0.99	●
3	Norway	5.84	80.65	0.98	●
4	Sweden	5.83	80.50	0.98	●
5	Estonia	5.80	79.94	0.97	●
6	Netherlands	5.75	79.18	0.96	
7	Finland	5.71	78.47	0.95	
8	Iceland	5.67	77.84	0.94	
9	Singapore	5.60	76.69	0.93	
10	Switzerland	5.57	76.23	0.93	
11	Israel	5.53	75.53	0.92	
12	Canada	5.49	74.78	0.91	
13	United Arab Emirates	5.47	74.45	0.90	●
14	Luxembourg	5.45	74.21	0.89	
15	Denmark	5.45	74.12	0.89	
16	Qatar	5.45	74.10	0.88	●
17	Germany	5.44	73.97	0.87	
18	Malaysia	5.42	73.74	0.86	
19	Ireland	5.33	72.23	0.85	
20	France	5.28	71.35	0.84	
21	Hong Kong (China)	5.27	71.20	0.84	
22	Belgium	5.22	70.36	0.83	
23	New Zealand	5.15	69.11	0.82	
24	Lithuania	5.14	68.94	0.81	
25	Austria	5.02	67.07	0.80	
26	Korea, Rep.	5.01	66.84	0.80	
27	Japan	4.98	66.34	0.79	
28	Australia	4.89	64.80	0.78	
29	China	4.86	64.40	0.77	
30	Czech Republic	4.82	63.65	0.76	
31	Slovakia	4.76	62.72	0.75	
32	Portugal	4.76	62.64	0.75	
33	Costa Rica	4.74	62.31	0.74	
34	Panama	4.72	62.07	0.73	
35	India	4.71	61.88	0.72	
36	Malta	4.67	61.23	0.71	
37	Azerbaijan	4.65	60.80	0.70	●
38	Indonesia	4.59	59.75	0.70	●
39	Spain	4.56	59.35	0.69	
40	Guatemala	4.55	59.21	0.68	●
41	South Africa	4.54	59.03	0.67	
42	Slovenia	4.54	58.94	0.66	
43	Thailand	4.53	58.87	0.66	
44	Bulgaria	4.51	58.57	0.65	
45	Bahrain	4.49	58.22	0.64	
46	Kenya	4.45	57.47	0.63	
47	Colombia	4.43	57.18	0.62	
48	Uruguay	4.42	56.98	0.61	
49	Mexico	4.42	56.96	0.61	
50	Latvia	4.40	56.59	0.60	
51	Saudi Arabia	4.39	56.49	0.59	
52	Cambodia	4.34	55.59	0.58	●
53	Dominican Republic	4.33	55.57	0.57	●
54	Chile	4.33	55.45	0.57	
55	Russian Federation	4.31	55.13	0.56	
56	Honduras	4.30	54.94	0.55	●
57	Philippines	4.29	54.82	0.54	
58	Armenia	4.28	54.60	0.53	
59	Hungary	4.27	54.48	0.52	
60	Croatia	4.26	54.29	0.52	
61	Viet Nam	4.25	54.16	0.51	
62	Poland	4.24	54.00	0.50	
63	Sri Lanka	4.22	53.61	0.49	
64	Jordan	4.20	53.25	0.48	
65	Senegal	4.18	52.96	0.48	
66	Ukraine	4.13	52.25	0.47	
67	Ecuador	4.13	52.16	0.46	
68	Rwanda	4.10	51.67	0.45	
69	Brazil	4.08	51.33	0.44	
70	TFYR of Macedonia	4.07	51.23	0.43	
71	Mauritius	4.05	50.91	0.43	
72	Côte d'Ivoire	4.05	50.81	0.42	●
73	Turkey	4.05	50.75	0.41	
74	Jamaica	4.04	50.71	0.40	
75	Italy	4.03	50.47	0.39	○
76	Namibia	4.01	50.13	0.39	
77	Kazakhstan	3.95	49.24	0.38	
78	Morocco	3.93	48.84	0.37	
79	Romania	3.92	48.71	0.36	
80	Argentina	3.91	48.50	0.35	
81	Brunei Darussalam	3.86	47.69	0.34	
82	Madagascar	3.86	47.65	0.34	
83	Oman	3.82	47.04	0.33	
84	Peru	3.82	46.97	0.32	
85	Kuwait	3.82	46.96	0.31	
86	Cyprus	3.80	46.64	0.30	
87	Benin	3.74	45.74	0.30	
88	Egypt	3.74	45.68	0.29	
89	Trinidad and Tobago	3.74	45.59	0.28	
90	Montenegro	3.73	45.50	0.27	○
91	Nigeria	3.71	45.21	0.26	
92	Moldova, Rep.	3.70	45.06	0.25	
93	Tanzania, United Rep.	3.68	44.69	0.25	
94	Greece	3.68	44.68	0.24	○
95	El Salvador	3.67	44.54	0.23	
96	Ethiopia	3.65	44.22	0.22	
97	Zambia	3.64	44.01	0.21	
98	Cameroon	3.62	43.74	0.20	
99	Tunisia	3.62	43.73	0.20	
100	Iran, Islamic Rep.	3.61	43.44	0.19	
101	Uganda	3.61	43.43	0.18	
102	Tajikistan	3.53	42.14	0.17	
103	Serbia	3.52	42.07	0.16	○
104	Bangladesh	3.52	42.03	0.16	
105	Lebanon	3.48	41.36	0.15	○
106	Botswana	3.48	41.34	0.14	
107	Georgia	3.48	41.34	0.13	○
108	Mongolia	3.47	41.23	0.12	
109	Mali	3.34	38.93	0.11	
110	Bosnia and Herzegovina	3.30	38.41	0.11	○
111	Kyrgyzstan	3.28	37.97	0.10	
112	Pakistan	3.28	37.96	0.09	
113	Mozambique	3.22	36.97	0.08	
114	Paraguay	3.17	36.20	0.07	
115	Bolivia, Plurinational St.	3.17	36.11	0.07	
116	Nepal	3.04	34.03	0.06	○
117	Zimbabwe	2.99	33.20	0.05	
118	Albania	2.96	32.61	0.04	○
119	Malawi	2.83	30.51	0.03	
120	Algeria	2.77	29.55	0.02	
121	Guinea (2015)	2.71	28.57	0.02	○
122	Burundi	2.59	26.47	0.01	○
123	Yemen	2.54	25.68	0.00	○
n/a	Belarus	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	

SOURCE: World Economic Forum, *Executive Opinion Survey 2016–2017*
NOTE: ● indicates a strength; ○ a weakness

7.2.1 Cultural and creative services exports

Cultural and creative services exports (% of total trade) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Costa Rica	10.05	100.00	0.98	●
1	Luxembourg (2014)	5.02	100.00	0.98	●
1	United States of America (2014)	1.98	100.00	0.98	●
4	Belgium (2014)	1.65	83.11	0.97	●
5	Romania (2014)	1.56	78.88	0.96	●
6	Croatia (2014)	1.55	77.97	0.95	●
7	Estonia (2014)	1.51	76.37	0.93	●
8	Israel (2014)	1.26	63.52	0.92	
9	Latvia (2014)	1.21	60.82	0.91	●
10	France (2014)	1.17	58.83	0.90	
11	Benin	1.15	58.16	0.89	●
12	Austria (2014)	1.10	55.47	0.88	
13	Bulgaria (2014)	1.10	55.26	0.87	●
14	Netherlands (2014)	1.07	54.04	0.86	
15	United Kingdom	1.03	52.16	0.85	
16	Poland (2014)	1.00	50.45	0.84	●
17	Russian Federation (2014)	0.94	47.51	0.82	
18	Slovenia (2014)	0.89	44.76	0.81	
19	Sweden (2014)	0.88	44.46	0.80	
20	Niger (2014)	0.74	37.24	0.79	●
21	Denmark (2014)	0.68	34.08	0.78	
22	Germany (2014)	0.66	33.33	0.77	
23	Canada (2014)	0.65	33.00	0.76	
24	Greece (2014)	0.64	32.36	0.75	
25	Hungary (2014)	0.62	31.16	0.74	
26	Portugal (2014)	0.60	30.52	0.73	
27	Czech Republic (2014)	0.50	25.46	0.71	
28	Cyprus (2014)	0.49	24.83	0.70	
29	Lithuania (2014)	0.44	22.45	0.69	
30	Guinea (2014)	0.40	20.41	0.68	●
31	Argentina	0.39	19.61	0.67	
32	Moldova, Rep.	0.38	19.38	0.66	
33	Burundi (2014)	0.34	17.08	0.65	●
34	Slovakia (2014)	0.33	16.64	0.64	
35	Armenia	0.33	16.60	0.63	
36	Iceland	0.33	16.56	0.62	
37	Ecuador	0.33	16.48	0.60	●
38	Australia (2014)	0.32	16.02	0.59	
39	Finland (2013)	0.31	15.77	0.58	
40	Burkina Faso	0.30	14.94	0.57	●
41	Italy (2014)	0.29	14.76	0.56	
42	Korea, Rep. (2014)	0.29	14.75	0.55	
43	TFYR of Macedonia	0.25	12.54	0.54	
44	Lebanon	0.25	12.43	0.53	
45	Serbia	0.23	11.48	0.52	
46	Ireland (2014)	0.21	10.74	0.51	○
47	Senegal	0.21	10.51	0.49	
48	South Africa	0.16	7.94	0.48	
49	Hong Kong (China) (2014)	0.15	7.71	0.47	
50	Panama	0.15	7.56	0.46	
51	Colombia (2014)	0.13	6.62	0.45	
52	India	0.13	6.37	0.44	
53	Ukraine	0.12	5.89	0.43	
54	Peru	0.10	5.04	0.42	
55	Japan	0.09	4.58	0.41	○
56	Brazil	0.09	4.53	0.40	
57	Montenegro	0.09	4.47	0.38	
58	Morocco	0.08	4.09	0.37	
59	Georgia	0.08	4.09	0.36	
60	Jamaica	0.07	3.70	0.35	
61	Bolivia, Plurinational St.	0.06	3.19	0.34	
62	Norway	0.06	2.97	0.33	○
63	Philippines	0.06	2.94	0.32	
64	Cameroon (2013)	0.06	2.92	0.31	
65	Albania	0.05	2.42	0.30	
66	Azerbaijan	0.05	2.29	0.29	
67	Belarus	0.05	2.29	0.27	
68	Malawi	0.04	2.03	0.26	
69	Mauritius	0.04	2.01	0.25	
70	China	0.03	1.66	0.24	
71	Mozambique (2014)	0.03	1.55	0.23	
72	Côte d'Ivoire	0.03	1.33	0.22	
73	Madagascar	0.03	1.29	0.21	
74	Mali	0.02	1.23	0.20	
75	Mexico	0.02	1.05	0.19	○
76	Guatemala	0.02	0.93	0.18	
77	Kazakhstan	0.01	0.74	0.16	
78	Pakistan (2012)	0.01	0.54	0.15	
79	Turkey	0.01	0.32	0.14	○
80	Uganda	0.01	0.26	0.13	
81	Bosnia and Herzegovina	0.00	0.26	0.12	○
82	Paraguay	0.00	0.20	0.11	
83	Bangladesh	0.00	0.17	0.10	
84	Algeria	0.00	0.16	0.09	
85	Togo (2014)	0.00	0.15	0.08	
86	Ethiopia	0.00	0.10	0.07	
87	Rwanda (2014)	0.00	0.03	0.05	○
88	Kenya (2014)	0.00	0.01	0.04	○
89	El Salvador (2013)	0.00	0.01	0.03	○
90	Malta (2013)	0.00	0.01	0.02	○
91	Mongolia (2007)	0.00	0.01	0.01	○
92	Honduras (2014)	0.00	0.00	0.00	○
n/a	Bahrain	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Chile	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	Egypt	n/a	n/a	n/a	
n/a	Indonesia	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Kyrgyzstan	n/a	n/a	n/a	
n/a	Malaysia	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	New Zealand	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Oman	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Singapore	n/a	n/a	n/a	
n/a	Spain	n/a	n/a	n/a	
n/a	Sri Lanka	n/a	n/a	n/a	
n/a	Switzerland	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Thailand	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Tunisia	n/a	n/a	n/a	
n/a	United Arab Emirates	n/a	n/a	n/a	
n/a	Uruguay	n/a	n/a	n/a	
n/a	Viet Nam	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: World Trade Organization, *Trade in Commercial Services* database, based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments Manual* and *Balance of Payments* database; Bureau of Economic Analysis (BEA) released October 2016

NOTE: ● indicates a strength; ○ a weakness

7.2.2 National feature films produced

Number of national feature films produced (per million population 15–69 years old) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Estonia	27.16	100.00	0.98	●
1	Iceland	55.95	100.00	0.98	●
1	Luxembourg (2011)	42.41	100.00	0.98	●
4	Malta	22.84	84.10	0.97	●
5	Mongolia	20.02	73.72	0.96	●
6	Denmark	17.68	65.10	0.95	
7	Switzerland	16.94	62.38	0.94	
8	Armenia	16.58	61.03	0.93	●
9	Slovenia	13.40	49.35	0.92	●
10	Montenegro	13.29	48.92	0.91	●
11	Latvia	12.23	45.04	0.90	●
12	Finland	11.58	42.65	0.89	
13	Nigeria (2011)	11.16	41.09	0.88	●
14	Hong Kong (China)	10.40	38.28	0.88	
15	Ireland	10.11	37.22	0.87	
16	Mauritius	9.42	34.68	0.86	●
17	New Zealand	8.83	32.51	0.85	
18	Belgium	8.69	31.99	0.84	
19	Spain	7.74	28.50	0.83	
20	Sweden	7.38	27.16	0.82	
21	Azerbaijan	7.36	27.11	0.81	●
22	Czech Republic	7.24	26.68	0.80	
23	Netherlands	7.19	26.48	0.79	
24	Korea, Rep.	6.94	25.55	0.78	
25	France	6.82	25.12	0.77	
26	Japan	6.72	24.76	0.76	
27	United Kingdom	6.57	24.18	0.75	
28	Austria	6.50	23.91	0.74	
29	TFYR of Macedonia	6.41	23.61	0.73	
30	Slovakia	6.32	23.25	0.72	
31	Argentina	6.22	22.91	0.71	
32	Norway	6.18	22.74	0.70	
33	Israel	6.13	22.55	0.69	
34	Hungary	5.69	20.96	0.68	
35	Georgia	5.53	20.36	0.67	
36	Greece	5.48	20.17	0.66	
37	Serbia	5.43	19.99	0.65	
38	Singapore	4.84	17.83	0.64	
39	Bulgaria	4.82	17.75	0.63	
40	Bosnia and Herzegovina	4.80	17.68	0.63	
41	Uruguay	4.70	17.30	0.62	
42	Togo	4.62	17.03	0.61	●
43	Cyprus	4.58	16.88	0.60	
44	Croatia	4.58	16.87	0.59	
45	Italy	4.42	16.28	0.58	
46	Lithuania	4.39	16.17	0.57	
47	Portugal	4.22	15.55	0.56	
48	Costa Rica	4.04	14.89	0.55	
49	Germany	3.95	14.53	0.54	
50	Canada	3.91	14.40	0.53	
51	Malaysia	3.66	13.46	0.52	
52	Lebanon	3.63	13.37	0.51	
53	United States of America	3.45	12.70	0.50	
54	Albania	3.30	12.17	0.49	
55	Cambodia	3.11	11.46	0.48	
56	Chile	2.92	10.76	0.47	
57	Madagascar	2.62	9.66	0.46	
58	Turkey	2.51	9.24	0.45	
59	India	2.15	7.90	0.44	
60	Ecuador	2.14	7.89	0.43	
61	Australia	1.93	7.12	0.42	○
62	Romania	1.83	6.75	0.41	
63	Cameroon (2009)	1.83	6.74	0.40	●
64	Tajikistan (2013)	1.77	6.51	0.39	
65	Mozambique	1.70	6.24	0.38	
66	Colombia	1.63	5.99	0.38	
67	Mexico	1.62	5.96	0.37	
68	Iran, Islamic Rep.	1.47	5.40	0.36	
69	Poland	1.45	5.35	0.35	○
70	Peru	1.41	5.20	0.34	
71	United Arab Emirates	1.40	5.17	0.33	
72	Tunisia	1.37	5.03	0.32	
73	Kazakhstan	1.32	4.87	0.31	
74	Paraguay (2009)	1.29	4.74	0.30	
75	Guatemala (2010)	1.17	4.31	0.29	
76	Russian Federation	1.14	4.20	0.28	
77	Sri Lanka (2013)	1.04	3.84	0.27	
78	Thailand (2010)	0.98	3.61	0.26	
79	Dominican Republic (2009)	0.96	3.52	0.25	
80	Honduras	0.95	3.50	0.24	
81	Bolivia, Plurinational St.	0.89	3.26	0.23	
82	Brazil	0.86	3.17	0.22	○
83	Philippines (2013)	0.84	3.08	0.21	
84	Guinea (2010)	0.83	3.04	0.20	
85	Morocco	0.76	2.81	0.19	
86	Niger (2011)	0.73	2.69	0.18	
87	Bangladesh (2009)	0.66	2.43	0.17	
88	China	0.65	2.39	0.16	○
89	South Africa	0.60	2.20	0.15	○
90	Egypt	0.58	2.14	0.14	
91	Kyrgyzstan (2013)	0.53	1.93	0.13	
92	Burkina Faso	0.52	1.92	0.13	
93	Indonesia (2012)	0.51	1.86	0.12	
94	Panama (2010)	0.41	1.52	0.11	
95	Senegal	0.36	1.34	0.10	
96	Moldova, Rep.	0.32	1.17	0.09	○
97	El Salvador (2008)	0.26	0.96	0.08	
98	Viet Nam (2009)	0.19	0.71	0.07	○
99	Burundi	0.17	0.61	0.06	
100	Belarus (2011)	0.14	0.52	0.05	○
101	Mali (2011)	0.12	0.46	0.04	○
102	Ukraine	0.09	0.33	0.03	○
103	Pakistan	0.01	0.03	0.02	○
104	Bahrain (2013)	0.00	0.00	0.00	○
104	Oman (2009)	0.00	0.00	0.00	○
n/a	Algeria	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Jordan	n/a	n/a	n/a	
n/a	Kenya	n/a	n/a	n/a	
n/a	Kuwait	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Qatar	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Saudi Arabia	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	
n/a	Yemen	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: UNESCO Institute for Statistics, *UIS online database*; United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2015 Revision*

