The Global Innovation Index 2017: Innovation Feeding the World

Soumitra Dutta, Rafael Escalona Reynoso, and **Jordan Litner,** Cornell SC Johnson College of Business, Cornell University

Bruno Lanvin, INSEAD

Sacha Wunsch-Vincent and **Francesca Guadagno,** WIPO

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

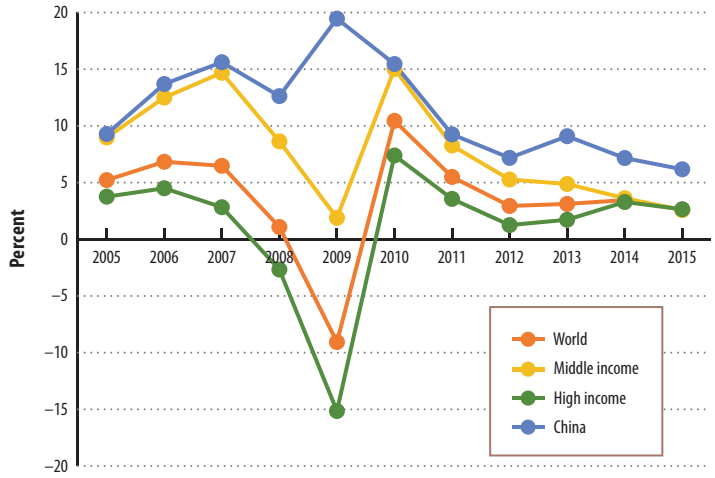
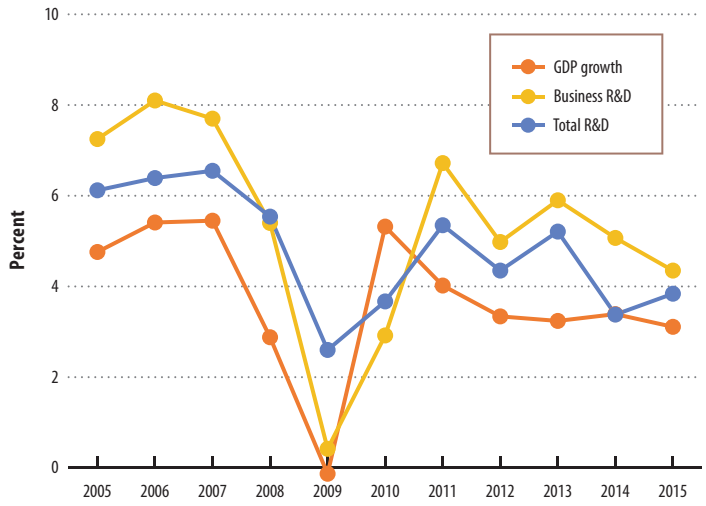


Figure 1b: R&D expenditures growth, 2005–15



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

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(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.

