

Key Findings

Key Findings of the GII 2017

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

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

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

In spite of this new growth momentum, investment and productivity growth are still at historic lows. China aside, investment growth in middle-income countries has now fallen to levels similar to that of rich countries (Figure A). Furthermore,

the productivity crisis is more topical today than ever. The downturn has amplified the phenomenon of lacklustre productivity gains in rich countries, in conjunction with weakened technological innovation and diffusion. Emerging economies are affected as well, with their catch-up to advanced-country productivity slowing.

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

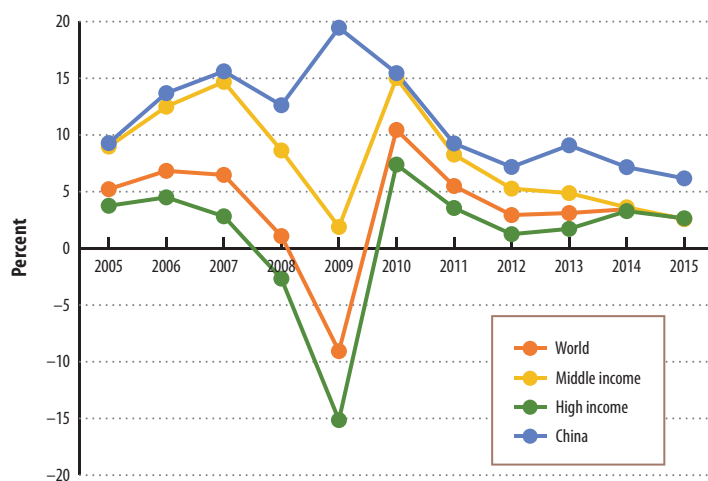
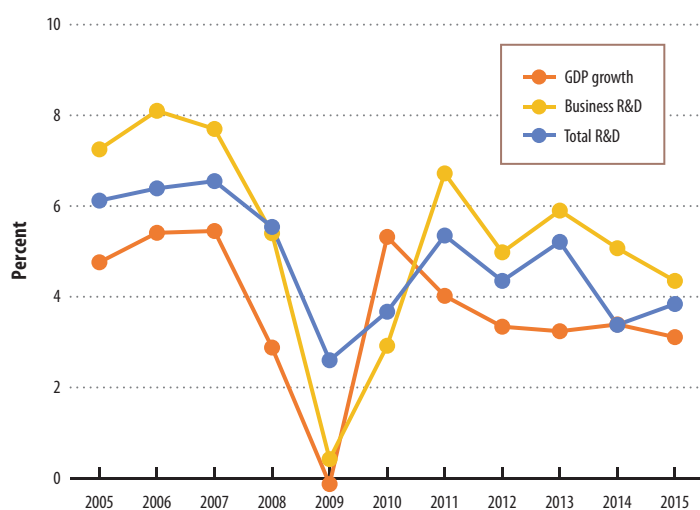
Finding 2: Smart, digital agricultural innovation and a better uptake of innovation in developing countries can help overcome serious food challenges

Today a fresh innovation drive is required to confront slow growth in agricultural productivity and the bottlenecks in today’s agricultural innovation systems. First and foremost, lagging agricultural productivity

growth in low- and middle-income economies and lagging agricultural R&D spending across all economies both need to be reversed. Second, innovations need to disperse more effectively throughout the agricultural and food sector, especially in developing countries.

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

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

Figure A: Global investment and business R&D falling short**Investment growth, 2005–15****R&D expenditures growth, 2005–15**

Source: See Figure 1 from Chapter 1.

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

New technologies aside, the brunt of agricultural innovation is found in improved processes and services that

occur along the agricultural value chain, be it in high-income or low-income economies, not only in novel technologies. In the case of developing countries, there are many significant bottlenecks along the value

chain. These are mostly obstacles concerned with liquidity constraints, agricultural inputs of imperfect quality, insufficient information and awareness, and a lack of post-harvest and distribution infrastructure.

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

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

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

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

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

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

Switzerland leads the rankings for the seventh consecutive year. In the top 25, some economies—such as the Netherlands, Denmark, Germany, Japan, France, Israel, and China—move up. Yet rich countries

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

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

Source: See Table 5 from Chapter 1.

take most of the top 25 spots, with middle-income countries growing more distant to the top 25 this year, rather than closing the gap.

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

countries, with China being the only middle-income country closing the gap.

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

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

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

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

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

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

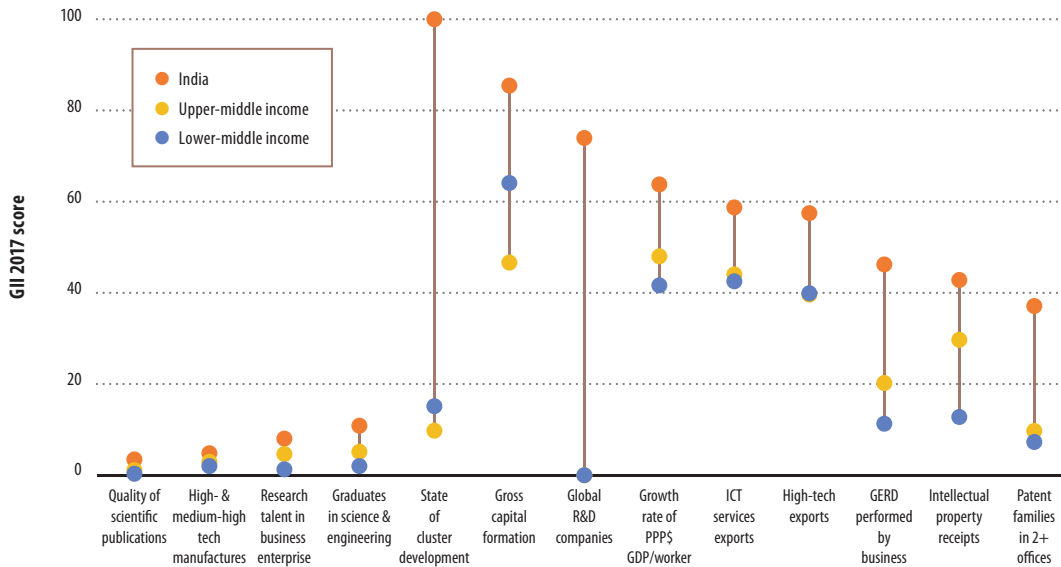
The different elements of a potentially strong networked innovation powerhouse are coming together in Asia. For a start, and despite enduring economic setbacks, Japan has continued to be a driving force of global innovation since the late 1970s. Later,

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

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

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

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

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

Source: See Figure 6 in Chapter 1.

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

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

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

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

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

outperforming every year since 2011—including in the 2017 edition.

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

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

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

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

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

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

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

country is still facing a high degree of uncertainty.

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

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

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

level to assess innovation clusters more broadly.

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

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