NOTE: ● indicates a strength; ○ a weakness

7.2.3 Global entertainment and media market

Global entertainment and media market (per thousand population 15–69 years old) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Norway	2.87	100.00	1.00	●
2	Switzerland	2.83	98.69	0.98	●
3	United States of America	2.78	97.10	0.97	●
4	Denmark	2.18	75.97	0.95	
5	United Kingdom	2.06	71.62	0.94	
6	Sweden	2.05	71.47	0.92	
7	Austria	1.88	65.32	0.90	
8	Australia	1.84	63.93	0.89	
9	Finland	1.80	62.57	0.87	
10	Japan	1.78	61.79	0.85	
11	Germany	1.67	57.82	0.84	
12	New Zealand	1.64	56.78	0.82	
13	Hong Kong (China)	1.62	56.17	0.81	
14	Canada	1.60	55.57	0.79	
15	France	1.53	53.11	0.77	
16	Belgium	1.52	52.84	0.76	
17	Netherlands	1.45	50.35	0.74	
18	Ireland	1.42	49.29	0.73	
19	Korea, Rep.	1.36	47.05	0.71	
20	Singapore	1.22	42.16	0.69	
21	Israel	1.04	35.90	0.68	
22	Portugal	0.94	32.24	0.66	
23	Italy	0.82	28.07	0.65	
24	Spain	0.76	25.99	0.63	
25	Qatar	0.76	25.94	0.61	
26	Czech Republic	0.60	20.30	0.60	
27	Greece	0.55	18.57	0.58	
28	United Arab Emirates	0.49	16.46	0.56	
29	Argentina	0.40	13.41	0.55	
30	Hungary	0.38	12.62	0.53	
31	Saudi Arabia	0.34	11.31	0.52	
32	Malaysia	0.34	11.19	0.50	
33	Chile	0.34	11.17	0.48	
34	Poland	0.33	11.05	0.47	
35	Kuwait	0.33	10.71	0.45	
36	Malta	0.27	8.79	0.44	
37	South Africa	0.26	8.58	0.42	
38	Mexico	0.26	8.27	0.40	
39	Bahrain	0.25	8.04	0.39	
40	Brazil	0.25	7.89	0.37	
41	Turkey	0.22	6.95	0.35	
42	Peru	0.19	5.94	0.34	
43	Thailand	0.18	5.52	0.32	
44	China	0.16	5.02	0.31	
45	Romania	0.16	4.89	0.29	
46	Oman	0.16	4.76	0.27	
47	Colombia	0.16	4.73	0.26	
48	Russian Federation	0.15	4.59	0.24	○
49	Lebanon	0.10	2.96	0.23	
50	Kenya	0.09	2.34	0.21	
51	Philippines	0.09	2.33	0.19	
52	Indonesia	0.07	1.80	0.18	
53	Jordan	0.07	1.66	0.16	○
54	Iran, Islamic Rep.	0.06	1.29	0.15	
55	Algeria	0.05	1.14	0.13	
56	Egypt	0.05	1.01	0.11	
57	Viet Nam	0.05	0.91	0.10	○
58	Tunisia	0.05	0.90	0.08	○
59	Nigeria	0.04	0.81	0.06	
60	Morocco	0.04	0.55	0.05	○
61	India	0.03	0.30	0.03	○
62	Pakistan	0.03	0.20	0.02	○
63	Yemen	0.02	0.00	0.00	○
n/a	Albania	n/a	n/a	n/a	

Rank	Country/Economy	Value	Score (0–100)	Percent rank
n/a	Armenia	n/a	n/a	n/a
n/a	Azerbaijan	n/a	n/a	n/a
n/a	Bangladesh	n/a	n/a	n/a
n/a	Belarus	n/a	n/a	n/a
n/a	Benin	n/a	n/a	n/a
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a
n/a	Bosnia and Herzegovina	n/a	n/a	n/a
n/a	Botswana	n/a	n/a	n/a
n/a	Brunei Darussalam	n/a	n/a	n/a
n/a	Bulgaria	n/a	n/a	n/a
n/a	Burkina Faso	n/a	n/a	n/a
n/a	Burundi	n/a	n/a	n/a
n/a	Cambodia	n/a	n/a	n/a
n/a	Cameroon	n/a	n/a	n/a
n/a	Costa Rica	n/a	n/a	n/a
n/a	Côte d'Ivoire	n/a	n/a	n/a
n/a	Croatia	n/a	n/a	n/a
n/a	Cyprus	n/a	n/a	n/a
n/a	Dominican Republic	n/a	n/a	n/a
n/a	Ecuador	n/a	n/a	n/a
n/a	El Salvador	n/a	n/a	n/a
n/a	Estonia	n/a	n/a	n/a
n/a	Ethiopia	n/a	n/a	n/a
n/a	Georgia	n/a	n/a	n/a
n/a	Guatemala	n/a	n/a	n/a
n/a	Guinea	n/a	n/a	n/a
n/a	Honduras	n/a	n/a	n/a
n/a	Iceland	n/a	n/a	n/a
n/a	Jamaica	n/a	n/a	n/a
n/a	Kazakhstan	n/a	n/a	n/a
n/a	Kyrgyzstan	n/a	n/a	n/a
n/a	Latvia	n/a	n/a	n/a
n/a	Lithuania	n/a	n/a	n/a
n/a	Luxembourg	n/a	n/a	n/a
n/a	Madagascar	n/a	n/a	n/a
n/a	Malawi	n/a	n/a	n/a
n/a	Mali	n/a	n/a	n/a
n/a	Mauritius	n/a	n/a	n/a
n/a	Moldova, Rep.	n/a	n/a	n/a
n/a	Mongolia	n/a	n/a	n/a
n/a	Montenegro	n/a	n/a	n/a
n/a	Mozambique	n/a	n/a	n/a
n/a	Namibia	n/a	n/a	n/a
n/a	Nepal	n/a	n/a	n/a
n/a	Niger	n/a	n/a	n/a
n/a	Panama	n/a	n/a	n/a
n/a	Paraguay	n/a	n/a	n/a
n/a	Rwanda	n/a	n/a	n/a
n/a	Senegal	n/a	n/a	n/a
n/a	Serbia	n/a	n/a	n/a
n/a	Slovakia	n/a	n/a	n/a
n/a	Slovenia	n/a	n/a	n/a
n/a	Sri Lanka	n/a	n/a	n/a
n/a	Tajikistan	n/a	n/a	n/a
n/a	Tanzania, United Rep.	n/a	n/a	n/a
n/a	TFYR of Macedonia	n/a	n/a	n/a
n/a	Togo	n/a	n/a	n/a
n/a	Trinidad and Tobago	n/a	n/a	n/a
n/a	Uganda	n/a	n/a	n/a
n/a	Ukraine	n/a	n/a	n/a
n/a	Uruguay	n/a	n/a	n/a
n/a	Zambia	n/a	n/a	n/a
n/a	Zimbabwe	n/a	n/a	n/a

SOURCE: PwC's *Global Entertainment and Media Outlook, 2016–2020*; United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2015 Revision* (population); International Monetary Fund, *World Economic Outlook Database*, October 2016 (current US$ GDP); Middle East & North Africa in World Bank's *DataBank*

NOTE: ● indicates a strength; ○ a weakness

7.2.4 Printing and publishing output

Printing and publishing manufactures output (% of manufactures total output) | 2014

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Iceland (2006)	6.36	100.00	0.99	●
1	Malta (2009)	36.18	100.00	0.99	●
3	Lebanon (2007)	4.18	64.70	0.98	●
4	Kenya (2013)	3.82	58.79	0.97	●
5	Mauritius (2012)	3.24	49.44	0.96	●
6	Panama (2013)	3.20	48.80	0.95	●
7	Georgia (2013)	3.12	47.41	0.94	●
8	Latvia (2013)	3.00	45.41	0.93	●
9	Mongolia (2011)	2.94	44.52	0.92	●
10	Tanzania, United Rep. (2010)	2.84	42.87	0.91	●
11	Peru (2011)	2.66	39.93	0.90	●
12	TFYR of Macedonia (2011)	2.62	39.24	0.89	●
13	Cyprus	2.60	39.05	0.88	
14	United Arab Emirates (2012)	2.50	37.35	0.87	
15	South Africa (2010)	2.44	36.30	0.86	●
16	Costa Rica (2013)	2.39	35.64	0.85	●
17	Saudi Arabia (2009)	2.31	34.33	0.84	●
18	Colombia (2012)	2.23	33.01	0.83	●
19	Australia (2013)	2.09	30.66	0.82	
20	Japan (2012)	2.09	30.64	0.81	
21	Madagascar (2006)	2.08	30.51	0.80	●
22	Estonia	1.99	29.14	0.79	
23	United Kingdom	1.95	28.36	0.78	
24	United States of America (2008)	1.88	27.35	0.77	
25	Armenia (2013)	1.82	26.38	0.76	
26	Ethiopia	1.79	25.78	0.74	●
27	New Zealand (2012)	1.75	25.20	0.73	
28	Slovenia	1.75	25.19	0.72	
29	Moldova, Rep. (2013)	1.75	25.16	0.71	
30	Malawi (2012)	1.74	24.95	0.70	●
31	Sri Lanka (2012)	1.74	24.94	0.69	●
32	Serbia	1.60	22.76	0.68	
33	Ecuador (2008)	1.55	21.95	0.67	●
34	Bahrain (2013)	1.53	21.63	0.66	
35	Spain	1.49	20.99	0.65	
36	Netherlands	1.35	18.69	0.64	○
37	Paraguay (2010)	1.33	18.33	0.63	●
38	Bulgaria	1.31	18.05	0.62	
39	Norway	1.29	17.77	0.61	
40	Sweden	1.29	17.65	0.60	○
41	Cameroon (2008)	1.28	17.60	0.59	●
42	Austria	1.28	17.58	0.58	○
43	Portugal	1.27	17.35	0.57	
44	Uruguay (2011)	1.23	16.73	0.56	
45	Belgium	1.23	16.65	0.55	
46	Israel	1.22	16.62	0.54	
47	Russian Federation	1.22	16.59	0.53	
48	Italy	1.21	16.37	0.52	
49	Algeria (2008)	1.21	16.33	0.51	●
50	Finland	1.20	16.21	0.50	○
51	Jordan (2013)	1.19	16.11	0.49	
52	Burundi (2012)	1.18	15.88	0.48	
53	Tajikistan (2013)	1.17	15.73	0.47	
54	Luxembourg	1.17	15.68	0.46	
55	France	1.15	15.48	0.45	○
56	Bolivia, Plurinational St. (2010)	1.14	15.23	0.44	
57	Poland	1.14	15.20	0.43	
58	Switzerland	1.12	14.94	0.42	○
59	Germany	1.12	14.86	0.41	○
60	Lithuania	1.09	14.38	0.40	
61	Chile (2013)	1.06	13.98	0.39	
62	Romania (2013)	1.06	13.95	0.38	
63	Bosnia and Herzegovina (2011)	1.06	13.94	0.37	
64	Denmark	1.02	13.29	0.36	○
65	Czech Republic	1.01	13.20	0.35	○
66	Ukraine	0.97	12.46	0.34	
67	Turkey	0.93	11.88	0.33	
68	Qatar (2013)	0.91	11.58	0.32	
69	Greece	0.91	11.57	0.31	
70	Malaysia (2012)	0.86	10.71	0.30	
71	Ireland (2013)	0.83	10.16	0.29	○
72	Senegal (2012)	0.82	10.14	0.28	
73	Hungary	0.81	9.88	0.27	○
74	Morocco (2013)	0.80	9.81	0.26	
75	Singapore	0.79	9.49	0.24	○
76	Thailand (2011)	0.77	9.17	0.23	
77	Brazil (2013)	0.76	9.14	0.22	
78	Oman	0.73	8.65	0.21	
79	Kazakhstan (2013)	0.73	8.53	0.20	
80	Tunisia (2007)	0.72	8.37	0.19	
81	Viet Nam (2012)	0.70	8.06	0.18	
82	Azerbaijan (2013)	0.66	7.51	0.17	
83	Kyrgyzstan (2013)	0.66	7.43	0.16	
84	Kuwait (2013)	0.64	7.20	0.15	
85	India	0.60	6.48	0.14	
86	Slovakia	0.59	6.37	0.13	○
87	Mexico (2011)	0.57	5.99	0.12	○
88	Indonesia (2013)	0.52	5.24	0.11	○
89	China (2011)	0.52	5.18	0.10	○
90	Philippines (2012)	0.51	5.06	0.09	○
91	Brunei Darussalam (2010)	0.48	4.58	0.08	○
92	Nepal (2011)	0.43	3.80	0.07	
93	Egypt (2012)	0.43	3.80	0.06	○
94	Canada	0.39	3.04	0.05	○
95	Yemen (2012)	0.36	2.60	0.04	
96	Pakistan (2006)	0.33	2.12	0.03	○
97	Korea, Rep.	0.28	1.31	0.02	○
98	Iran, Islamic Rep.	0.21	0.22	0.01	○
99	Bangladesh (2011)	0.20	0.00	0.00	○
n/a	Albania	n/a	n/a	n/a	
n/a	Argentina	n/a	n/a	n/a	
n/a	Belarus	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Croatia	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Hong Kong (China)	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Montenegro	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Nigeria	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Uganda	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: United Nations Industrial Development Organization, *Industrial Statistics Database;* 2-digit level of International Standard Industrial Classification ISIC Revision 3 (INDSTAT2 2015)

NOTE: ● indicates a strength; ○ a weakness

7.2.5 Creative goods exports

Creative goods exports (% of total trade) | 2015

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	China	12.83	100.00	1.00	●
2	Malaysia	10.27	92.06	0.99	●
3	Mexico	9.98	91.02	0.98	●
4	Czech Republic	9.75	90.21	0.98	●
5	Thailand	9.53	89.39	0.97	●
6	Slovakia	9.33	88.65	0.96	●
7	Viet Nam	5.98	73.44	0.95	●
8	Hungary	5.86	72.78	0.94	●
9	Poland	5.48	70.59	0.94	●
10	Singapore	5.16	68.60	0.93	
11	Netherlands	4.69	65.52	0.92	
12	Latvia	4.17	61.80	0.91	●
13	Indonesia	3.89	59.72	0.90	●
14	Switzerland	3.80	58.98	0.90	
15	United Kingdom	3.60	57.37	0.89	
16	Korea, Rep.	3.11	53.01	0.88	
17	Turkey	3.05	52.48	0.87	●
18	India	2.57	47.56	0.86	●
19	Italy	2.28	44.42	0.85	
20	Japan	2.24	43.89	0.85	
21	Dominican Republic	2.20	43.47	0.84	●
22	Germany	2.18	43.23	0.83	
23	Lithuania	2.12	42.48	0.82	
24	Tunisia	2.06	41.75	0.81	●
25	Ireland	1.95	40.26	0.81	
26	Egypt	1.94	40.22	0.80	●
27	Israel	1.82	38.59	0.79	
28	Belgium	1.81	38.52	0.78	
29	Denmark	1.80	38.38	0.77	
30	France	1.69	36.85	0.77	
31	United States of America	1.67	36.57	0.76	
32	Sweden	1.65	36.17	0.75	
33	United Arab Emirates	1.62	35.85	0.74	
34	Bahrain	1.25	30.11	0.73	
35	Bolivia, Plurinational St.	1.25	30.08	0.73	●
36	Greece	1.25	29.97	0.72	
37	Portugal	1.23	29.69	0.71	
38	Estonia	1.20	29.19	0.70	
39	Romania	1.19	28.96	0.69	
40	Austria	1.17	28.71	0.69	
41	Mauritius	1.14	28.11	0.68	
42	Jordan	1.02	26.06	0.67	●
43	Bulgaria	0.96	24.92	0.66	
44	Croatia	0.94	24.49	0.65	
45	Slovenia	0.91	23.77	0.65	
46	Spain	0.88	23.34	0.64	
47	Lebanon (2014)	0.81	21.80	0.63	
48	Australia	0.80	21.65	0.62	
49	Russian Federation	0.79	21.45	0.61	
50	Serbia	0.76	20.81	0.60	
51	Namibia (2014)	0.67	18.85	0.60	
52	El Salvador	0.66	18.61	0.59	
53	Finland	0.64	18.24	0.58	
54	Canada	0.63	18.04	0.57	
55	South Africa	0.59	17.04	0.56	
56	Cambodia	0.56	16.27	0.56	●
57	Costa Rica	0.55	15.98	0.55	
58	Iran, Islamic Rep. (2011)	0.53	15.60	0.54	
59	Norway	0.52	15.27	0.53	
60	Armenia	0.43	13.04	0.52	
61	Guatemala	0.43	12.96	0.52	
62	Kuwait	0.41	12.49	0.51	
63	Ukraine	0.40	12.21	0.50	
64	Malta	0.36	11.26	0.49	
65	Bosnia and Herzegovina	0.34	10.63	0.48	
66	New Zealand	0.29	9.14	0.48	○
67	Peru	0.28	8.91	0.47	
68	Kenya (2013)	0.28	8.85	0.46	
69	Sri Lanka	0.26	8.43	0.45	
70	Zimbabwe (2014)	0.26	8.36	0.44	
71	Colombia	0.24	7.73	0.44	
72	Brazil	0.23	7.53	0.43	
73	Nepal	0.22	7.35	0.42	●
74	Belarus	0.21	6.98	0.41	
75	Montenegro	0.19	6.22	0.40	
76	Botswana	0.18	6.14	0.40	
77	Morocco	0.18	6.09	0.39	
78	Qatar	0.18	5.92	0.38	
79	Hong Kong (China)	0.17	5.75	0.37	○
80	Kazakhstan	0.16	5.40	0.36	
81	TFYR of Macedonia	0.16	5.28	0.35	
82	Chile	0.16	5.23	0.35	
83	Paraguay	0.15	4.98	0.34	
84	Rwanda	0.15	4.97	0.33	
85	Brunei Darussalam	0.13	4.37	0.32	
86	Argentina	0.12	4.23	0.31	
87	Madagascar	0.12	4.20	0.31	
88	Albania	0.12	4.10	0.30	
89	Luxembourg	0.12	3.94	0.29	○
90	Côte d'Ivoire	0.10	3.57	0.28	
91	Georgia	0.10	3.45	0.27	
92	Malawi	0.10	3.35	0.27	
93	Senegal	0.10	3.35	0.26	
94	Honduras (2014)	0.10	3.34	0.25	
95	Iceland	0.08	2.92	0.24	○
96	Saudi Arabia	0.08	2.66	0.23	
97	Uruguay	0.07	2.56	0.23	
98	Kyrgyzstan	0.07	2.47	0.22	
99	Pakistan	0.07	2.32	0.21	
100	Bangladesh (2011)	0.06	2.14	0.20	
101	Tanzania, United Rep. (2014)	0.06	2.11	0.19	
102	Moldova, Rep.	0.06	2.10	0.19	
103	Trinidad and Tobago (2010)	0.06	2.00	0.18	
104	Ecuador	0.06	1.94	0.17	
105	Uganda	0.06	1.93	0.16	
106	Zambia	0.04	1.45	0.15	
107	Cyprus	0.04	1.44	0.15	○
108	Jamaica	0.03	1.19	0.14	○
109	Burkina Faso	0.03	0.91	0.13	
110	Oman (2014)	0.02	0.66	0.12	○
111	Ethiopia	0.02	0.59	0.11	
112	Niger (2014)	0.02	0.53	0.10	
113	Burundi (2014)	0.01	0.46	0.10	
114	Guinea (2014)	0.01	0.45	0.09	
115	Nigeria (2014)	0.01	0.38	0.08	
116	Panama	0.01	0.36	0.07	○
117	Benin	0.01	0.31	0.06	
118	Cameroon	0.01	0.29	0.06	○
119	Azerbaijan	0.01	0.27	0.05	○
120	Mongolia	0.01	0.17	0.04	○
121	Mozambique	0.01	0.17	0.03	○
122	Mali (2012)	0.00	0.13	0.02	○
123	Togo (2014)	0.00	0.11	0.02	○
124	Yemen (2014)	0.00	0.02	0.01	
125	Algeria	0.00	0.00	0.00	○
n/a	Philippines	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	