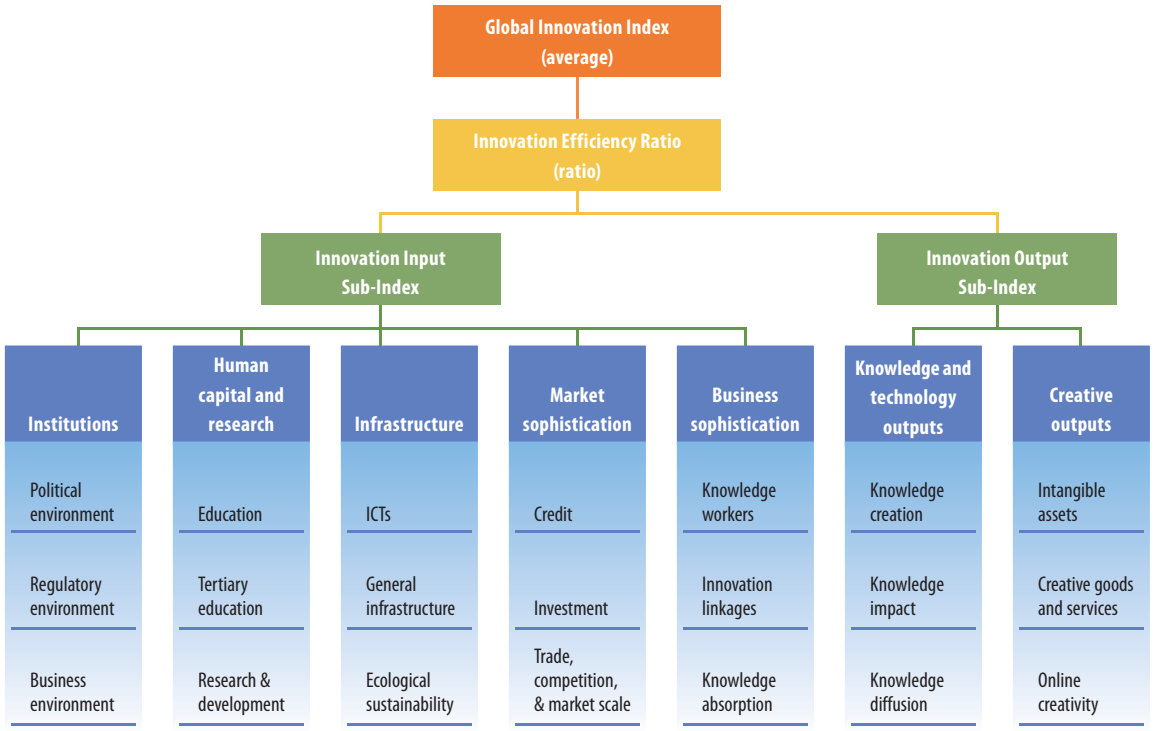
Fourth, both the private sector and government can also help infuse excellence and innovative attitudes in other vital sectors into the agriculture sector. In India, such an approach has helped enhance the impact of information technology (IT) in unlocking value for the grassroots level in areas such 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*

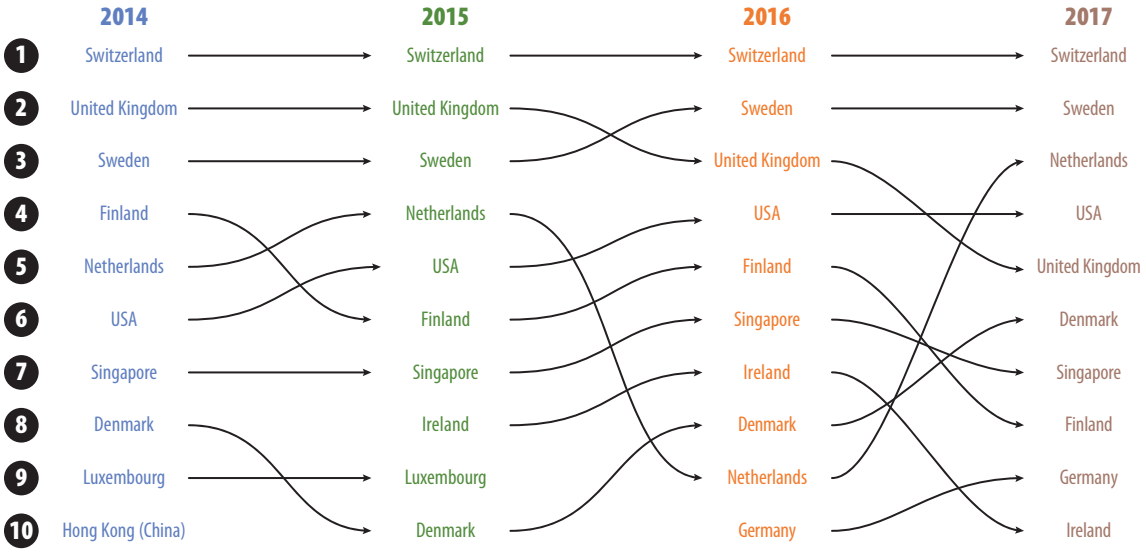
Furthermore, stability remains across the top 25 economies with only a few exceptions. China moves up by three places, becoming the 22nd most innovative economy in the world after entering the top 25 in the GII 2016. Israel gains four positions this year, ranking 17th and swapping spots with New Zealand (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	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	