SOURCE: United Nations, *COMTRADE* database; 2009 UNESCO Framework for Cultural Statistics, Table 3, *International trade of cultural goods and services based on the 2007 Harmonised System (HS 2007)*; World Trade Organization, *Trade in Commercial Services* database, itself based on the sixth (2009) edition of the International Monetary Fund's *Balance of Payments Manual* and *Balance of Payments* database

NOTE: ● indicates a strength; ○ a weakness

7.3.1 Generic top-level domains (gTLDs)

Generic top-level domains (gTLDs) (per thousand population 15–69 years old) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Iceland	100.00	100.00	0.99	●
1	United States of America	100.00	100.00	0.99	●
3	Malta	94.51	94.51	0.98	●
4	Luxembourg	92.55	92.55	0.98	●
5	Netherlands	77.94	77.94	0.97	●
6	Canada	76.36	76.36	0.96	●
7	Hong Kong (China)	70.80	70.80	0.95	
8	Cyprus	68.23	68.23	0.94	●
9	Australia	63.61	63.61	0.94	
10	United Kingdom	61.89	61.89	0.93	
11	Ireland	61.44	61.44	0.92	
12	Switzerland	60.48	60.48	0.91	
13	Germany	55.34	55.34	0.90	
14	Norway	51.48	51.48	0.90	
15	Denmark	48.45	48.45	0.89	
16	Panama	44.64	44.64	0.88	●
17	Sweden	43.00	43.00	0.87	
18	France	41.31	41.31	0.87	
19	Austria	36.92	36.92	0.86	
20	New Zealand	34.29	34.29	0.85	
21	Finland	29.25	29.25	0.84	
22	Spain	28.10	28.10	0.83	
23	Singapore	25.84	25.84	0.83	
24	Israel	23.19	23.19	0.82	
25	Italy	23.13	23.13	0.81	
26	Bulgaria	22.70	22.70	0.80	
27	Belgium	22.13	22.13	0.79	
28	Slovenia	21.12	21.12	0.79	
29	Portugal	18.90	18.90	0.78	
30	Czech Republic	17.08	17.08	0.77	
31	Japan	15.09	15.09	0.76	
32	Croatia	14.14	14.14	0.75	
33	Lithuania	13.81	13.81	0.75	
34	Mauritius	12.72	12.72	0.74	
35	Greece	12.42	12.42	0.73	
36	Turkey	12.20	12.20	0.72	
37	Costa Rica	11.51	11.51	0.71	
38	United Arab Emirates	11.20	11.20	0.71	
39	Hungary	10.33	10.33	0.70	
40	Latvia	9.43	9.43	0.69	
41	Estonia	9.22	9.22	0.68	
42	Namibia	8.66	8.66	0.67	
43	Korea, Rep.	8.19	8.19	0.67	
44	Kuwait	8.14	8.14	0.66	
45	Albania	7.29	7.29	0.65	
46	Poland	7.07	7.07	0.64	
47	Brunei Darussalam	7.05	7.05	0.63	
48	Lebanon	6.87	6.87	0.63	
49	Jordan	6.63	6.63	0.62	
50	TFYR of Macedonia	6.57	6.57	0.61	
51	Uruguay	6.38	6.38	0.60	
52	Malaysia	6.34	6.34	0.60	
53	Bahrain	5.44	5.44	0.59	
54	Thailand	5.37	5.37	0.58	
55	Peru	5.30	5.30	0.57	
56	Trinidad and Tobago	4.54	4.54	0.56	●
57	Romania	4.46	4.46	0.56	
58	Qatar	4.41	4.41	0.55	
59	Ukraine	4.39	4.39	0.54	
60	Guatemala	4.30	4.30	0.53	
61	Russian Federation	3.34	3.34	0.52	
62	South Africa	3.23	3.23	0.52	
63	Saudi Arabia	3.10	3.10	0.51	
64	Slovakia	3.08	3.08	0.50	
65	Argentina	3.07	3.07	0.49	
66	Dominican Republic	2.92	2.92	0.48	
67	Colombia	2.90	2.90	0.48	
68	Armenia	2.79	2.79	0.47	
69	Tunisia	2.71	2.71	0.46	
70	Viet Nam	2.56	2.56	0.45	
71	Mexico	2.55	2.55	0.44	
72	El Salvador	2.55	2.55	0.44	
73	Bosnia and Herzegovina	2.44	2.44	0.43	
74	China	2.36	2.36	0.42	
75	Chile	2.18	2.18	0.41	
76	Ecuador	2.13	2.13	0.40	
77	Moldova, Rep.	2.12	2.12	0.40	
78	Jamaica	1.90	1.90	0.39	
79	Iran, Islamic Rep.	1.84	1.84	0.38	
80	Bolivia, Plurinational St.	1.83	1.83	0.37	
81	Oman	1.81	1.81	0.37	
82	Belarus	1.77	1.77	0.36	
83	Georgia	1.76	1.76	0.35	
84	Paraguay	1.69	1.69	0.34	
85	Morocco	1.60	1.60	0.33	
86	Brazil	1.59	1.59	0.33	
87	Indonesia	1.57	1.57	0.32	
88	Serbia	1.51	1.51	0.31	
89	Montenegro	1.42	1.42	0.30	
90	Egypt	1.24	1.24	0.29	
91	Philippines	1.16	1.16	0.29	
92	Cambodia	1.11	1.11	0.28	
93	Kenya	1.06	1.06	0.27	
94	Botswana	1.05	1.05	0.26	
95	Senegal	1.05	1.05	0.25	
96	Azerbaijan	1.03	1.03	0.25	
97	Niger	1.02	1.02	0.24	
98	India	0.95	0.95	0.23	
99	Sri Lanka	0.78	0.78	0.22	
100	Honduras	0.65	0.65	0.21	
101	Togo	0.64	0.64	0.21	
102	Mongolia	0.64	0.64	0.20	
103	Pakistan	0.62	0.62	0.19	
104	Benin	0.60	0.60	0.18	
105	Nigeria	0.52	0.52	0.17	
106	Côte d'Ivoire	0.51	0.51	0.17	
107	Algeria	0.49	0.49	0.16	
108	Nepal	0.47	0.47	0.15	
109	Zimbabwe	0.40	0.40	0.14	
110	Yemen	0.37	0.37	0.13	
111	Bangladesh	0.36	0.36	0.13	
112	Kazakhstan	0.33	0.33	0.12	○
113	Uganda	0.23	0.23	0.11	
114	Kyrgyzstan	0.20	0.20	0.10	
115	Malawi	0.19	0.19	0.10	
116	Cameroon	0.17	0.17	0.09	
117	Tanzania, United Rep.	0.17	0.17	0.08	
118	Rwanda	0.16	0.16	0.07	○
119	Mali	0.15	0.15	0.06	
120	Madagascar	0.13	0.13	0.06	
121	Zambia	0.11	0.11	0.05	○
122	Burkina Faso	0.07	0.07	0.04	○
123	Tajikistan	0.05	0.05	0.03	○
124	Guinea	0.05	0.05	0.02	
125	Burundi	0.04	0.04	0.02	○
126	Mozambique	0.03	0.03	0.01	○
127	Ethiopia	0.00	0.00	0.00	○

SOURCE: ZookNIC Inc; United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2015 Revision* (population)

NOTE: ● indicates a strength; ○ a weakness

7.3.2 Country-code top-level domains (ccTLDs)

Country-code top-level domains (ccTLDs) (per thousand population 15–69 years old) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Montenegro	100.00	100.00	0.98	●
1	Netherlands	100.00	100.00	0.98	●
1	Switzerland	100.00	100.00	0.98	●
4	Denmark	98.36	98.36	0.98	●
5	Germany	83.84	83.84	0.97	●
6	Iceland	77.01	77.01	0.96	
7	United Kingdom	69.54	69.54	0.95	
8	Luxembourg	63.94	63.94	0.94	
9	Sweden	63.56	63.56	0.94	
10	New Zealand	62.42	62.42	0.93	
11	Austria	61.44	61.44	0.92	●
12	Belgium	58.05	58.05	0.91	●
13	Norway	56.82	56.82	0.90	
14	Australia	52.79	52.79	0.90	
15	Czech Republic	49.65	49.65	0.89	●
16	Latvia	43.03	43.03	0.88	
17	Estonia	40.66	40.66	0.87	
18	Portugal	35.57	35.57	0.87	●
19	Finland	31.59	31.59	0.86	
20	Hungary	29.08	29.08	0.85	●
21	Canada	28.65	28.65	0.84	
22	Poland	27.93	27.93	0.83	●
23	Lithuania	26.56	26.56	0.83	●
24	Slovakia	25.47	25.47	0.82	●
25	Slovenia	24.40	24.40	0.81	
26	Italy	21.40	21.40	0.80	
27	France	20.19	20.19	0.79	
28	Ireland	20.18	20.18	0.79	
29	Romania	18.39	18.39	0.78	●
30	Hong Kong (China)	17.49	17.49	0.77	
31	Colombia	17.24	17.24	0.76	
32	Spain	16.65	16.65	0.75	
33	Greece	16.30	16.30	0.75	
34	Russian Federation	15.18	15.18	0.74	
35	Israel	13.48	13.48	0.73	
36	Singapore	11.89	11.89	0.72	
37	Chile	11.85	11.85	0.71	
38	Mali	11.07	11.07	0.71	●
39	Uruguay	10.02	10.02	0.70	
40	Croatia	9.53	9.53	0.69	
41	South Africa	8.90	8.90	0.68	
42	Korea, Rep.	8.03	8.03	0.67	
43	Brazil	7.66	7.66	0.67	
44	Malta	7.30	7.30	0.66	
45	Argentina	5.79	5.79	0.65	
46	China	5.78	5.78	0.64	
47	United Arab Emirates	5.63	5.63	0.63	
48	Belarus	5.18	5.18	0.63	
49	Japan	5.06	5.06	0.62	
50	Ukraine	5.05	5.05	0.61	
51	Armenia	4.89	4.89	0.60	
52	Cyprus	4.70	4.70	0.60	
53	Serbia	4.35	4.35	0.59	
54	Malaysia	4.34	4.34	0.58	
55	Iran, Islamic Rep.	4.29	4.29	0.57	
56	Qatar	3.45	3.45	0.56	
57	Kazakhstan	3.09	3.09	0.56	
58	United States of America	2.92	2.92	0.55	
59	Mexico	2.77	2.77	0.54	
60	Viet Nam	2.59	2.59	0.53	
61	Moldova, Rep.	2.34	2.34	0.52	
62	Mauritius	2.31	2.31	0.52	
63	Georgia	2.14	2.14	0.51	
64	Turkey	2.05	2.05	0.50	
65	Bulgaria	2.03	2.03	0.49	
66	Indonesia	1.98	1.98	0.48	
67	Bosnia and Herzegovina	1.96	1.96	0.48	
68	Costa Rica	1.61	1.61	0.47	
69	Trinidad and Tobago	1.48	1.48	0.46	
70	Mongolia	1.44	1.44	0.45	
71	TFYR of Macedonia	1.37	1.37	0.44	
72	Peru	1.36	1.36	0.44	
73	Botswana	1.35	1.35	0.43	
74	Albania	1.34	1.34	0.42	
75	Paraguay	1.26	1.26	0.41	
76	Bahrain	1.24	1.24	0.40	
77	Panama	1.19	1.19	0.40	
78	Ecuador	1.15	1.15	0.39	
79	Azerbaijan	1.08	1.08	0.38	
80	Dominican Republic	1.07	1.07	0.37	
81	Jamaica	0.96	0.96	0.37	
82	Brunei Darussalam	0.93	0.93	0.36	
83	Nepal	0.83	0.83	0.35	
84	Morocco	0.79	0.79	0.34	
85	India	0.73	0.73	0.33	
86	Kenya	0.69	0.69	0.33	
87	Saudi Arabia	0.62	0.62	0.32	
88	El Salvador	0.57	0.57	0.31	
89	Bolivia, Plurinational St.	0.49	0.49	0.30	
90	Guatemala	0.45	0.45	0.29	
91	Honduras	0.44	0.44	0.29	
92	Kyrgyzstan	0.40	0.40	0.28	
93	Kuwait	0.40	0.40	0.27	
94	Thailand	0.38	0.38	0.26	
95	Tajikistan	0.37	0.37	0.25	
96	Malawi	0.31	0.31	0.25	
97	Philippines	0.31	0.31	0.24	
98	Jordan	0.29	0.29	0.23	○
99	Lebanon	0.27	0.27	0.22	
100	Cameroon	0.27	0.27	0.21	
101	Tunisia	0.20	0.20	0.21	
102	Sri Lanka	0.17	0.17	0.20	
103	Senegal	0.17	0.17	0.19	
104	Côte d'Ivoire	0.14	0.14	0.18	
105	Oman	0.13	0.13	0.17	
106	Tanzania, United Rep.	0.13	0.13	0.17	
107	Burundi	0.11	0.11	0.16	
108	Pakistan	0.11	0.11	0.15	
109	Nigeria	0.10	0.10	0.14	
110	Algeria	0.09	0.09	0.13	
111	Mozambique	0.08	0.08	0.13	
112	Rwanda	0.06	0.06	0.12	
113	Cambodia	0.06	0.06	0.11	
114	Zimbabwe	0.06	0.06	0.10	
115	Guinea	0.05	0.05	0.10	
116	Uganda	0.05	0.05	0.09	
117	Namibia	0.04	0.04	0.08	○
118	Madagascar	0.04	0.04	0.07	
119	Burkina Faso	0.04	0.04	0.06	
120	Egypt	0.04	0.04	0.06	○
121	Benin	0.02	0.02	0.05	○
122	Yemen	0.02	0.02	0.04	
123	Bangladesh	0.01	0.01	0.03	○
124	Ethiopia	0.01	0.01	0.02	
125	Niger	0.00	0.00	0.02	
126	Zambia	0.00	0.00	0.01	○
127	Togo	0.00	0.00	0.00	○

SOURCE: ZookNIC Inc; United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2015 Revision* (population)

NOTE: ● indicates a strength; ○ a weakness

7.3.3 Wikipedia yearly edits

Wikipedia yearly page edits (per million population 15–69 years old) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	Serbia	100.00	100.00	1.00	●
2	Norway	75.54	75.54	0.99	●
3	Israel	73.40	73.40	0.98	●
4	Sweden	71.00	71.00	0.98	●
5	Estonia	70.73	70.73	0.97	●
6	Finland	69.98	69.98	0.96	
7	Armenia	69.57	69.57	0.95	●
8	Netherlands	69.27	69.27	0.94	
9	Hong Kong (China)	68.02	68.02	0.94	
10	France	67.25	67.25	0.93	●
11	Iceland (2014)	67.15	67.15	0.92	
12	United Kingdom	66.89	66.89	0.91	
13	New Zealand	66.67	66.67	0.90	
14	Latvia	66.63	66.63	0.90	●
15	Germany	65.49	65.49	0.89	
16	Hungary	65.47	65.47	0.88	●
17	Luxembourg (2014)	65.40	65.40	0.87	
18	Spain	65.22	65.22	0.87	
19	Austria	65.00	65.00	0.86	
20	Slovenia	64.86	64.86	0.85	
21	Switzerland	64.72	64.72	0.84	
22	Czech Republic	64.62	64.62	0.83	
23	Canada	64.13	64.13	0.83	
24	Australia	63.80	63.80	0.82	
25	Denmark	63.25	63.25	0.81	
26	Bulgaria	63.20	63.20	0.80	
27	Ireland	63.14	63.14	0.79	
28	Uruguay	62.96	62.96	0.79	●
29	Italy	62.52	62.52	0.78	
30	Lithuania	61.59	61.59	0.77	
31	Poland	60.22	60.22	0.76	
32	Cyprus (2014)	60.15	60.15	0.75	
33	Belgium	59.91	59.91	0.75	
34	Russian Federation	59.63	59.63	0.74	
35	Greece	59.42	59.42	0.73	
36	TFYR of Macedonia (2014)	59.41	59.41	0.72	
37	Croatia	59.35	59.35	0.71	
38	Slovakia	59.05	59.05	0.71	
39	Ukraine	58.93	58.93	0.70	
40	Georgia	58.86	58.86	0.69	
41	United States of America	58.84	58.84	0.68	
42	Malta (2014)	58.61	58.61	0.67	
43	Bosnia and Herzegovina	58.22	58.22	0.67	
44	Singapore	57.68	57.68	0.66	
45	Portugal	56.40	56.40	0.65	
46	Belarus	55.33	55.33	0.64	
47	Japan	54.76	54.76	0.63	
48	Azerbaijan	54.42	54.42	0.63	
49	Chile	53.86	53.86	0.62	
50	Korea, Rep.	53.57	53.57	0.61	
51	Montenegro (2014)	53.06	53.06	0.60	
52	Jordan	51.96	51.96	0.60	
53	Argentina	51.47	51.47	0.59	
54	Turkey	50.32	50.32	0.58	
55	Iran, Islamic Rep.	50.10	50.10	0.57	
56	Kazakhstan	49.76	49.76	0.56	
57	Moldova, Rep. (2014)	49.68	49.68	0.56	
58	Kuwait (2014)	49.43	49.43	0.55	
59	Romania	49.35	49.35	0.54	
60	Albania (2014)	49.10	49.10	0.53	
61	Bahrain (2014)	49.05	49.05	0.52	
62	Mongolia (2014)	48.87	48.87	0.52	
63	Panama (2014)	48.16	48.16	0.51	
64	Viet Nam	47.72	47.72	0.50	
65	Costa Rica (2014)	45.42	45.42	0.49	
66	Saudi Arabia	44.85	44.85	0.48	
67	Brazil	44.65	44.65	0.48	
68	United Arab Emirates (2014)	44.38	44.38	0.47	
69	Malaysia	44.29	44.29	0.46	
70	Qatar (2014)	43.94	43.94	0.45	
71	Trinidad and Tobago (2014)	42.41	42.41	0.44	
72	Lebanon (2014)	41.71	41.71	0.44	
73	Kyrgyzstan (2014)	41.50	41.50	0.43	
74	Peru	41.39	41.39	0.42	
75	Thailand	41.22	41.22	0.41	
76	Colombia	41.00	41.00	0.40	
77	Sri Lanka (2014)	39.88	39.88	0.40	
78	Nepal (2014)	39.81	39.81	0.39	
79	Mauritius (2014)	39.42	39.42	0.38	
80	Dominican Republic (2014)	39.21	39.21	0.37	
81	Brunei Darussalam (2014)	38.96	38.96	0.37	
82	Philippines	38.89	38.89	0.36	
83	Oman (2014)	38.42	38.42	0.35	
84	Morocco	38.29	38.29	0.34	
85	Mexico	38.21	38.21	0.33	
86	Ecuador (2014)	37.87	37.87	0.33	
87	El Salvador (2014)	37.65	37.65	0.32	
88	Paraguay (2014)	36.36	36.36	0.31	
89	South Africa	36.32	36.32	0.30	
90	Guatemala (2014)	35.60	35.60	0.29	
91	Egypt	34.75	34.75	0.29	
92	Namibia (2014)	34.56	34.56	0.28	
93	Bolivia, Plurinational St. (2014)	34.56	34.56	0.27	
94	Indonesia	34.45	34.45	0.26	
95	Honduras (2014)	33.60	33.60	0.25	
96	Tunisia (2014)	32.79	32.79	0.25	
97	Tajikistan (2014)	31.78	31.78	0.24	
98	Jamaica (2014)	30.93	30.93	0.23	
99	Algeria (2014)	28.87	28.87	0.22	
100	India	28.40	28.40	0.21	
101	Pakistan	28.25	28.25	0.21	
102	Cambodia (2014)	28.14	28.14	0.20	
103	Bangladesh	26.33	26.33	0.19	
104	Yemen (2014)	24.03	24.03	0.18	
105	Kenya (2014)	23.60	23.60	0.17	
106	Benin (2014)	21.56	21.56	0.17	
107	Uganda (2014)	18.08	18.08	0.16	
108	Côte d'Ivoire (2014)	16.58	16.58	0.15	
109	Madagascar (2014)	15.39	15.39	0.14	
110	China	15.13	15.13	0.13	○
111	Botswana (2014)	14.13	14.13	0.13	
112	Nigeria (2014)	12.64	12.64	0.12	
113	Zimbabwe (2014)	11.85	11.85	0.11	
114	Senegal (2014)	10.60	10.60	0.10	
115	Tanzania, United Rep. (2014)	10.13	10.13	0.10	
116	Mozambique (2014)	9.81	9.81	0.09	
117	Rwanda (2014)	9.31	9.31	0.08	
118	Togo (2014)	9.16	9.16	0.07	
119	Cameroon (2014)	6.64	6.64	0.06	○
120	Zambia (2014)	6.58	6.58	0.06	○
121	Mali (2014)	4.50	4.50	0.05	
122	Burundi (2014)	2.85	2.85	0.04	
123	Ethiopia (2014)	2.65	2.65	0.03	
124	Malawi (2014)	2.07	2.07	0.02	○
125	Burkina Faso (2014)	1.11	1.11	0.02	○
126	Guinea (2014)	0.02	0.02	0.01	○
127	Niger (2014)	0.00	0.00	0.00	○

SOURCE: Wikimedia Foundation; United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2012 Revision* (population)

NOTE: ● indicates a strength; ○ a weakness

7.3.4 Video uploads on YouTube

Number of video uploads on YouTube (scaled by population 15–69 years old) | 2016

Rank	Country/Economy	Value	Score (0–100)	Percent rank	
1	United States of America	100.00	100.00	1.00	●
2	Latvia	81.80	81.80	0.99	●
3	United Kingdom	76.36	76.36	0.97	●
4	Israel	64.85	64.85	0.96	
5	Netherlands	64.02	64.02	0.94	
6	Sweden	63.18	63.18	0.93	
7	Estonia	62.97	62.97	0.92	
8	New Zealand	60.88	60.88	0.90	
9	Canada	58.58	58.58	0.89	
10	Ireland	57.32	57.32	0.88	
11	Denmark	56.07	56.07	0.85	
11	Finland	56.07	56.07	0.85	
13	Singapore	55.86	55.86	0.83	
14	Hong Kong (China)	54.60	54.60	0.82	
15	Spain	53.35	53.35	0.81	
16	Switzerland	49.16	49.16	0.79	
17	Norway	47.49	47.49	0.76	
17	Portugal	47.49	47.49	0.76	
19	Italy	47.28	47.28	0.75	
20	Kuwait	45.82	45.82	0.74	●
21	Korea, Rep.	45.40	45.40	0.71	
21	Saudi Arabia	45.40	45.40	0.71	
23	Australia	44.77	44.77	0.68	
23	Czech Republic	44.77	44.77	0.68	
25	Belgium	44.14	44.14	0.67	
26	France	43.31	43.31	0.65	
27	Bahrain	42.89	42.89	0.64	
28	Russian Federation	42.05	42.05	0.63	
29	Brazil	39.75	39.75	0.60	
29	Greece	39.75	39.75	0.60	
31	Lithuania	39.54	39.54	0.58	
32	United Arab Emirates	39.12	39.12	0.57	
33	Hungary	38.91	38.91	0.56	
34	Qatar	37.66	37.66	0.54	
35	Argentina	37.45	37.45	0.53	
36	Bulgaria	36.82	36.82	0.50	
36	Germany	36.82	36.82	0.50	
38	Chile	35.98	35.98	0.49	
39	Poland	35.77	35.77	0.47	
40	Romania	35.36	35.36	0.46	
41	Austria	34.94	34.94	0.43	○
41	Ukraine	34.94	34.94	0.43	
43	Croatia	30.33	30.33	0.42	
44	Turkey	29.50	29.50	0.40	
45	Slovenia	28.87	28.87	0.39	○
46	Thailand	28.24	28.24	0.38	
47	Serbia	26.99	26.99	0.36	
48	Slovakia	26.57	26.57	0.35	
49	Japan	25.31	25.31	0.33	○
50	TFYR of Macedonia	25.10	25.10	0.32	
51	Mexico	24.90	24.90	0.31	
52	Viet Nam	24.27	24.27	0.29	
53	Montenegro	23.85	23.85	0.28	
54	Colombia	23.43	23.43	0.26	
55	Bosnia and Herzegovina	23.22	23.22	0.25	
56	Indonesia	22.80	22.80	0.24	
57	Peru	20.29	20.29	0.22	
58	Malaysia	19.04	19.04	0.21	○
59	Jordan	18.83	18.83	0.19	○
60	Lebanon	16.95	16.95	0.18	
61	Oman	12.97	12.97	0.17	
62	Morocco	12.55	12.55	0.15	○
63	Philippines	9.21	9.21	0.13	○
63	Tunisia	9.21	9.21	0.13	○

Rank	Country/Economy	Score (0–100)	Score (0–100)	Percent rank	
65	Egypt	7.95	7.95	0.11	
66	Algeria	6.49	6.49	0.10	
67	South Africa	2.93	2.93	0.08	○
68	India	2.51	2.51	0.07	○
69	Senegal	1.88	1.88	0.06	○
70	Kenya	1.05	1.05	0.04	○
71	Yemen	0.84	0.84	0.03	
72	Nigeria	0.42	0.42	0.01	○
73	Uganda	0.00	0.00	0.00	○
n/a	Albania	n/a	n/a	n/a	
n/a	Armenia	n/a	n/a	n/a	
n/a	Azerbaijan	n/a	n/a	n/a	
n/a	Bangladesh	n/a	n/a	n/a	
n/a	Belarus	n/a	n/a	n/a	
n/a	Benin	n/a	n/a	n/a	
n/a	Bolivia, Plurinational St.	n/a	n/a	n/a	
n/a	Botswana	n/a	n/a	n/a	
n/a	Brunei Darussalam	n/a	n/a	n/a	
n/a	Burkina Faso	n/a	n/a	n/a	
n/a	Burundi	n/a	n/a	n/a	
n/a	Cambodia	n/a	n/a	n/a	
n/a	Cameroon	n/a	n/a	n/a	
n/a	China	n/a	n/a	n/a	
n/a	Costa Rica	n/a	n/a	n/a	
n/a	Côte d'Ivoire	n/a	n/a	n/a	
n/a	Cyprus	n/a	n/a	n/a	
n/a	Dominican Republic	n/a	n/a	n/a	
n/a	Ecuador	n/a	n/a	n/a	
n/a	El Salvador	n/a	n/a	n/a	
n/a	Ethiopia	n/a	n/a	n/a	
n/a	Georgia	n/a	n/a	n/a	
n/a	Guatemala	n/a	n/a	n/a	
n/a	Guinea	n/a	n/a	n/a	
n/a	Honduras	n/a	n/a	n/a	
n/a	Iceland	n/a	n/a	n/a	
n/a	Iran, Islamic Rep.	n/a	n/a	n/a	
n/a	Jamaica	n/a	n/a	n/a	
n/a	Kazakhstan	n/a	n/a	n/a	
n/a	Kyrgyzstan	n/a	n/a	n/a	
n/a	Luxembourg	n/a	n/a	n/a	
n/a	Madagascar	n/a	n/a	n/a	
n/a	Malawi	n/a	n/a	n/a	
n/a	Mali	n/a	n/a	n/a	
n/a	Malta	n/a	n/a	n/a	
n/a	Mauritius	n/a	n/a	n/a	
n/a	Moldova, Rep.	n/a	n/a	n/a	
n/a	Mongolia	n/a	n/a	n/a	
n/a	Mozambique	n/a	n/a	n/a	
n/a	Namibia	n/a	n/a	n/a	
n/a	Nepal	n/a	n/a	n/a	
n/a	Niger	n/a	n/a	n/a	
n/a	Pakistan	n/a	n/a	n/a	
n/a	Panama	n/a	n/a	n/a	
n/a	Paraguay	n/a	n/a	n/a	
n/a	Rwanda	n/a	n/a	n/a	
n/a	Sri Lanka	n/a	n/a	n/a	
n/a	Tajikistan	n/a	n/a	n/a	
n/a	Tanzania, United Rep.	n/a	n/a	n/a	
n/a	Togo	n/a	n/a	n/a	
n/a	Trinidad and Tobago	n/a	n/a	n/a	
n/a	Uruguay	n/a	n/a	n/a	
n/a	Zambia	n/a	n/a	n/a	
n/a	Zimbabwe	n/a	n/a	n/a	

SOURCE: Google, parent company of YouTube; United Nations, Department of Economic and Social Affairs, Population Division, *World Population Prospects: The 2012 Revision* (population)

NOTE: ● indicates a strength; ○ a weakness

Appendix III

Sources and Definitions

Sources and Definitions

This appendix complements the data tables by providing, for each of the 81 indicators included in the Global Innovation Index (GII) this year, its title, its description, its definition, and its source. For each indicator for each country/economy, the most recent value within the 10-year period 2007–16 was used (with four exceptions: indicators 2.2.2, 5.1.2, 6.2.5, and 7.2.4, for which time periods were extended to 2006, and are noted in this appendix). Further details are explained in Appendix IV Technical Notes. The single year given next to the description corresponds to the most frequent year for which data were available; when more than one year is considered, the period is indicated at the end of the indicator's source in parentheses.

Some indicators received special treatment in the computation. A few variables required scaling by some other indicator to be comparable across countries, or through division by gross domestic product (GDP) in current US dollars, purchasing power parity GDP in international dollars (PPP$ GDP), population, total exports, total trade, and so on. Details are provided in this appendix. The scaling factor was in each case the value corresponding to the same year of the particular indicator. In addition, 35 indicators that were assigned half weight are singled out with an 'a'. Finally, indicators for which higher scores indicate worse outcomes, commonly known as 'bads', are differentiated with a 'b' (details on the computation can be found in Appendix IV Technical Notes).

A total of 57 variables are hard data; 19 are composite indicators from international agencies, distinguished with an asterisk (*); and 5 are survey questions from the World Economic Forum's Executive Opinion Survey (EOS), singled out with a dagger (†).

1 Institutions

1.1 Political environment

1.1.1 Political stability and absence of violence/terrorism

Political stability and absence of violence/terrorism index* | 2015

Index that measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. Scores are standardized.

Source: World Bank, Worldwide Governance Indicators, 2016 update. (http://info.worldbank.org/governance/wgi/index.aspx#home)

1.1.2 Government effectiveness

Government effectiveness index* | 2015

Index that reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Scores are standardized.

Source: World Bank, Worldwide Governance Indicators, 2016 update. (http://info.worldbank.org/governance/wgi/index.aspx#home)

1.2 Regulatory environment

1.2.1 Regulatory quality

Regulatory quality index*[a] | 2015

Index that reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private-sector development. Scores are standardized.

Source: World Bank, Worldwide Governance Indicators, 2016 update. (http://info.worldbank.org/governance/wgi/index.aspx#home)

1.2.2 Rule of law

Rule of law index*[a] | 2015

Index that reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Scores are standardized.

Source: World Bank, Worldwide Governance Indicators, 2016 update. (http://info.worldbank.org/governance/wgi/index.aspx#home)

1.2.3 Cost of redundancy dismissal

Sum of notice period and severance pay for redundancy dismissal (in salary weeks, averages for workers with 1, 5, and 10 years of tenure, with a minimum threshold of 8 weeks)[b] | 2016

Doing Business has historically studied the flexibility of regulation of employment specifically as it relates to the areas of hiring, working hours, and redundancy. Over the period from 2007 to 2011 improvements were made to align the methodology for the labour market regulation indicators (formerly the employing workers indicators) with the letter and spirit of the International Labour Organization (ILO) conventions. Redundancy cost measures the cost of advance notice requirements and severance payments due when terminating a redundant worker, expressed in weeks of salary. The average value of notice requirements and severance payments applicable to a worker with 1 year of tenure, a worker with 5 years, and a worker with 10 years is also considered. One month is recorded as 4 and 1/3 weeks. If the redundancy cost adds up to 8 or fewer weeks of salary, a value of 8 is assigned but the actual number of weeks is published. If the cost adds up to more than 8 weeks of salary, the score is the number of weeks. Assumptions about the worker: the worker is a cashier in a supermarket or grocery store, age 19, with one year of work experience; is a full-time employee; is not a member of the labour union, unless membership is mandatory. Assumptions about the business: the business is a limited liability company (or the equivalent in the economy); operates a supermarket or grocery store in the economy's largest business city (for 11 economies the data are also collected for the second largest business city); has 60 employees; is subject to collective bargaining agreements if such agreements cover more than 50% of the food retail sector and they apply even to firms that are not party to them; abides by every law and regulation but does not grant workers more benefits than those mandated by law, regulation, or (if applicable) collective bargaining agreements.

Source: World Bank, Ease of Doing Business Index 2017: Equal Opportunity for All (2014–16). (http://www.doingbusiness.org/reports/global-reports/doing-business-2017)

1.3 Business environment

1.3.1 Ease of starting a business

Ease of starting a business (distance to frontier)* | 2016

The ranking of economies on the ease of starting a business is determined by sorting their distance to frontier scores for starting a business. These scores are the simple average of the distance to frontier scores for each of the component indicators. *Doing Business* records all procedures officially required, or commonly done in practice, for an entrepreneur to start up and formally operate an industrial or commercial business, as well as the time and cost to complete these procedures and the paid-in minimum capital requirement. These procedures include obtaining all necessary licenses and permits and completing any required notifications, verifications, or inscriptions for the company and employees with relevant authorities. To make the data comparable across economies, several assumptions about the business and the procedures are used. The business: is a limited liability company (or its legal equivalent). If there is more than one type of limited liability company in the economy, the limited liability form most common among domestic firms is chosen. Information on the most common form is obtained from incorporation lawyers or the statistical office; the business operates in the economy's largest business city. For 11 economies the data are also collected for the second largest business city; the business is 100% domestically owned and has five owners, none of whom is a legal entity; has start-up capital of 10 times income per capita; performs general industrial or commercial activities, such as the production or sale to the public of products or services. The business does not perform foreign trade activities and does not handle products subject to a special tax regime, for example, liquor or tobacco. It is not using heavily polluting production processes; leases the commercial plant or offices and is not a proprietor of real estate; the amount of the annual lease for the office space is equivalent to 1 times income per capita; the size of the entire office space is approximately 929 square meters (10,000 square feet); does not qualify for investment incentives or any special benefits; has at least 10 and up to 50 employees one month after the commencement of operations, all of them domestic nationals; has a turnover of at least 100 times income per capita; has a company deed 10 pages long. The distance to frontier score shows the distance of an economy to the 'frontier', which is derived from the most efficient practice or highest score achieved on each indicator.

Source: World Bank, Ease of Doing Business Index 2017: Equal Opportunity for All (2016). (http://www.doingbusiness.org/reports/global-reports/doing-business-2017)

1.3.2 Ease of resolving insolvency

Ease of resolving insolvency (distance to frontier)* | 2016

The ranking of economies on the ease of resolving insolvency is determined by sorting their distance to frontier scores for resolving insolvency. These scores are the simple average of the distance to frontier scores for the recovery rate and the strength of insolvency framework index. The recovery rate is recorded as cents on the dollar recovered by secured creditors through reorganization, liquidation, or debt enforcement (foreclosure or receivership) proceedings. The calculation takes into account the outcome: whether the business emerges from the proceedings as a going concern or the assets are sold piecemeal. Then the costs of the proceedings are deducted (1 cent for each percentage point of the value of the debtor's estate). Finally, the value lost as a result of the time the money remains tied up in insolvency proceedings is taken into account, including the loss of value due to depreciation of a hotel's furniture. Consistent with international accounting practice, the annual depreciation rate for furniture is taken to be 20%. The furniture is assumed to account for a quarter of the total value of assets. The recovery rate is the present value of the remaining proceeds, based on end-2015 lending rates from the International Monetary Fund's *International Financial Statistics*, supplemented with data from central banks and the Economist Intelligence Unit. If an economy had zero cases a year over the past five years involving a judicial reorganization, judicial liquidation, or debt enforcement procedure (foreclosure or receivership), the economy receives a 'no practice' mark on the time, cost, and outcome indicators. This means that creditors are unlikely to recover their money through a formal legal process. The recovery rate for 'no practice' economies is zero. In addition, a 'no practice' economy receives a score of 0 on the strength of insolvency framework index even if its legal framework includes provisions related to insolvency proceedings (liquidation or reorganization). The strength of insolvency framework index is based on four other indices: commencement of proceedings index, management of debtor's assets index, reorganization proceedings index, and creditor participation index. To make the data on the time, cost, and outcome of insolvency proceedings comparable across economies, several assumptions about the business and the case are used: the business is a limited liability company; operates in the economy's largest business city. For 11 economies the data are also collected for the second largest business city; the business is 100% domestically owned, with the founder, who is also chairman of the supervisory board, owning 51% (no other shareholder holds more than 5% of shares); has downtown real estate, where it runs a hotel, as its major asset; has a professional general manager; has 201 employees and 50 suppliers, each of which is owed money for the last delivery; has a 10-year loan agreement with a domestic bank secured by a mortgage over the hotel's real estate property. A universal business charge (an enterprise charge) is also assumed in economies where such collateral is recognized. If the laws of the economy do not specifically provide for an enterprise charge but contracts commonly use some other provision to that effect, this provision is specified in the loan agreement; the business has observed the payment schedule and all other conditions of the loan up to now; has a market value, operating as a going concern, of 100 times income per capita or $200,000, whichever is greater. The market value of the company's assets, if sold piecemeal, is 70% of the market value of the business. Refer to indicator 1.3.1 for details regarding the distance to frontier measure.