(Continued on next page)

Table 1: Global Innovation Index 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

Median: 0.62

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)*

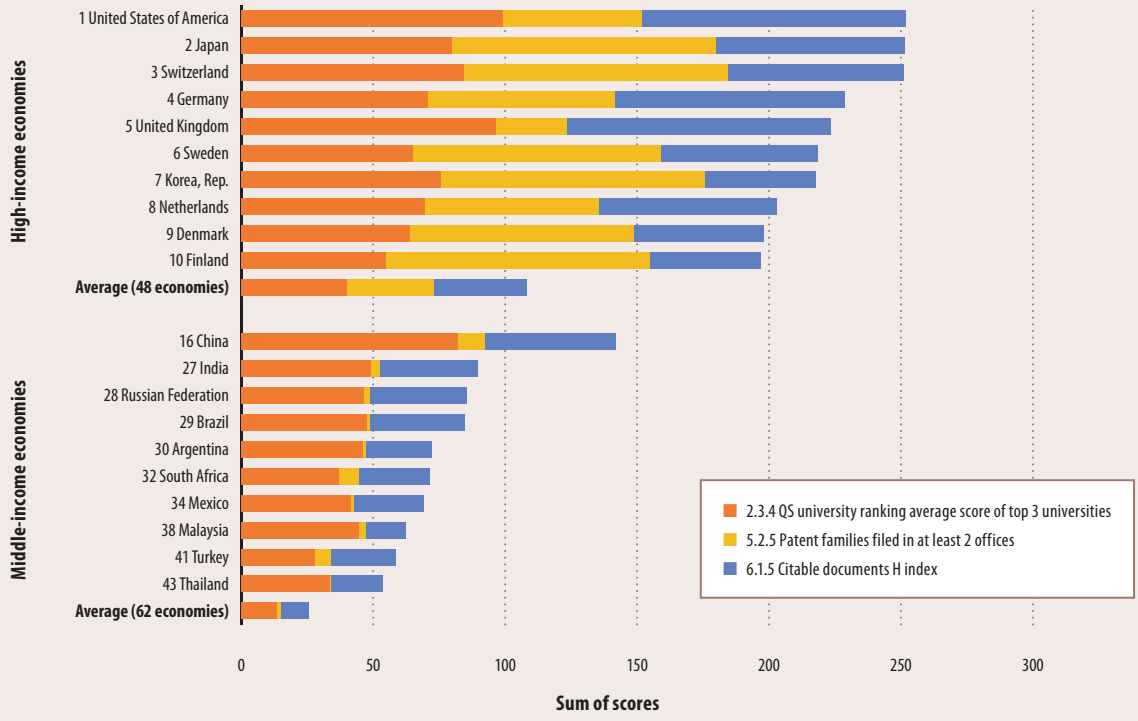
Country/Economy	Score (0–100)	Rank	Income	Rank	Region	Rank	Median: 25.60
Philippines	25.57	65	LM	7	SEAO	12	
Saudi Arabia	25.00	66	HI	44	NAWA	9	
Bahrain	24.92	67	HI	45	NAWA	**10**	
Morocco	24.85	68	LM	8	NAWA	11	
South Africa	24.74	69	UM	16	SSF	1	
Kenya	24.71	70	LM	9	SSF	2	
Tunisia	24.62	71	LM	10	NAWA	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.

(Continued on next page)

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.

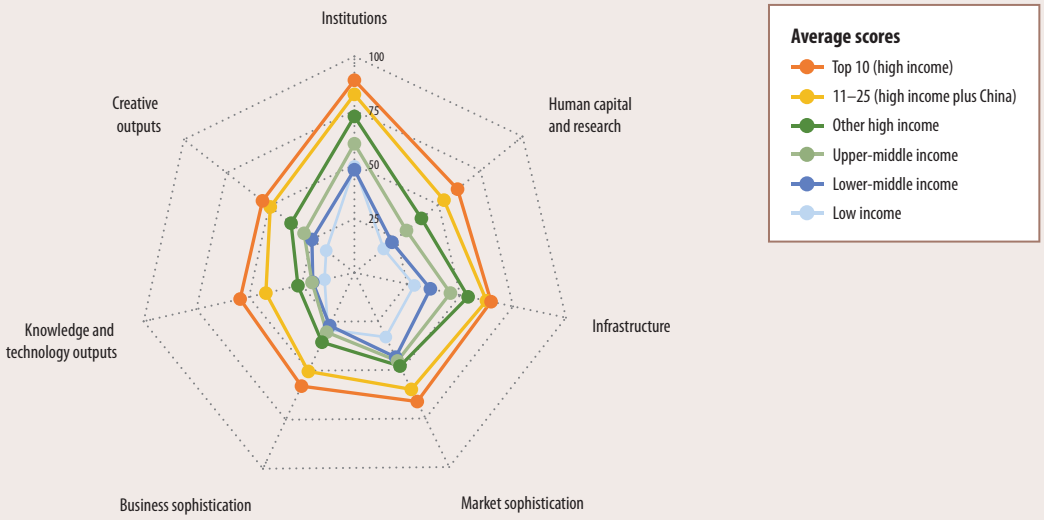
Low-income economies moving closer to middle-income ones

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

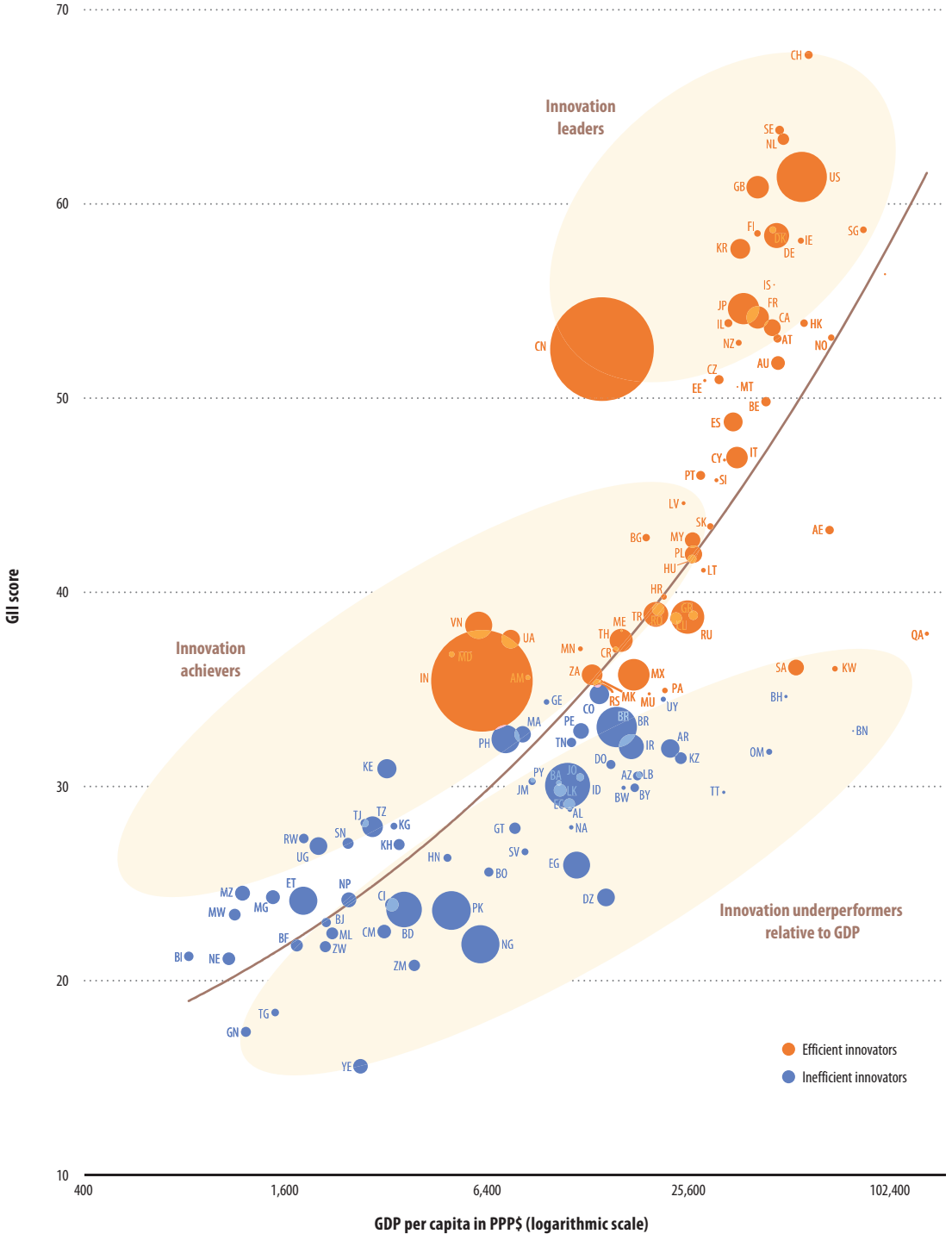
This section discusses regional and sub-regional trends, with snapshots for some of the economies leading in the rankings.