Source: World Bank, Ease of Doing Business Index 2017: Equal Opportunity for All (2016). (http://www.doingbusiness.org/reports/global-reports/doing-business-2017)

1.3.3 Ease of paying taxes

Ease of paying taxes (distance to frontier)* | 2016

The ranking of economies on the ease of paying taxes is determined by sorting their distance to frontier scores for paying taxes. These scores are the simple average of the distance to frontier scores for each of the component indicators, with a threshold and a nonlinear transformation applied to one of the component indicators, the total tax rate. The 'threshold' is defined as the total tax rate at the 15th percentile of the overall distribution of the total tax rate indicator for all years included in the analysis up to and including *Doing Business 2015*. The threshold is set at 26.1%. All economies with a total tax rate below this threshold receive the same score as the economy at the threshold. The threshold is not based on any economic theory of an 'optimal tax rate' that minimizes distortions or maximizes efficiency in an economy's overall tax system. Instead, it is mainly empirical in nature, set at the lower end of the distribution of tax rates levied on medium-size enterprises in the manufacturing sector as observed through the paying taxes indicators. To make the data comparable across economies, several assumptions about the business and the taxes and contributions are used. The business: is a limited liability, taxable company. If there is more than one type of limited liability company in the economy, the limited liability form most common among domestic firms is chosen. The most common form is reported by incorporation lawyers or the statistical office; the business started operations on 1 January 2014. At that time the company purchased all the assets shown in its balance sheet and hired all its workers; it operates in the economy's largest business city. For 11 economies the data are also collected for the second largest business city; the business is 100% domestically owned and has five owners, all of whom are natural persons; at the end of 2014, it has a start-up capital of 102 times income per capita; performs general industrial or commercial activities. Specifically, it produces ceramic flowerpots and sells them at retail. It does not participate in foreign trade (no import or export) and does not handle products subject to a special tax regime, for example, liquor or tobacco; at the beginning of 2015, it owns two plots of land, one building, machinery, office equipment, computers, and one truck and leases one truck; does not qualify for investment incentives or any benefits apart from those related to the age or size of the company; has 60 employees—4 managers, 8 assistants, and 48 workers. All are nationals, and one manager is also an owner. The company pays for additional medical insurance for employees (not mandated by any law) as an additional benefit. In addition, in some economies reimbursable business travel and client entertainment expenses are considered fringe benefits. When applicable, it is assumed that the company pays the fringe benefit tax on this expense or that the benefit becomes taxable income for the employee. The case study assumes no additional salary for meals, transportation, education, or others. Therefore, even when such benefits are frequent, they are not added to or removed from the taxable gross salaries to arrive at the labour tax or contribution calculation; it has a turnover of 1,050 times income per capita; makes a loss in the first year of operation; has a gross margin (pretax) of 20% (that is, sales are 120% of the cost of goods sold); distributes 50% of its net profits as dividends to the owners at the end of the second year; sells one of its plots of land at a profit at the beginning of the second year; is subject to a series of detailed assumptions on expenses and transactions to further standardize the case. For example, the owner who is also a manager spends 10% of income per capita on traveling for the company (20% of this owner's expenses are purely private, 20% are for entertaining customers, and 60% are for business travel). All financial statement variables are proportional to 2012 income per capita as of and including *Doing Business 2014* (this is an update from *Doing Business 2013* and previous years' reports, where the variables were proportional to 2005 income per capita). For some economies a multiple of two or three times the income per capita has been used to estimate the financial statement variables. The 2012 income per capita was not sufficient to bring the salaries of all the case study employees up to the minimum wage thresholds that exist in these economies. Assumptions about the taxes and contributions: all the taxes and contributions recorded are those paid in the second year of operation (calendar year 2015). A tax or contribution is considered distinct if it has a different name or is collected by a different agency. Taxes and contributions with the same name and agency, but charged at different rates depending on the business, are counted as the same tax or contribution; the number of times the company pays taxes and contributions in a year is the number of different taxes or contributions multiplied by the frequency of payment (or withholding) for each tax. The frequency of payment includes advance payments (or withholding) as well as regular payments (or withholding). Refer to indicator 1.3.1 for details regarding the distance to frontier measure.

Source: World Bank, Ease of Doing Business Index 2017: Equal Opportunity for All (2016). (http://www.doingbusiness.org/reports/global-reports/doing-business-2017)

2 Human capital and research

2.1 Education

2.1.1 Expenditure on education

Government expenditure on education (% of GDP) | 2013

Government operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment, as a percentage of gross domestic product (GDP).

Source: UNESCO Institute for Statistics, UIS online database (2007–16). (http://data.uis.unesco.org/)

2.1.2 Government expenditure on education per pupil, secondary

Government expenditure per pupil, secondary (% of GDP per capita) | 2013

Government spending on education divided by the total number of secondary students, as a percentage of GDP per capita. Government expenditure (current and capital) includes government spending on educational institutions (both public and private), education administration, and subsidies for private entities (students/households and other private entities).

Source: UNESCO Institute for Statistics, UIS online database (2007–16). (http://data.uis.unesco.org/)

2.1.3 School life expectancy

School life expectancy, primary to tertiary education (years) | 2014

Total number of years of schooling that a child of a certain age can expect to receive in the future, assuming that the probability of his or her being enrolled in school at any particular age is equal to the current enrolment ratio for that age.

Source: UNESCO Institute for Statistics, UIS online database (2007–16). (http://data.uis.unesco.org)

2.1.4 Assessment in reading, mathematics, and science

PISA average scales in reading, mathematics, and science[a] | 2015

The Organisation for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) develops triennial international surveys that examine 15-year-old students' performance in reading, mathematics, and science. The scores are calculated in each year so that the mean is 500 and the standard deviation 100. The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem, and Israeli settlements in the West Bank under the terms of international law. B-S-J-G (China) refers to the four PISA-participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong. CABA (Argentina) refers to the adjudicated region of Ciudad Autónoma de Buenos Aires (CABA). FYROM refers to the Former Yugoslav Republic of Macedonia. Russia refers to the Russian Federation. 2015 scores from the United Arab Emirates are from Dubai. 2010 scores from India are from Himachal Pradesh and Tamil Nadu (average); 2010 scores from the Bolivarian Republic of Venezuela are from Miranda. The results of adjudication and subsequent further examinations showed that the PISA Technical Standards were met in all countries and economies that participated in PISA 2015 except for the following countries: In Albania, the PISA assessment was conducted in accordance with the operational standards and guidelines of the OECD. However, because of the ways in which the data were captured, it was not possible to match the data in the test with the data from the student questionnaire. As a result, Albania cannot be included in analyses that relate students' responses from the questionnaires to the test results. In Argentina, the PISA assessment was conducted in accordance with the operational standards and guidelines of the OECD. However, there was a significant decline in the proportion of 15-year-olds who were covered by the test, both in absolute and relative numbers. There had been a re-structuring of Argentina's secondary schools, except for those in the adjudicated region of Ciudad Autónoma de Buenos Aires, which is likely to have affected the coverage of eligible schools listed in the sampling frame. As a result, Argentina's results may not be comparable to those of other countries or to results for Argentina from previous years. In Kazakhstan, the national coders were found to be lenient in marking. Consequently, the human-coded items did not meet PISA standards and were excluded from the international data. Since human-coded items form an important part of the constructs that are tested by PISA, the exclusion of these items resulted in a significantly smaller coverage of the PISA test. As a result, Kazakhstan's results may not be comparable to those of other countries or to results for Kazakhstan from previous years. In Malaysia, the PISA assessment was conducted in accordance with the operational standards and guidelines of the OECD. However, the weighted response rate among the initially sampled Malaysian schools (51%) falls well short of the standard PISA response rate of 85%. Therefore, the results may not be comparable to those of other countries or to results for Malaysia from previous years.

Source: OECD Programme for International Student Assessment (PISA) (2010–15). (www.pisa.oecd.org/)

2.1.5 Pupil-teacher ratio, secondary

Pupil-teacher ratio, secondary[a,b] | 2015

The number of pupils enrolled in secondary school divided by the number of secondary school teachers (regardless of their teaching assignment). Where the data are missing for some countries, the ratios for upper-secondary are reported; if these are also missing, the ratios for lower-secondary are reported instead.

Source: UNESCO Institute for Statistics, UIS online database (2007–16). (http://data.uis.unesco.org)

2.2 Tertiary education

2.2.1 Tertiary enrolment

School enrolment, tertiary (% gross)[a] | 2015

The ratio of total tertiary enrolment, regardless of age, to the population of the age group that officially corresponds to the tertiary level of education. Tertiary education, whether or not at an advanced research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level.

Source: UNESCO Institute for Statistics, UIS online database (2007–16). (http://data.uis.unesco.org)

2.2.2 Graduates in science and engineering

Tertiary graduates in science, engineering, manufacturing, and construction (% of total tertiary graduates) | 2013

The share of all tertiary graduates in science, manufacturing, engineering, and construction out of all tertiary graduates. Because of the change in the International Standard Classification of Education (ISCED) fields of classification and the transition to new questionnaires, when countries did not report detailed data, the UIS was not able to re-assign numbers into new field classifications. As a result, the UIS was not able to produce this indicator for select countries, per recommendation of the UIS, the dataset from the Global Innovation Index 2016 was used.

Source: UNESCO Institute for Statistics, UIS online database (2006–14). (http://data.uis.unesco.org)

2.2.3 Tertiary-level inbound mobility

Tertiary-level inbound mobility rate (%)[a] | 2015

The number of students from abroad studying in a given country, as a percentage of the total tertiary enrolment in that country.

Source: UNESCO Institute for Statistics, UIS online database (2007–16). (http://data.uis.unesco.org)

2.3 Research and development (R&D)

2.3.1 Researchers

Researchers, full-time equivalence (FTE) (per million population) | 2015

Researchers per million population, full-time equivalence. Researchers in R&D are professionals engaged in the conception or creation of new knowledge, products, processes, methods, or systems and in the management of the projects concerned. Postgraduate PhD students (ISCED97 level 6) engaged in R&D are included.

Source: UNESCO Institute for Statistics, UIS online database (2007–15). (http://data.uis.unesco.org)

2.3.2 Gross expenditure on R&D (GERD)

GERD: Gross expenditure on R&D (% of GDP) | 2015

Total domestic intramural expenditure on R&D during a given period as a percentage of GDP. Intramural R&D expenditure is all expenditure for R&D performed within a statistical unit or sector of the economy during a specific period, whatever the source of funds.

Source: UNESCO Institute for Statistics, UIS online database (2007–15). (http://data.uis.unesco.org)

2.3.3 Global R&D companies, average expenditure top 3

Average expenditure of the top 3 global companies by R&D, mn $US* | 2016

Average expenditure on R&D of the top three global companies. If a country has fewer than three global companies listed, the figure is either the average of the sum of the two companies listed or the total for a single listed company. A score of zero is given to countries with no listed companies.

Source: EU JRC Industrial R&D Investment Scoreboard 2016. (http://iri.jrc.ec.europa.eu/scoreboard16.html)

2.3.4 QS university ranking average score of top 3 universities

Average score of the top 3 universities at the QS world university ranking* | 2016

Average score of the top three universities per country. If fewer than three universities are listed in the QS ranking of the global top 700 universities, the sum of the scores of the listed universities is divided by three, thus implying a score of zero for the non-listed universities.

Source: QS Quacquarelli Symonds Ltd, QS World University Ranking 2016/2017, Top Universities. (https://www.topuniversities.com/university-rankings/world-university-rankings/2016)

3 Infrastructure

3.1 Information and communication technologies (ICTs)

3.1.1 ICT access

ICT access index* | 2016

The ICT access index is a composite index that weights five ICT indicators (20% each): (1) Fixed telephone subscriptions per 100 inhabitants; (2) Mobile cellular telephone subscriptions per 100 inhabitants; (3) International Internet bandwidth (bit/s) per Internet user; (4) Percentage of households with a computer; and (5) Percentage of households with Internet access. It is the first sub-index in ITU's ICT Development Index (IDI).

Source: International Telecommunication Union, Measuring the Information Society 2016, ICT Development Index 2016. (http://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2016.aspx)

3.1.2 ICT use

ICT use index* | 2016

The ICT use index is a composite index that weights three ICT indicators (33% each): (1) Percentage of individuals using the Internet; (2) Fixed (wired)-broadband Internet subscriptions per 100 inhabitants; (3) Active mobile-broadband subscriptions per 100 inhabitants. It is the second sub-index in ITU's ICT Development Index (IDI).

Source: International Telecommunication Union, Measuring the Information Society 2016, ICT Development Index 2016. (http://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2016.aspx)

3.1.3 Government's online service

Government's online service index* | 2016

To arrive at a set of Online Service Index (OSI) values for 2016, a total of 111 researchers, including UN experts and online United Nations Volunteers (UNVs) from over 60 countries with coverage of 66 languages assessed each country's national website in the native language, including the national portal, e-services portal, and e-participation portal, as well as the websites of the related ministries of education, labour, social services, health, finance, and environment as applicable. The UNVs included qualified graduate students and volunteers from universities in the field of public administration.

Note: The precise meaning of these values varies from one edition of the Survey to the next as understanding of the potential of e-government changes and the underlying technology evolves. Read about the methodology at http://unpan3.un.org/egovkb/en-us/About/Methodology.

Source: United Nations Public Administration Network, e-Government Survey 2016. (https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2016)

3.1.4 Online e-participation

E-Participation Index* | 2016

The E-Participation Index (EPI) is derived as a supplementary index to the UN E-Government Survey. It extends the dimension of the Survey by focusing on the use of online services to facilitate provision of information by governments to citizens ('e-information sharing'), interaction with stakeholders ('e-consultation'), and engagement in decision-making processes.

A country's EPI reflects its e-participation mechanisms that are deployed by the government as compared to all other countries. The purpose of this measure is not to prescribe any particular practice, but rather to offer insight into how different countries are using online tools to promote interaction between citizen and government, as well as among citizens, for the benefit of all. Because the EPI is a qualitative assessment based on the availability and relevance of participatory services available on government websites, the comparative ranking of countries is for illustrative purposes and should serve only as an indicator of the broad trends in promoting citizen engagement. As with the E-Government Development Index (EGDI), the EPI is not intended as an absolute measurement of e-participation, but rather it attempts to capture the e-participation performance of counties relative to one another at a particular point in time. The index ranges from 0 to 1, with 1 showing greater e-participation.

Note: The precise meaning of these values varies from one edition of the Survey to the next as understanding of the potential of e-government changes and the underlying technology evolves. Read about the methodology at http://unpan3.un.org/egovkb/en-us/About/Methodology.

Source: United Nations Public Administration Network, e-Government Survey 2016. (https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2016)

3.2 General infrastructure

3.2.1 Electricity output

Electricity output (kWh per capita)[a] | 2014

Electricity production, measured at the terminals of all alternator sets in a station. In addition to hydropower, coal, oil, gas, and nuclear power generation, this indicator covers generation by geothermal, solar, wind, and tide and wave energy, as well as that from combustible renewables and waste. Production includes the output of electric plants that are designed to produce electricity only as well as that of combined heat and power plants. Electricity output in KWh is scaled by population.

Source: International Energy Agency (IEA) World Energy Balances on-line data service, 2015 edition (2014–15). (http://www.iea.org/statistics/)

3.2.2 Logistics performance

Logistics Performance Index*[a] | 2016

A multidimensional assessment of logistics performance, the Logistics Performance Index (LPI) ranks 160 countries on six dimensions of trade—including customs performance, infrastructure quality, and timeliness of shipments—that have increasingly been recognized as important to development. The data used in the ranking come from a survey of logistics professionals who are asked questions about the foreign countries in which they operate. The LPI's six components include: (1) the efficiency of customs and border management clearance ('Customs'); (2) the quality of trade and transport infrastructure ('Infrastructure'); (3) the ease of arranging competitively priced shipments ('Ease of arranging shipments'); (4) the competence and quality of logistics services—trucking, forwarding, and customs brokerage ('Quality of logistics services'); (5) the ability to track and trace consignments ('Tracking and tracing'); and (6) the frequency with which shipments reach consignees within scheduled or expected delivery times ('Timeliness'). The LPI uses standard statistical techniques to aggregate the data into a single indicator that can be used for cross-country comparisons.

Source: World Bank and Turku School of Economics, Logistics Performance Index 2016; Arvis et al., 2016, Connecting to Compete 2016: Trade Logistics in the Global Economy. (http://lpi.worldbank.org/)

3.2.3 Gross capital formation

Gross capital formation (% of GDP) | 2016

Gross capital formation is expressed as a ratio of total investment in current local currency to GDP in current local currency. Investment or gross capital formation is measured by the total value of the gross fixed capital formation and changes in inventories and acquisitions less disposals of valuables for a unit or sector, on the basis of the System of National Accounts (SNA) of 1993.

Source: International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP). (https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

3.3 Ecological sustainability

3.3.1 GDP per unit of energy use

GDP per unit of energy use (2010 PPP$ per kg of oil equivalent) | 2014

Purchasing power parity gross domestic product (PPP$ GDP) per kilogram of oil equivalent of energy use. Total primary energy supply (TPES) is made up of production + imports – exports – international marine bunkers – international aviation bunkers +/– stock changes.

Source: International Energy Agency (IEA) World Energy Balances on-line data service, 2016 edition (2014–15). (http://www.iea.org/statistics/)

3.3.2 Environmental performance

Environmental Performance Index* | 2015

This index ranks countries on 20 performance indicators tracked across policy categories that cover both environmental public health and ecosystem vitality. These indicators gauge how close countries are to established environmental policy goals. The index ranges from 0 to 100, with 100 indicating best performance.

Source: Yale University and Columbia University Environmental Performance Index 2016. (http://epi.yale.edu/)

3.3.3 ISO 14001 environmental certificates

ISO 14001 Environmental management systems—Requirements with guidance for use: Number of certificates issued (per billion PPP$ GDP)[a] | 2015

ISO 14001:2015 specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance. ISO 14001:2015 is intended for use by an organization seeking to manage its environmental responsibilities in a systematic manner that contributes to the environmental pillar of sustainability. ISO 14001:2015 helps an organization achieve the intended outcomes of its environmental management system, which provide value for the environment, the organization itself, and interested parties. Consistent with the organization's environmental policy, the intended outcomes of an environmental management system include enhancement of environmental performance, fulfilment of compliance obligations, and achievement of environmental objectives. ISO 14001:2015 is applicable to any organization, regardless of size, type, or nature, and applies to the environmental aspects of its activities, products, and services that the organization determines it can either control or influence from a life cycle perspective. ISO 14001:2015 does not state specific environmental performance criteria. ISO 14001:2015 can be used in whole or in part to systematically improve environmental management. Claims of conformity to ISO 14001:2015, however, are not acceptable unless all its requirements are incorporated into an organization's environmental management system and fulfilled without exclusion. The data are reported per billion PPP$ GDP.

Source: International Organization for Standardization, The ISO Survey 2015; International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP) (2015). (https://www.iso.org/the-iso-survey.html; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

4 Market sophistication

4.1 Credit

4.1.1 Ease of getting credit

Ease of getting credit (distance to frontier)* | 2016

The ranking of economies on the ease of getting credit is determined by sorting their distance to frontier scores for getting credit. These scores are the distance to frontier score for the sum of the strength of the legal rights index (range 0–12) and the depth of credit information index (range 0–8). *Doing Business* measures the legal rights of borrowers and lenders with respect to secured transactions through one set of indicators and the reporting of credit information through another. The first set of indicators measures whether certain features that facilitate lending exist within the applicable collateral and bankruptcy laws. The second set measures the coverage, scope, and accessibility of credit information available through credit reporting service providers such as credit bureaus or credit registries. Although *Doing Business* compiles data on getting credit for public registry coverage (% of adults) and for private bureau coverage (% of adults), these indicators are not included in the ranking. Refer to indicator 1.3.1 for details regarding the distance to frontier measure.

Source: World Bank, Ease of Doing Business Index 2017: Equal Opportunity for All (2016). (http://www.doingbusiness.org/reports/global-reports/doing-business-2017)

4.1.2 Domestic credit to private sector

Domestic credit to private sector (% of GDP) | 2015

Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. The financial corporations include monetary authorities and deposit money banks, as well as other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other financial corporations are finance and leasing companies, money lenders, insurance corporations, pension funds, and foreign exchange companies.

Source: International Monetary Fund, International Financial Statistics and data files; and World Bank and OECD GDP estimates; extracted from the World Bank's World Development Indicators database (2008–15). (http://data.worldbank.org/)

4.1.3 Microfinance institutions' gross loan portfolio

Microfinance institutions: Gross loan portfolio (% of GDP) | 2015

Combined gross loan balances per microfinance institution (current US$), divided by GDP (current US$) and multiplied by 100.

Source: Microfinance Information Exchange, Mix Market database; International Monetary Fund, World Economic Outlook Database, October 2016 (current US$ GDP) (2007–15). (https://reports.themix.org/; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

4.2 Investment

4.2.1 Ease of protecting minority investors

Ease of protecting minority investors (distance to frontier)* | 2016

The ranking is the simple average of the distance to frontier scores for the extent of conflict of interest regulation index and the extent of shareholder governance index. The extent of conflict of interest regulation index measures the protection of shareholders against directors' misuse of corporate assets for personal gain by distinguishing three dimensions of regulation that address conflicts of interest: transparency of related-party transactions (extent of disclosure index), shareholders' ability to sue and hold directors liable for self-dealing (extent of director liability index), and access to evidence and allocation of legal expenses in shareholder litigation. The extent of shareholder governance index measures shareholders' rights in corporate governance by distinguishing three dimensions of good governance: shareholders' rights and role in major corporate decisions (extent of shareholder rights index); governance safeguards protecting shareholders from undue board control and entrenchment (extent of ownership and control index); and corporate transparency on ownership stakes, compensation, audits, and financial prospects (extent of corporate transparency index). The index also measures whether a subset of relevant rights and safeguards are available in limited companies. The data come from a questionnaire administered to corporate and securities lawyers and are based on securities regulations, company laws, civil procedure codes, and court rules of evidence. Refer to indicator 1.3.1 for details regarding the distance to frontier measure.

Source: World Bank, Ease of Doing Business Index 2017: Equal Opportunity for All (2016). (http://www.doingbusiness.org/reports/global-reports/doing-business-2017)

4.2.2 Market capitalization

Market capitalization of listed domestic companies (% of GDP)[a] | 2015

Market capitalization (also known as 'market value') is the share price times the number of shares outstanding (including their several classes) for listed domestic companies. Investment funds, unit trusts, and companies whose only business goal is to hold shares of other listed companies are excluded. Data are end-of-year values.

Source: World Federation of Exchanges database; extracted from the World Bank's World Development Indicators database (2008–15). (http://data.worldbank.org/)

4.2.3 Venture capital deals

Venture capital per investment location: Number of deals (per billion PPP$ GDP)[a] | 2016

Thomson Reuters data on private equity deals, per deal, with information on the location of investment, investment company, investor firms, and funds, among other details. The data are reported per billion PPP$ GDP.

Note: Formerly the Intellectual Property and Science business of Thomson Reuters, *Clarivate Analytics* is now an independent company.

Source: Thomson Reuters, Thomson One Banker Private Equity database; International Monetary Fund, World Economic Outlook Database October 2016 (PPP$ GDP) (2015–16). (https://www.thomsonone.com; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

4.3 Trade, competition, and market scale

4.3.1 Applied tariff rate, weighted mean

Tariff rate, applied, weighted mean, all products (%)[a,b] | 2015

Weighted mean applied tariff is the average of effectively applied rates weighted by the product import shares corresponding to each partner country. Data are classified using the Harmonized System of trade at the six- or eight-digit level. Tariff line data were matched to Standard International Trade Classification (SITC) revision 3 codes to define commodity groups and import weights. To the extent possible, specific rates have been converted to their ad valorem equivalent rates and have been included in the calculation of weighted mean tariffs. Import weights were calculated using the United Nations Statistics Division's Commodity Trade (Comtrade) database. Effectively applied tariff rates at the six- and eight-digit product level are averaged for products in each commodity group. When the effectively applied rate is unavailable, the most favoured nation rate is used instead.

Source: World Bank, based on data from United Nations Conference on Trade and Development's Trade Analysis and Information System (TRAINS) database and the World Trade Organization's (WTO) Integrated Data Base (IDB) and Consolidated Tariff Schedules (CTS) database; extracted from World Bank World Development Indicators database (2011–15). (http://data.worldbank.org/)

4.3.2 Intensity of local competition

Average answer to the survey question: In your country, how intense is competition in the local markets? [1 = not intense at all; 7 = extremely intense][†a] | 2016

Source: World Economic Forum, Executive Opinion Survey 2016–2017. (https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1)

4.3.3 Domestic market scale

Domestic market size as measured by GDP, bn PPP$ | 2016

The domestic market size is measured by gross domestic product (GDP) based on the purchasing-power-parity (PPP) valuation of country GDP, in current international dollars (billions).

Source: World Bank, International Monetary Fund, World Economic Outlook Database October 2016 (PPP$ GDP) (2016). (https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

5 Business sophistication

5.1 Knowledge workers

5.1.1 Employment in knowledge-intensive services

Employment in knowledge-intensive services (% of workforce) | 2015

Sum of people in categories 1 to 3 as a percentage of total people employed, according to the International Standard Classification of Occupations (ISCO). Categories included are: ISCO-08: 1 Managers, 2 Professionals, and 3 Technicians and associate professionals (years 2007–15); ISCO-88: 1 Legislators, senior officials and managers, 2 Professionals, 3 Technicians and associate professionals (2007–15); ISCO-68: 1 Professional, technical and related workers (category 0 Armed forces is excluded), 2 Administrative and managerial workers, 3 Clerical and related workers (years 2007–08).

Source: International Labour Organization ILOSTAT Database of Labour Statistics (2007–15). (http://www.ilo.org/ilostat/)

5.1.2 Firms offering formal training

Firms offering formal training (% of firms) | 2013

The percentage of firms offering formal training programs for their permanent, full-time employees. The time period of data for Guinea includes 2006 for heightened coverage based on this economy's GII 2016 data availability.

Source: World Bank, Enterprise Surveys (2006–16). (http://www.enterprisesurveys.org/).

5.1.3 GERD performed by business enterprise

GERD: Performed by business enterprise (% of GDP)[a] | 2015

Gross expenditure on R&D performed by business enterprise as a percentage of GDP.

Source: UNESCO Institute for Statistics, UIS online database (2007–15). (http://data.uis.unesco.org)

5.1.4 GERD financed by business enterprise

GERD: Financed by business enterprise (% of total GERD)[a] | 2015

Gross expenditure on R&D financed by business enterprise as a percentage of total gross expenditure on R&D.

Source: UNESCO Institute for Statistics, UIS online database (2007–16). (http://data.uis.unesco.org)

5.1.5 Females employed with advanced degrees

Females employed with advanced degrees, % total employed (25+ years old)[a] | 2015

The percentage of females employed with advanced degrees out of total employed. The employed comprise all persons of working age who, during a specified brief period, were in one of the following categories: (1) paid employment (whether at work or with a job but not at work); or (2) self-employment (whether at work or with an enterprise but not at work). Data are disaggregated by level of education, which refers to the highest level of education completed, classified according to the International

Standard Classification of Education (ISCE).

Source: International Labour Organization, ILOSTAT Annual Indicators (2009–16); and Statistics Canada, Table 282-0004; Labour Force Survey estimates (LFS) by educational attainment, sex and age group, annual, CANSIM, accessed 9 February 2017. (http://www.ilo.org/ilostat/; http://laborsta.ilo.org/; http://www.statcan.gc.ca/)

5.2 Innovation linkages

5.2.1 University/industry research collaboration

Average answer to the survey question: In your country, to what extent do businesses and universities collaborate on research and development (R&D)? [1 = do not collaborate at all; 7 = collaborate extensively][†a] | 2016

Source: World Economic Forum, Executive Opinion Survey 2016–2017. (https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1)

5.2.2 State of cluster development

Average answer to the survey question on the role of clusters in the economy: In your country, how widespread are well-developed and deep clusters (geographic concentrations of firms, suppliers, producers of related products and services, and specialized institutions in a particular field)? [1 = nonexistent; 7 = widespread in many fields][†] | 2016

Source: World Economic Forum, Executive Opinion Survey 2016–2017. (https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1)

5.2.3 GERD financed by abroad

GERD: Financed by abroad (% of total GERD) | 2015

Percentage of gross expenditure on R&D financed by abroad—i.e., with foreign financing.

Source: UNESCO Institute for Statistics, UIS online database (2007–16). (http://data.uis.unesco.org)

5.2.4 Joint venture/strategic alliance deals

Joint ventures/strategic alliances: Number of deals, fractional counting (per billion PPP$ GDP)[a] | 2016

Thomson Reuters data on joint ventures/strategic alliances deals, per deal, with details on the country of origin of partner firms, among others. For each year, each participating nation of each company in a deal (*n* countries per deal) gets, per deal, a score equivalent to 1/*n* (with the effect that all country scores add up to the number of deals reported that year). The data are reported per billion PPP$ GDP.

Note: Formerly the Intellectual Property and Science business of Thomson Reuters, *Clarivate Analytics* is now an independent company.

Source: Thomson Reuters, Thomson One Banker Private Equity, SDC Platinum database; International Monetary Fund World Economic Outlook Database, October 2016 (PPP$ GDP) (2015–16). (http://banker.thomsonib.com; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

5.2.5 Patent families filed in two offices

Number of patent families filed by residents in at least two offices (per billion PPP$ GDP)[a] | 2013

A 'patent family' is a set of interrelated patent applications filed in one or more countries or jurisdictions to protect the same invention. Patent families containing applications filed in at least two different offices is a subset of patent families where protection of the same invention is sought in at least two different countries. In this report, 'patent families data' refers to patent applications filed by residents in at least two IP offices; the data are scaled by PPP$ GDP (billions). A 'patent' is a set of exclusive rights granted by law to applicants for inventions that are new, non-obvious, and commercially applicable. A patent is valid for a limited period of time (generally 20 years), during which patent holders can commercially exploit their inventions on an exclusive basis. In return, applicants are obliged to disclose their inventions to the public in a manner that enables others, skilled in the art, to replicate the invention. The patent system is designed to encourage innovation by providing innovators with time-limited exclusive legal rights, thus enabling them to appropriate the returns from their innovative activity.

Source: World Intellectual Property Organization, Intellectual Property Statistics; International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP) (2008–13). (http://www.wipo.int//ipstats/; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

5.3 Knowledge absorption

5.3.1 Intellectual property payments

Charges for use of intellectual property n.i.e., payments (%, total trade)[a] | 2015

Charges for the use of intellectual property not included elsewhere payments (% of total trade) according to the Extended Balance of Payments Services Classification EBOPS 2010—that is, code SH Charges for the use of intellectual property not included elsewhere as a percentage of total trade. 'Total trade' is defined as the sum of total imports code G goods and code SOX commercial services (excluding government goods and services not included elsewhere) plus total exports of code G goods and code SOX commercial services (excluding government goods and services not included elsewhere), divided by 2. According to the sixth edition of the International Monetary Fund's *Balance of Payments Manual*, the item 'Goods' covers general merchandise, net exports of goods under merchanting and nonmonetary gold. The 'commercial services' category is defined as being equal to 'services' minus 'government goods and services not included elsewhere'. Receipts are between residents and nonresidents for the use of proprietary rights (such as patents, trademarks, copyrights, industrial processes and designs including trade secrets, franchises), and for licenses to reproduce or distribute (or both) intellectual property embodied in produced originals or prototypes (such as copyrights on books and manuscripts, computer software, cinematographic works, and sound recordings) and related rights (such as for live performances and television, cable, or satellite broadcast).

Source: World Trade Organization, Trade in Commercial Services database, based on the sixth (2009) edition of the International Monetary Fund's Balance of Payments Manual and Balance of Payments database (2009–15). (http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx; http://www.oecd.org/std/its/EBOPS-2010.pdf)

5.3.2 High-tech imports

High-tech net imports (% of total trade) | 2015

High-technology imports minus re-imports (% of total trade). The list of commodities contains technical products with a high intensity of R&D, based on the Eurostat classification, itself based on SITC Rev.4 and the Organisation for Economic Co-operation and Development (OECD) definition. Commodities belong to the following sectors: aerospace; computers & office machines; electronics, telecommunications; pharmacy; scientific instruments; electrical machinery; chemistry; non-electrical machinery; and armament.

Source: United Nations, COMTRADE database; Eurostat, Annex 5: High-tech aggregation by SITC Rev. 4, April 2009 (2010–15). (http://comtrade.un.org/; http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an5.pdf)

5.3.3 ICT services imports
Telecommunications, computers, and information services imports (% of total trade) | 2015

Telecommunications, computer and information services (% of total trade) according to the Extended Balance of Payments Services Classification EBOPS 2010, coded SI: Telecommunications, computer and information services.

Source: World Trade Organization, Trade in Commercial Services database, based on the sixth (2009) edition of the International Monetary Fund's Balance of Payments Manual and Balance of Payments database (2009–15). (http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx; http://www.oecd.org/std/its/EBOPS-2010.pdf)

5.3.4 Foreign direct investment net inflows
Foreign direct investment (FDI), net inflows (% of GDP, three-year average) | 2015

Foreign direct investment is the average of the most recent three years of net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.

Source: International Monetary Fund, International Financial Statistics and Balance of Payments databases, World Bank, International Debt Statistics, and World Bank and OECD GDP estimates; extracted from the World Bank's World Development Indicators database (2013–15). (http://data.worldbank.org/)

5.3.5 Research talent in business enterprise
Researchers in business enterprise (%) | 2015

Full-time equivalence (FTE) researchers in the business enterprise sector refers to 'researchers' as professionals engaged in the conception or creation of new knowledge, products, processes, methods, and systems, as well as in the management of these projects, broken down by the sectors in which they are employed (business enterprise, government, higher education, and private non-profit organizations). In the context of R&D statistics, the business enterprise sector includes all firms, organizations, and institutions whose primary activity is the market production of goods or services (other than higher education) for sale to the general public at an economically significant price, and the private non-profit institutions mainly serving them; the core of this sector is made up of private enterprises. This also includes public enterprises.

Source: UNESCO Institute for Statistics, UIS online database (2007–15); (http://data.uis.unesco.org)

6 Knowledge and technology outputs

6.1 Knowledge creation

6.1.1 Patent applications by origin
Number of resident patent applications filed at a given national or regional patent office (per billion PPP$ GDP)[a] | 2015

'Patent' is defined in the description of indicator 5.2.5. A 'resident patent application' refers to an application filed with an IP office or an office acting on behalf of the state or jurisdiction in which the first-named applicant has residence. For example, an application filed with the Japan Patent Office (JPO) by a resident of Japan is considered a resident application for Japan. Similarly, an application filed with the European Patent Office (EPO) by an applicant who resides in any of the EPO member states, for example, Germany, is considered a resident application for that member state (Germany).

Source: World Intellectual Property Organization, Intellectual Property Statistics; International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP) (2010–15). (http://www.wipo.int/ipstats/; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

6.1.2 PCT international applications by origin
Number of international patent applications filed by residents at the Patent Cooperation Treaty (per billion PPP$ GDP)[a] | 2016

These are the number of Patent Cooperation Treaty (PCT) international patent applications filed through the WIPO-administered Patent Cooperation Treaty in 2016. A 'PCT international application' refers to a patent application filed through the WIPO-administered Patent Cooperation Treaty (PCT) during the international phase outlined by the PCT System. The origin of PCT applications are defined by the residence of the first-named applicant. The PCT System facilitates the filing of patent applications worldwide, making it possible to seek patent protection for an invention simultaneously in each of a large number of countries by first filing a single international patent application.

Source: World Intellectual Property Organization, Intellectual Property Statistics; International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP) (2014–16). (http://www.wipo.int/ipstats/; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

6.1.3 Utility model applications by origin
Number of utility model applications filed by residents at the national patent office (per billion PPP$ GDP) | 2015

These are the number of resident utility model applications filed at a given national or regional patent office in 2014. A 'resident UM application' refers to an application filed with an IP office of, or an office acting on behalf of, the state or jurisdiction in which the first-named applicant has residence. For example, an application filed with the IP office of Germany by a resident of Germany is considered a resident application for Germany. A utility model grant is a special form of patent right issued by a state or jurisdiction to an inventor or the inventor's assignee for a fixed period of time. The terms and conditions for granting a utility model are slightly different from those for normal patents and include a shorter term of protection and less stringent patentability requirements. A utility model is sometimes referred to in certain countries as 'petty patents', 'short-term patents', or 'innovation patents'.

Source: World Intellectual Property Organization, Intellectual Property Statistics; International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP) (2010–15). (http://www.wipo.int/ipstats/; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

6.1.4 Scientific and technical publications
Number of scientific and technical journal articles (per billion PPP$ GDP)[a] | 2016

The number of scientific and engineering articles published in those fields, including: agriculture, astronomy, astrophysics, automation control systems, biochemistry molecular biology, biodiversity conservation, biotechnology applied microbiology, cell biology, chemistry, computer science, construction building technology, dentistry oral surgery medicine, engineering, environmental sciences, ecology, evolutionary biology, food science technology, general internal medicine, life sciences and biomedicine, marine freshwater biology, materials science, mathematical computational biology, mathematics, metallurgy and metallurgical engineering, meteorology atmospheric science, microbiology, nuclear science and technology, plant sciences, radiology nuclear medicine medical imaging, reproductive biology, research experimental medicine, science and technology, telecommunications, telecommunications, transportation, and veterinary sciences. Article counts are from a set of journals covered by the Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI). Articles are classified by year of publication and assigned to each country/economy on the basis of the institutional address(es) listed in the article. Articles are counted on a count basis (rather than a fractional basis)—that is, for articles with collaborating institutions from multiple countries/economies, each country/economy receives credit on the basis of its participating institutions. The data are reported per billion PPP$ GDP.

Note: Formerly the Intellectual Property and Science business of Thomson Reuters, *Clarivate Analytics* is now an independent company.

Source: Clarivate Analytics, special tabulations from Thomson Reuters, Web of Science, Science Citation Index (SCI) and Social Sciences Citation Index (SSCI); International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP) (2016). (https://apps.webofknowledge.com; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

6.1.5 Citable documents H index

The H index is the economy's number of published articles (H) that have received at least H citations*[a] | 2016

The H index expresses the journal's number of articles (H) that have received at least H citations. It quantifies both journal scientific productivity and scientific impact, and is also applicable to scientists, journals, etc. The H index is tabulated from the number of citations received in subsequent years by articles published in a given year, divided by the number of articles published that year.