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)

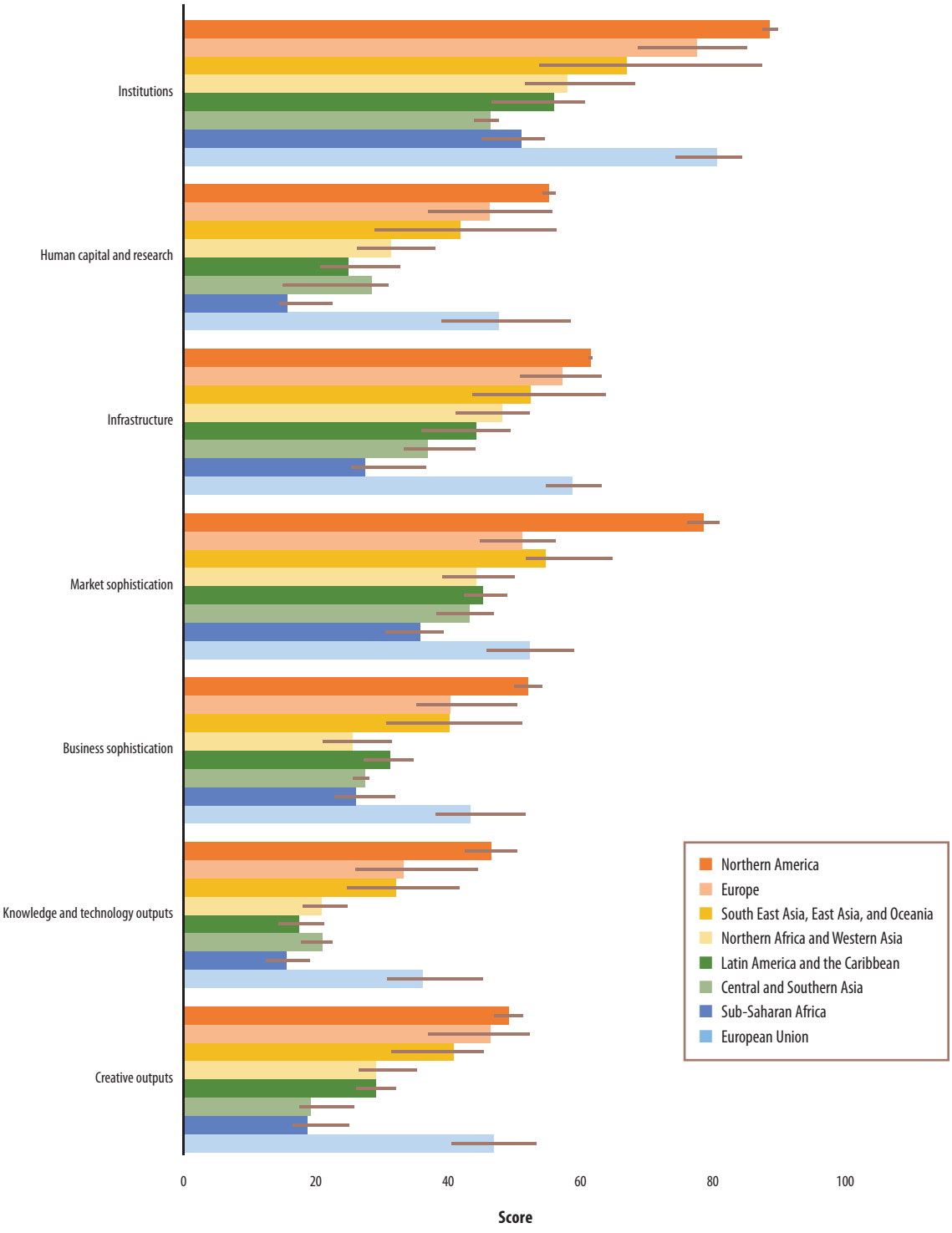
Country/Economy	GII	Institutions	Human capital and research	Infrastructure	Market sophistication	Business sophistication	Input	Knowledge and technology outputs	Creative outputs	Output	Efficiency
Switzerland	67.69	89.47	63.29	65.10	67.51	62.61	69.60	69.06	62.50	65.78	0.95
Sweden	63.82	88.31	63.71	69.13	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