Source: SCImago (2017) SJR—SCImago Journal & Country Rank. Retrieved February 2017. (http://www.scimagojr.com)

6.2 Knowledge impact

6.2.1 Growth rate of GDP per person engaged

Growth rate of GDP per person engaged (constant 1990 PPP$) | 2015

Growth of gross domestic product (GDP) per person engaged provides a measure of labour productivity (defined as output per unit of labour input). GDP per person employed is GDP divided by total employment in the economy. PPP$ GDP is converted to 1990 US$, converted at Geary Khamis PPPs.

Source: The Conference Board Total Economy Database™ Output, Labor and Labor Productivity, 1950–2016, May 2016. (https://www.conference-board.org/data/economydatabase/)

6.2.2 New business density

New business density (new registrations per thousand population 15–64 years old)[a] | 2014

Number of new firms, defined as firms registered in the current year of reporting, per thousand population aged 15–64 years old.

Source: World Bank, Doing Business 2016, Entrepreneurship (2009–14). (http://www.doingbusiness.org/data/exploretopics/entrepreneurship)

6.2.3 Total computer software spending

Total computer software spending (% of GDP)[a] | 2016

Computer software spending includes the total value of purchased or leased packaged software such as operating systems, database systems, programming tools, utilities, and applications. It excludes expenditures for internal software development and outsourced custom software development. The data are a combination of actual figures and estimates. Data are reported as a percentage of GDP.

Source: IHS Global Insight, Information and Communication Technology Database. (https://www.ihs.com/index.html)

6.2.4 ISO 9001 quality certificates

ISO 9001 Quality management systems—Requirements: Number of certificates issued (per billion PPP$ GDP)[a] | 2015

ISO 9001:2015 specifies requirements for a quality management system when an organization needs to demonstrate its ability to consistently provide products and services that meet customer and applicable statutory and regulatory requirements, and aims to enhance customer satisfaction through the effective application of the system, including processes for improvement of the system and the assurance of conformity to customer and applicable statutory and regulatory requirements. All the requirements of ISO 9001:2015 are generic and are intended to be applicable to any organization, regardless of its type or size, or the products and services it provides. The data are reported per billion PPP$ GDP. Refer to indicator 3.3.3 for more details.

Source: International Organization for Standardization (ISO), The ISO Survey of Management System Standard Certifications, 1993–2015; International Monetary Fund, World Economic Outlook database, October 2016 (PPP$ GDP) (2015). (http://www.iso.org; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

6.2.5 High-tech and medium-high-tech output

High-tech and medium-high-tech output (% of total manufactures output)[a] | 2014

High-tech and medium-high-tech output as a percentage of total manufactures output, on the basis of the Organisation for Economic Co-operation and Development (OECD) classification of Technology Intensity Definition, itself based on International Standard Industrial Classification ISIC Revision 3. The time periods of data for Iceland, Madagascar, and Pakistan include 2006 for heightened coverage based on these economies' GII 2016 data availability.

Source: United Nations Industrial Development Organization (UNIDO), Industrial Statistics Database, 3- and 4-digit level of International Standard Industrial Classification ISIC Revision 3 (INDSTAT4 2016); OECD, Directorate for Science, Technology and Industry, Economic Analysis and Statistics Division, 'ISIC REV. 3 Technology Intensity Definition: Classification of Manufacturing Industries into Categories Based on R&D Intensities', 7 July 2011 (2006–14). (http://www.unido.org/statistics.html; http://unstats.un.org/unsd/cr/registry/regcst.asp?cl=27; http://www.oecd.org/sti/ind/48350231.pdf)

6.3 Knowledge diffusion

6.3.1 Intellectual property receipts

Charges for use of intellectual property n.i.e., receipts (%, total trade)[a] | 2015

Charges for the use of intellectual property not included elsewhere receipts (% of total trade) according to the Extended Balance of Payments Services Classification EBOPS 2010—that is, code SH Charges for the use of intellectual property not included elsewhere as a percentage of total trade. 'Total trade' is defined as the sum of total imports code G goods and code SOX commercial services (excluding government goods and services not included elsewhere) plus total exports of code G goods and code SOX commercial services (excluding government goods and services not included elsewhere), divided by 2. According to the sixth edition of the International Monetary Fund's *Balance of Payments*

Manual, the item 'Goods' covers general merchandise, net exports of goods under merchanting and nonmonetary gold. The 'commercial services' category is defined as being equal to 'services' minus 'government goods and services not included elsewhere'. Receipts are between residents and nonresidents for the use of proprietary rights (such as patents, trademarks, copyrights, industrial processes, and designs including trade secrets, franchises), and for licenses to reproduce or distribute (or both) intellectual property embodied in produced originals or prototypes (such as copyrights on books and manuscripts, computer software, cinematographic works, and sound recordings) and related rights (such as for live performances and television, cable, or satellite broadcast).

Source: World Trade Organization, Trade in Commercial Services database, based on the sixth (2009) edition of the International Monetary Fund's Balance of Payments Manual and Balance of Payments database (2007–15). (http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx; http://www.oecd.org/std/its/EBOPS-2010.pdf)

6.3.2 High-tech exports

High-tech net exports (% of total trade)[a] | 2015

High-technology exports minus re-exports (% of total trade). See indicator 5.3.2 for details.

Source: United Nations, COMTRADE database; Eurostat, Annex 5: High-tech aggregation by SITC Rev. 4, April 2009 (2010–15). (http://comtrade.un.org/; http://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an5.pdf)

6.3.3 ICT services exports

Telecommunications, computers, and information services exports (% of total trade)[a] | 2015

Telecommunications, computer and information services (% of total trade) according to the Extended Balance of Payments Services Classification EBOPS 2010, coded SI: Telecommunications, computer and information services.

Source: World Trade Organization, Trade in Commercial Services database, based on the sixth (2009) edition of the International Monetary Fund's Balance of Payments Manual and Balance of Payments database (2009–15). (http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx; http://www.oecd.org/std/its/EBOPS-2010.pdf)

6.3.4 Foreign direct investment net outflows

Foreign direct investment (FDI), net outflows (% of GDP, three-year average)[a] | 2015

Foreign direct investment refers to the average of the most recent three years of direct investment equity flows in an economy. It is the sum of equity capital, reinvestment of earnings, and other capital. Direct investment is a category of cross-border investment associated with a resident in one economy having control or a significant degree of influence on the management of an enterprise that is resident in another economy. Ownership of 10 percent or more of the ordinary shares of voting stock is the criterion for determining the existence of a direct investment relationship. This series shows net outflows of investment from the reporting economy to the rest of the world, and is divided by GDP.

Source: International Monetary Fund, Balance of Payments database, supplemented by data from the United Nations Conference on Trade and Development and official national sources; extracted from the World Bank's World Development Indicators database (2013–15). (http://data.worldbank.org/)

7 Creative outputs

7.1 Intangible assets

7.1.1 Trademark application class count by origin

Number of trademark applications issued to residents at a given national or regional office (per billion PPP$ GDP) | 2015

The count of trademark applications is based on the total number of goods and services classes specified in resident trademark applications filed at a given national or regional office in 2015. Data refer to trademark application class counts—the number of classes specified in resident trademark applications—and include those filed at both the national office and the regional office, where applicable. Data are scaled by PPP$ GDP (billions). A 'trademark' is a sign used by the owner of certain products or provider of certain services to distinguish them from the products or services of other companies. A trademark can consist of words and/or combinations of words, such as slogans, names, logos, figures and images, letters, numbers, sounds and moving images, or a combination thereof. The procedures for registering trademarks are governed by the legislation and procedures of national and regional IP offices. Trademark rights are limited to the jurisdiction of the IP office that registers the trademark. Trademarks can be registered by filing an application at the relevant national or regional office(s) or by filing an international application through the Madrid System. A resident trademark application is one that is filed with an IP office or an office acting on behalf of the state or jurisdiction in which the applicant has residence. For example, an application filed with the Japan Patent Office (JPO) by a resident of Japan is considered a resident application for Japan. Similarly, an application filed with the Office for Harmonization in the Internal Market (OHIM) by an applicant who resides in any of the EU member states, such as France, is considered a resident application for that member state (France).

Source: World Intellectual Property Organization, Intellectual Property Statistics; International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP) (2010–15). (http://www.wipo.int//ipstats/; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

7.1.2 Industrial designs by origin

Number of designs contained in industrial design applications filed at a given national or regional office (per billion PPP$ GDP)[a] | 2015

This indicator refers to the number of designs contained in industrial design applications filed at a given national or regional office in 2015. Data refer to industrial design application design counts—the number of designs contained in applications—and include designs contained in resident industrial design applications filed at both the national office and at the regional office, where applicable. 'Resident design counts' refers to the number of designs contained in applications filed with the IP office of or at an office acting on behalf of the state or jurisdiction in which the applicant has residence. For example, an application filed with the Japan Patent Office (JPO) by a resident of Japan is considered a resident application for Japan. Similarly, an application filed with the Office for Harmonization in the Internal Market (OHIM) by an applicant who resides in any of the OHIM member states, such as Italy, is considered as a resident application for that member state (Italy).

Source: World Intellectual Property Organization, Intellectual Property Statistics; International Monetary Fund, World Economic Outlook Database, October 2016 (PPP$ GDP) (2013–15). (http://www.wipo.int//ipstats/; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx)

7.1.3 ICTs and business model creation

Average answer to the question: In your country, to what extent do ICTs enable new business models? [1 = not at all; 7 = to a great extent][†] | 2016

Source: World Economic Forum, Executive Opinion Survey 2016–2017. (https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1)

7.1.4 ICTs and organizational model creation

Average answer to the question: In your country, to what extent do ICTs enable new organizational models (e.g., virtual teams, remote working, telecommuting) within companies? [1 = not at all; 7 = to a great extent][†] | 2016

Source: World Economic Forum, Executive Opinion Survey 2016–2017. (https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1)

7.2 Creative goods and services

7.2.1 Cultural and creative services exports

Cultural and creative services exports (% of total trade)[a] | 2015

Creative services exports (% of total exports) according to the Extended Balance of Payments Services Classification EBOPS 2010—that is, EBOPS code SI3 Information services; code SJ22 Advertising, market research, and public opinion polling services; code SK1 Audiovisual and related services; and code SK24 Other personal cultural and recreational services as a percentage of total trade. On the score for the United States of America (USA), this includes SI3 Information services; the category Movies & TV programming from Table 2.1 (U.S. Trade in Services, BEA) in the absence of available data for code SK1 Audiovisual and related services (the category Movies & TV programming is specific to the USA in BPM6 statistics and does not have a code); Sports and performing arts (U.S. Trade in Services, BEA) is used instead of code SK24; Advertising (U.S. Trade in Services, BEA) is used instead of code SJ22.

Source: World Trade Organization, Trade in Commercial Services database, based on the sixth (2009) edition of the International Monetary Fund's Balance of Payments Manual and Balance of Payments database; Bureau of Economic Analysis (BEA) released October 2016 (2007–15). (http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx; http://www.oecd.org/std/its/EBOPS-2010.pdf; https://www.bea.gov/iTable/iTable.cfm)

7.2.2 National feature films produced

Number of national feature films produced (per million population 15–69 years old)[a] | 2015

A film with a running time of 60 minutes or longer. It includes works of fiction, animation, and documentaries. It is intended for commercial exhibition in cinemas. Feature films produced exclusively for television broadcasting, as well as newsreels and advertising films, are excluded. Data are reported per million population 15–69 years old. For Cambodia, Cameroon, Madagascar, and Nigeria, this indicator covers only feature films in video format.

Source: UNESCO Institute for Statistics, UIS online database; United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2015 Revision (population) (2008–15). (http://data.uis.unesco.org; http://esa.un.org/unpd/wpp/)

7.2.3 Global entertainment and media market

Global entertainment and media market (per thousand population 15–69 years old)[*a] | 2015

The Global Entertainment and Media Outlook (the Outlook) provides a single comparable source of five-year forecast and five-year historic consumer and advertiser spending data and commentary for 13 entertainment and media segments, across 61 countries. The data and intuitive online functionality allow one to easily browse, compare and contrast spending, and create charts and graphs. The segments covered by the Outlook are book publishing, business-to-business, filmed entertainment, Internet access, Internet advertising, magazine publishing, music, newspaper publishing, out-of-home advertising, radio, TV advertising, TV subscriptions and license fees, and video games. The score and rankings for the Global Media Expenditures for the 60 countries considered in the Outlook report are based on advertising and consumer digital and non-digital data in US$ millions at average 2015 exchange rates for the year 2015. These results are reported normalized per thousand population, 15–69 years old, for the year 2015. The figures for Algeria, Bahrain, the Islamic Republic of Iran, Jordan, Kuwait, Lebanon, Malta, Morocco, Oman, Qatar, Tunisia, and the Republic of Yemen were estimated from a total corresponding to Middle East and North Africa (MENA) countries using a breakdown of total GDP (current US$) for the above-mentioned countries to define referential percentages.

Source: The source of the data for the base of these calculations was derived from PwC's Global Entertainment and Media Outlook, 2016–2020; United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2015 Revision (population); World Economic Outlook Database, October 2016 (current US$ GDP); Middle East & North Africa in World Bank's DataBank. (http://www.pwc.com/outlook; http://esa.un.org/unpd/wpp/ ; https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx; http://data.worldbank.org/region/middle-east-and-north-africa)

7.2.4 Printing and publishing output

Printing and publishing manufactures output (% of manufactures total output) | 2014

Publishing, printing, and reproduction of recorded media output (ISIC Rev. 3 code 22) as a percentage of total manufacturing output (ISIC rev.3 code D). The time periods of data for Iceland, Madagascar, and Pakistan include 2006 for heightened coverage based on these economies' GII 2016 data availability.

Source: United Nations Industrial Development Organization, Industrial Statistics Database; 2-digit level of International Standard Industrial Classification ISIC Revision 3 (INDSTAT2 2015) (2006–14). (http://www.unido.org/statistics.html; http://unstats.un.org/unsd/cr/registry/regcst.asp?cl=2)

7.2.5 Creative goods exports

Creative goods exports (% of total trade) | 2015

Total value of creative goods exports, net of re-exports (current US$) over total trade. 'Total trade' is defined as the sum of total imports code G goods and code SOX commercial services (excluding government goods and services not included elsewhere) plus total exports of code G goods and code SOX commercial services (excluding government goods and services not included elsewhere), divided by 2. According to the sixth edition of the International Monetary Fund's *Balance of Payments Manual*, the item 'Goods' covers general merchandise, net exports of goods under merchanting and non-monetary gold. The 'commercial services' category is defined as being equal to 'services' minus 'government goods and services not included elsewhere'.

Source: United Nations, COMTRADE database; 2009 UNESCO Framework for Cultural Statistics, Table 3, International trade of cultural goods and services based on the 2007 Harmonised System (HS 2007); World Trade Organization, Trade in Commercial Services database, itself based on the sixth (2009) edition of the International Monetary Fund's Balance of Payments Manual and Balance of Payments database (2010–15). (http://comtrade.un.org/; http://www.uis.unesco.org/culture/Documents/framework-cultural-statistics-culture-2009-en.pdf; http://stat.wto.org/StatisticalProgram/WSDBStatProgramSeries.aspx; http://www.oecd.org/std/its/EBOPS-2010.pdf)

7.3 Online creativity

7.3.1 Generic top-level domains (gTLDs)

Generic top-level domains (gTLDs) (per thousand population 15–69 years old) | 2016

A generic top-level domain (gTLD) is one of the categories of top-level domains (TLDs) maintained by the Internet Assigned Numbers Authority (IANA) for use in the Internet. Generic TLDs can be unrestricted (.com, .info, .net, and .org) or restricted—that is, used on the basis of fulfilling eligibility criteria (.biz, .name, and .pro). Of these, the statistic covers the five generic domains .biz, .info, .org, .net, and .com. Generic domains .name and .pro, and sponsored domains (.arpa, .aero, .asia, .cat, .coop, .edu, .gov, .int, .jobs, .mil, .museum, .tel, .travel, and .xxx) are not included. Neither are country-code top-level domains (refer to indicator 7.3.2). The statistic represents the total number of registered domains (i.e., net totals by December 2016, existing domains + new registrations – expired domains). Data are collected on the basis of a 4% random sample of the total population of domains drawn from the root zone files (a complete listing of active domains) for each TLD. The geographic location of a domain is determined by the registration address for the domain name registrant that is returned from a whois query. These registration data are parsed by country and postal code and then aggregated to any number of geographic levels such as county, city, or country/economy. The original hard data were scaled by thousand population 15–69 years old. For confidentiality reasons, only normalized values are reported; while relative positions are preserved, magnitudes are not.

Source: ZookNIC Inc; United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2015 Revision (population). (http://www.zooknic.com; http://esa.un.org/unpd/wpp/Excel-Data/population.htm)

7.3.2 Country-code top-level domains (ccTLDs)

Country-code top-level domains (ccTLDs) (per thousand population 15–69 years old) | 2016

A country-code top-level domain (ccTLD) is one of the categories of top-level domains (TLDs) maintained by the Internet Assigned Numbers Authority (IANA) for use in the Internet. Country-code TLDs are two-letter domains especially designated for a particular economy, country, or autonomous territory (there are 324 ccTLDs, in various alphabets/characters). The statistic represents the total number of registered domains (i.e., net totals by December 2016, existing domains + new registrations – expired domains). Data are collected from the registry responsible for each ccTLD and represent the total number of domain registrations in the ccTLD. Each ccTLD is assigned to the country with which it is associated rather than based on the registration address of the registrant. ZookNIC reports that, for the ccTLDs it covers, 85–100% of domains are registered in the same country; the only exceptions are the ccTLDs that have been licensed for commercial worldwide use. Of this year's GII sample of countries, this is the case for the ccTLDs of the following economies: Argentina ar, Armenia am, Austria at, Bangladesh bd, Belarus by, Belgium be, Brazil br, Canada ca, Chile cl, China cn, Colombia co, Denmark dk, Estonia ee, Finland fi, France fr, Germany de, Greece gr, Guatemala gt, Hong Kong (China) hk, Iceland is, India in, Indonesia id, Islamic Republic of Iran ir, Israel il, Italy it, Latvia lv, Lithuania lt, Luxembourg lu, Malaysia my, Mauritius mu, Moldova md, Mongolia mn, Montenegro me, Nicaragua ni, Norway no, Peru pe, Poland pl, Republic of Korea kr, Romania ro, Serbia rs, Slovenia si, Spain es, Sri Lanka lk, Sweden se, Switzerland ch, Thailand th, Tunisia tn, Turkey tr, and Viet Nam vn (this list is based on www.wikipedia.org). Data are reported per thousand population 15–69 years old. For confidentiality reasons, only normalized values are reported; while relative positions are preserved, magnitudes are not.

Source: ZookNIC Inc; United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2015 Revision (population). (http://www.zooknic.com; https://esa.un.org/unpd/wpp/)

7.3.3 Wikipedia yearly edits

Wikipedia yearly edits by country (per million population 15–69 years old) | 2014

Data extracted from Wikimedia Foundation's internal data sources. For every country with more than 100,000 edit counts in 2016, the data from 2016 are used. For all other countries, the data from 2014 are utilized. The data excludes bot contributions to the extent that is identifiable in the data sources. Data are reported per million population 15–69 years old.