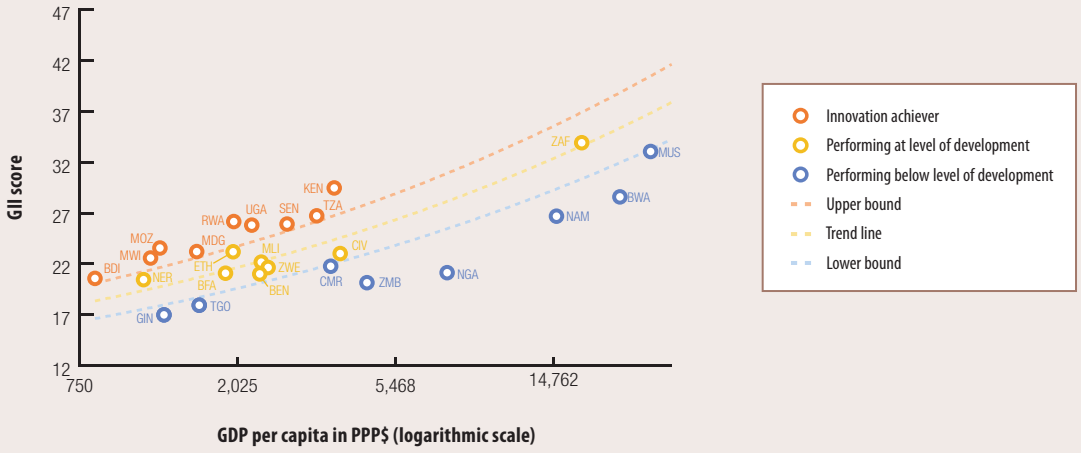
Since 2012 and to this day, the number of Sub-Saharan Africa countries in the group of innovation achievers has been the highest among all regions.[1] Strengths in the region remain in areas considered crucial for the expansion of innovation locally. Factors such as improved business environments offer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

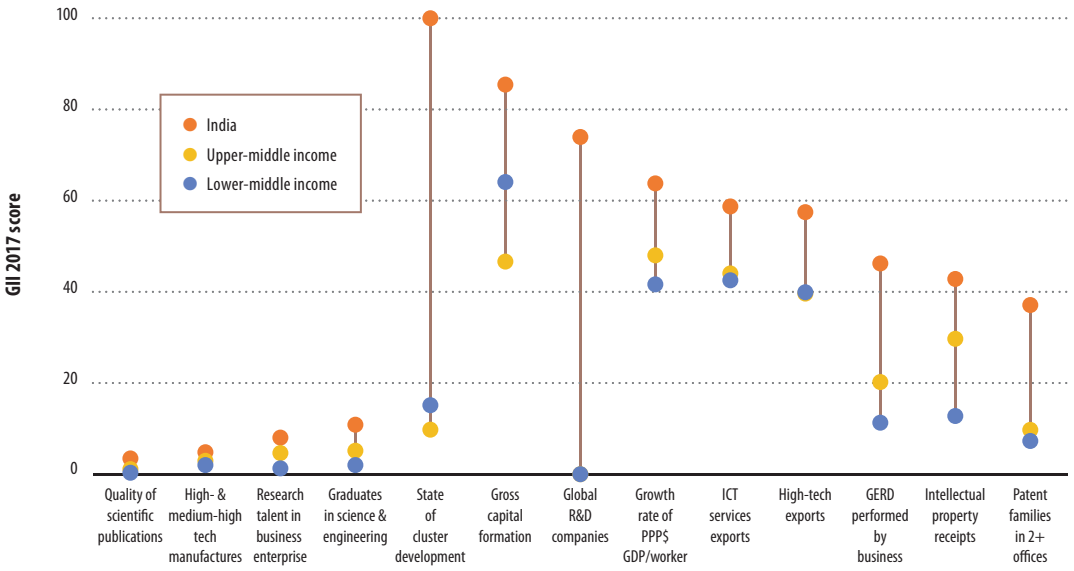
Central and Southern Asia (9 economies)

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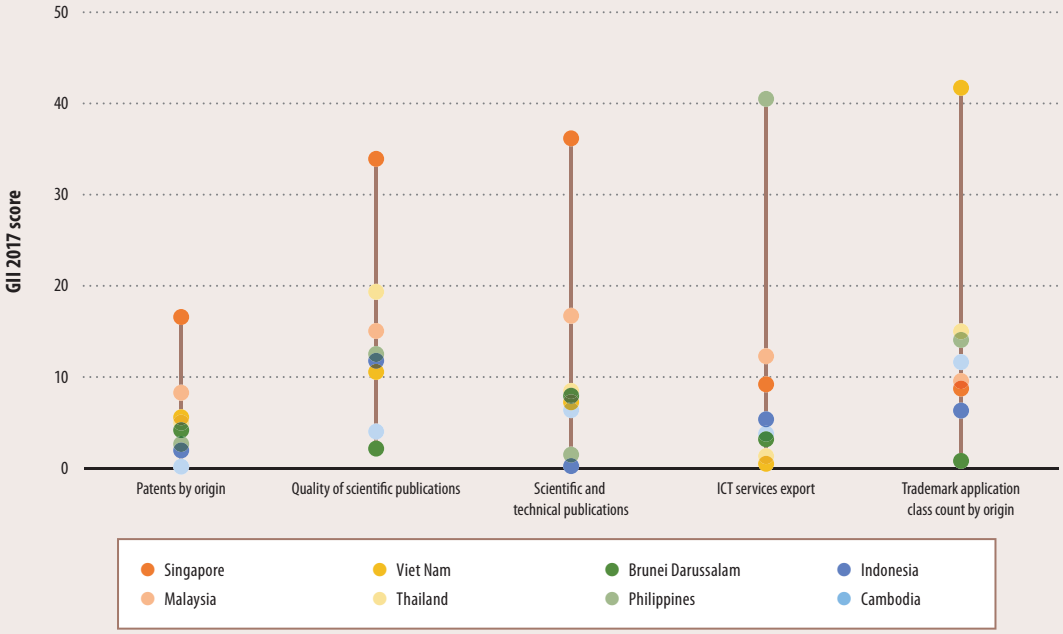
Box 6: ASEAN: Singapore and the new Asian Tigers? *(continued)*

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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