Source: Wikimedia Foundation; United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2012 Revision (population). (https://wikimediafoundation.org; https://esa.un.org/unpd/wpp/)

7.3.4 Video uploads on YouTube

Number of video uploads on YouTube (scaled by population 15–69 years old) | 2015

Total number of video uploads on YouTube, per country, scaled by population 15–69 years old. The raw data are survey based: the country of affiliation is chosen by each user on the basis of a multi-choice selection. This metric counts all video upload events by users. For confidentiality reasons, only normalized values are reported; while relative positions are preserved, magnitudes are not.

Source: Google, parent company of YouTube; United Nations, Department of Economic and Social Affairs, Population Division, World Population Prospects: The 2012 Revision (population). (http://www.youtube.com; http://esa.un.org/unpd/wpp/Excel-Data/population.htm; http://www.comscore.com/Industries/Media)

Appendix IV

Technical Notes

Technical Notes

Audit by the Joint Research Centre of the European Commission

The Joint Research Centre (JRC) of the European Commission has researched extensively on the complexity of composite indicators ranking economies' performances along policy lines. For the seventh consecutive year, the JRC has agreed to perform a thorough robustness and sensitivity analysis of the Global Innovation Index (GII) to look at some structural changes made to the list of indicators by the GII developing team (see Table 1 of Annex 2 to Chapter 1 for more details).

The recommendations from the JRC audit of the 2016 GII model were reviewed and incorporated into the 2017 GII model. Expanding on recommendations included in the GII 2016, this year an economy must have a minimum symmetric data coverage of at least 36 indicators in the Innovation Input Sub-Index (66%) and 18 indicators in the Innovation Output Sub-Index (66%), and it must have scores for at least two sub-pillars per pillar. The GII rules on data requirements will be continually strengthened in future years, incentivizing countries to further improve their data collection.

A final audit was performed in May 2017 on the 2017 GII model, the results of which are included in Annex 3 to Chapter 1.

Composite indicators

The GII relies on seven pillars. Each pillar is divided into three sub-pillars, and each sub-pillar is composed of two to five individual indicators. Each sub-pillar score is calculated as the weighted average of its individual indicators. Each pillar score is calculated as the weighted average of its sub-pillar scores.

The notion of weights as importance coefficients was, as in the previous three years, discarded to ensure a greater statistical coherence of the model, following the recommendations of the JRC.[1]

The GII includes three indices and one ratio:

1. The Innovation Input Sub-Index is the simple average of the first five pillar scores.
2. The Innovation Output Sub-Index is the simple average of the last two pillar scores.
3. The Global Innovation Index is the simple average of the Input and Output Sub-Indices.
4. The Innovation Efficiency Ratio is the ratio of the Output Sub-Index over the Input Sub-Index.

Country/economy rankings are provided for indicator, sub-pillar, pillar, and index scores.

The Innovation Efficiency Ratio serves to highlight those economies that have achieved more with less as well as those that lag behind in terms of achieving their innovation potential. In theory, assuming that innovation results go hand in hand with innovation enablers, efficiency ratios should evolve around the number one. This measure thus allows us to complement the GII by providing an insight that should be neutral to the development stages of economies.[2]

Individual indicators

The model includes 81 indicators, which fall into the following three categories:

1. quantitative/objective/hard data (57 indicators),
2. composite indicators/index data (19 indicators), and
3. survey/qualitative/subjective/soft data (5 indicators).

Hard data

Hard data series (57 indicators) are drawn from a variety of public and private sources such as United Nations agencies, including the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Industrial Development Organization (UNIDO), the World Intellectual Property Organization (WIPO), the World Bank, the Joint Research Centre of the European Commission (JRC), PwC, Bureau van Dijk (BvD), Thomson Reuters, IHS Global Insight, and Google.

Indicators are often correlated with population, gross domestic product (GDP), or some other size-related factor; they require scaling by some relevant size indicator for economy comparisons to be valid. Most indicators are either scaled at the source or do not need to be scaled; for the rest, the scaling factor was chosen to represent a fair picture of economy differences. This affected 40 indicators, which can be broadly divided into four groups:

1. Indicators 2.1.1, 2.3.2, 3.2.3, 4.1.2, 4.1.3, 4.2.2, 5.1.3, 5.3.4, 6.2.3, and 6.3.4 were scaled by GDP in current US dollars.[3]
2. The count variables 3.3.3, 4.2.3, 5.2.4, 5.2.5, 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.2.4, 7.1.1, and 7.1.2 were scaled by GDP in purchasing power parity current international dollars (PPP$ GDP). This choice of denominator was dictated by a willingness to appropriately account for differences in development stages; in addition, scaling these variables by population would improperly bias results to the detriment of economies with large young or large ageing populations.[4]
3. Variables 3.2.1, 5.1.5, 6.2.2, 7.2.2, 7.2.3, 7.3.1, 7.3.2, 7.3.3, and 7.3.4 were scaled by population (total population for 3.2.1, population 25+ years old for 5.1.5, population 15–64 years old for 6.2.2, and population 15–69 years old for the rest).[5]
4. Sectoral indicators 5.3.1, 5.3.2, 5.3.3, 6.3.1, 6.3.2, 6.3.3, 7.2.1, and 7.2.5 were scaled by total trade; indicators 6.2.5 and 7.2.4 were scaled by the total unit corresponding to the particular statistic.[6]

Indices

Composite indicators come from a series of specialized agencies and academic institutions such as the World Bank, the International Telecommunication Union (ITU), the UN Public Administration Network (UNPAN), and Yale and Columbia Universities. Statisticians discourage the use of an 'index within an index' on two main grounds: the distorting effect of the use of different computing methodologies and the risk of duplicating variables. The normalization procedure partially solves for the former (more on this below). To avoid incurring the mistake of including a particular indicator more than once (directly and indirectly through a composite indicator), only indices with a narrow focus (19 in total) were selected.

Any remaining downside is outweighed by the gains in terms of model parsimony, acknowledgement of expert opinion, and focus on multi-dimensional phenomena that can hardly be captured by a single indicator.[7]

Survey data

Survey data are drawn from the World Economic Forum's Executive Opinion Survey (EOS). Survey questions are drafted to capture subjective perceptions on specific topics; five EOS questions were retained to capture phenomena strongly linked to innovative activities for which hard data either do not exist or have low economy coverage.

Country/economy coverage and missing data

This year's GII covers 127 economies, which were selected on the basis of the availability of data. Economies with a minimum indicator coverage of 36 indicators in the Innovation Input Sub-Index (66%) and 18 indicators in the Innovation Output Sub-Index (66%) were retained. This minimum data coverage threshold rule was adjusted—on the recommendation of the JRC—from the 60% minimum coverage for both Sub-Indices introduced in the GII 2016—to maintain and improve the significance of both the GII results and the country sample. In addition, all selected countries are required to have scores for at least two sub-pillars per pillar.

The last record available for each economy was considered, with a cut-off at year 2007, with four exceptions: indicators 2.2.2, 5.1.2, 6.2.5, and 7.2.4, for which time periods were extended to 2006.[8]

For the sake of transparency and replicability of results, no additional effort was made to fill missing values. Missing values are indicated with 'n/a' and are not considered in the sub-pillar score. However, the JRC audit assessed the robustness of the GII modelling choices (i.e., no imputation of missing data, fixed predefined weights, and arithmetic averages) by imputing missing data, applying random weights, and using geometric averages. Since 2012, on the basis of this assessment, a confidence interval is provided for each ranking in the GII as well as the Input and Output Sub-Indices (see Annex 3 to Chapter 1).

Treatment of series with outliers

Potentially problematic indicators with outliers that could polarize results and unduly bias the rankings were treated according to the rules listed below, following the recommendations of the JRC. This affected a total of 33 indicators; 31 out of the 57 hard data indicators and 2 out of the 19 composite indicators.

First rule: Selection

The identification of indicators as problematic used skewness or kurtosis. The problematic indicators had either:

- an absolute value of skewness greater than 2.25, *or*
- a kurtosis greater than 3.5.[9]

Second rule: Treatment

Series with one to five outliers (28 cases) were winsorized: The values distorting the indicator distribution were assigned the next highest value, up to the level where skewness and/or kurtosis entered within the ranges specified above.[10]

With one exception (see note 10) for series with five or more outliers (5 cases), skewness and/or kurtosis entered within the ranges specified above after multiplication by a given factor *f* and transformation by natural logs.[11] Since only 'goods' were affected (i.e., indicators for which higher values indicate better outcomes, as opposed to 'bads'), the formula used was:

$$\ln\left[\frac{(\max \times f - 1)\ \ (\text{economy value} - \min)}{\max - \min} + 1\right]^{12}$$

where 'min' and 'max' are the minimum and maximum indicator sample values.

Normalization

The 81 indicators were then normalized into the [0, 100] range, with higher scores representing better outcomes. Normalization was made according to the min-max method, where the min and max values were given by the minimum and maximum indicator sample values respectively, except for index and survey data, for which the original series' range of values was kept as min and max values (for example, [1, 7] for the World Economic Forum Executive Opinion Survey questions; [0, 100] for World Bank's World Governance Indicators; [0, 10] for ITU indices, etc.). The following formula was applied:

- **Goods:**

$$\frac{\text{economy value} - \min}{\max - \min} \times 100$$

- **Bads:**

$$\frac{\max - \text{economy value}}{\max - \min} \times 100$$

Notes

1 Paruolo et al. (2013) show that a theoretical inconsistency exists between the real theoretical meaning of weights and the meaning generally attributed to them by the standard practice in constructing composite indicators that use them as importance coefficients in combination with linear aggregation rules. The approach followed in the GII this year, in the last several years, is to assign weights of 0.5 or 1.0 to each component in a composite to ensure the highest correlations between them (i.e., indicator/sub-pillar, sub-pillar/pillar, etc.). Two sub-pillars (7.2 Creative goods and services, and 7.3 Online creativity) and 35 indicators (1.2.1, 1.2.2, 2.1.4, 2.1.5, 2.2.1, 2.2.3, 3.2.1, 3.2.2, 3.3.3, 4.2.2, 4.2.3, 4.3.1, 4.3.2, 5.1.3, 5.1.4, 5.1.5, 5.2.1, 5.2.4, 5.2.5, 5.3.1, 6.1.1, 6.1.2, 6.1.4, 6.1.5, 6.2.2, 6.2.3, 6.2.4, 6.2.5, 6.3.1, 6.3.2, 6.3.3, 7.1.2, 7.2.1, 7.2.2, and 7.2.3) are weighted 0.5; the rest have a weight of 1.0.

Seven indicators with Pearson correlation coefficients with their respective sub-pillar scores below 0.3 were kept in the model to ensure a conceptual coherence (as opposed to a statistical coherence) in the belief that some cyclical (as opposed to structural) dimension might be at the source of their behaviour as 'noise' (see also Annex 3 to Chapter 1): government expenditure on secondary education per pupil (2.1.2), graduates in science and engineering (2.2.2), gross capital formation (3.2.3), GERD financed by abroad (5.2.3), foreign direct investment net inflows (5.3.4), growth rate of GDP per person engaged (6.2.1), and printing and publishing output (7.2.4). Two out of the seven indicators listed above—2.1.2 and 7.2.4—are found to be non-influential in the GII framework for the first time this year. The remaining five indicators were found to be non-influential also in the GII 2016. On the other hand, two indicators that were found to be non-influential last year—GDP per unit of energy use (3.3.1) and Microfinance institutions' gross loan portfolio (4.1.3)—are instead found to be influential in this year's framework.

2 To account for differences in development, other composite indicators use weighting schemes differentiated by income level.

3 These indicators are expenditure on education (2.1.1); gross expenditure on R&D (GERD) (2.3.2); gross capital formation (3.2.3); domestic credit to private sector (4.1.2); microfinance institutions' gross loan portfolio (4.1.3); market capitalization (4.2.2); GERD performed by business enterprise (5.1.3); foreign direct investment net inflows (5.3.4); total computer software spending (6.2.3); and foreign direct investment net outflows (6.3.4).

4 These count variables are mainly indicators that increase disproportionately with economic growth. They include: ISO 14001 environmental certificates (3.3.3); venture capital deals (4.2.3); joint venture/strategic alliance deals (5.2.4); patent families filed in two or more offices (5.2.5); patent applications by origin (6.1.1); PCT applications by origin (6.1.2); utility model applications by origin (6.1.3); scientific and technical publications (6.1.4); ISO 9001 quality certificates (6.2.4); trademark application class count by origin (7.1.1); and industrial designs by origin (7.1.2).

5 These variables are electricity output (3.2.1); females employed with advanced degrees (5.1.5); new business density (6.2.2); national feature films produced (7.2.2); global entertainment and media market (7.2.3); generic (7.3.1) and country-code (7.3.2) top-level Internet domains; Wikipedia yearly edits (7.3.3); and video uploads on YouTube (7.3.4).

6 Intellectual property payments (5.3.1); high-tech imports less re-imports (5.3.2); ICT services imports (5.3.3); intellectual property receipts (6.3.1); high-tech exports less re-exports (6.3.2); ICT services exports (6.3.3); cultural and creative services exports (7.2.1); and creative goods exports (7.2.5) were scaled by total trade; high-tech and medium-high-tech output (6.2.5) and printing and publishing output (7.2.4) were scaled by total manufactures output.

7 For example, GII sub-pillar 3.1 Information and communication technologies (ICTs) is composed of four indices: ITU's ICT Access and Use sub-indices and UNPAN's Government Online Service and E-Participation indices. The first two are components of ITU's ICT Development Index together with an ICT skills sub-index that was not considered, because it duplicates GII pillar 2. Similarly, the Online Service Index is a component of UNPAN's E-Government Development Index together with two indices on Telecommunication Infrastructure and Human Capital that were not considered, because they duplicate GII pillars 3 and 2, respectively. The e-Participation Index was developed separately by UNPAN in 2010.

8 Indicator 2.2.2 (graduates in science and engineering): Because of the change in ISCED fields of classification and the transition to new questionnaires, when countries did not report detailed data, the UIS was not able to re-assign numbers into new field classifications. As a result, the UIS was not able to produce this indicator for these countries, so—per the recommendation of the UIS—the dataset from the GII 2016 was used. There was one economy affected: Hong Kong (China). Indicator 5.1.2 (firms offering formal training): The time period of data for Guinea includes 2006 for heightened coverage based on this economy's GII 2016 data availability. Indicator 6.2.5 (high-tech and medium-high-tech output) and indicator 7.2.4 (printing and publishing output): The time periods of data for Iceland, Madagascar, and Pakistan for these indicators include 2006 for heightened coverage based on these economies' GII 2016 data availability.

9 Based on Groeneveld and Meeden (1984), which sets the criteria of absolute skewness above 1 and kurtosis above 3.5. The skewness criterion was relaxed to account for the small sample at hand (127 economies).

10 This distributional issue affects the following variables: 1.2.3, 3.2.1, 3.3.3, 4.2.2, 5.3.2, 5.3.3, 6.1.5, 6.2.1, 6.2.2, 6.3.2, 7.1.1, 7.2.4, and 7.3.1 (1 outlier); 5.3.1, 7.2.1, 7.2.2, and 7.3.2 (2 outliers); 2.2.3, 4.1.3, 4.2.3, 5.2.5, 6.1.1, 6.1.2, 6.1.3, 6.2.5, and 6.3.3 (3 outliers); and 7.1.2 (4 outliers). The treatment criterion was relaxed this year to allow a single series (6.3.4) with 7 outliers—6 outliers given the next highest value and 1 given the next lowest value—to be winsorized instead of subjected to natural log transformation. This is because applying a log transformation at 1, 10, and 100 had the reverse effect, and instead of reducing skewness and kurtosis, it increased them.

11 This distributional issue affects variables 2.3.3, 4.3.3, 5.3.4, 6.3.1, and 7.2.5 (factor *f* of 1).

12 The corresponding formula for bads is:

$$\ln\left[\frac{(\max \times f - 1) \times (\max - \text{economy value})}{\max - \min} + 1\right]$$

These formulas achieve two things: converting all series into 'goods' and scaling the series to the range [1, max] so that natural logs are positive starting at 0.

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Appendix V

About the Authors

About the Authors

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Kyle Bergquist is a Data Analyst in the Economics and Statistics Division of the World Intellectual Property Organization (WIPO). Mr Bergquist holds a Master of Science in Economics from the University of Neuchâtel in Switzerland and a Bachelor of Arts in Political Science from the University of Nevada in the United States. Prior to working at WIPO, Mr Bergquist was a data analyst for the patient safety department at CRICO, the malpractice insurance company for the Harvard medical community, where his research focused on the occurrence and prevention of adverse medical events as well as risk assessment. His research topics of interest are intellectual property, environmental policy, and economic geography.

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Innovation is now widely recognized as a central driver of economic growth and development. The Global Innovation Index (GII) aims to capture the multi-dimensional facets of innovation by providing a rich database of detailed metrics for 127 economies, which represent 92.5% of the world's population and 97.6% of global GDP. As Ban Ki-moon, the eighth Secretary-General of the United Nations, noted at the UN Economic and Social Council in 2013, the GII is a *'unique tool for refining innovation policies . . . for providing an accurate picture on the role of science, technology and innovation in sustainable development'*.

The GII 2017 marks the 10th edition of the GII, providing data and insights gleaned from tracking innovation across the globe for more than a decade. The GII was created to measure and understand which economies and regions respond best to the challenges of innovation, and has helped to shape the innovation agendas of nations since 2007. For more than 10 years, the agriculture and food sector has faced growing global demand and increased competition for limited natural resources. Within the agricultural and food systems, innovation is indispensable to achieving sustainable productivity growth; this innovation must be a priority and include organizational change, cooperation along the value chain, public and private investment in R&D, adaptation and adoption of new innovations, and education. A review of how innovation and technology trends and the enabling environments in which these systems operate and evolve will be essential to the success of this endeavour, creating an urgent need for improved metrics and indicators. The analysis in this year's edition, *The Global Innovation Index 2017: Innovation Feeding the World,* is dedicated to this theme, paving the way for improved strategies and policy making to foster innovation in food systems.

Launched by INSEAD in 2007, today the GII is co-published by Cornell University, INSEAD, and the World Intellectual Property Organization (WIPO), a specialized agency of the United Nations. The 2017 edition of the GII draws on the expertise of its Knowledge Partners: the Confederation of Indian Industry, PricewaterhouseCoopers (PwC) and Strategy&, and the National Confederation of Industry (CNI) and Serviço Brasileiro de Apoio às Micro e Pequenas Empresas (Sebrae), as well as an Advisory Board of eminent international experts. For the seventh consecutive year, the Joint Research Centre (JRC) of the European Commission audited the GII calculations.

The GII is concerned primarily with improving the journey towards a better way to measure and understand innovation and with identifying targeted policies and good practices that foster innovation. Written in a nontechnical language, the GII appeals to diverse groups including policy makers, business leaders, academics, and organizations of civil society.

The full report can be downloaded at **www.globalinnovationindex.org.**

ISBN 9791095870043

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