# Benchmarking Innovation Outperformance at the Global and Country Levels

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National innovation policies and programmes are flourishing. Especially in developing countries, the emphasis on fostering innovation has now also increased. At the global level, the need to spur innovation to foster economic growth and to find solutions to social challenges is increasingly recognized.

Accordingly, benchmarking innovation performance is becoming a greater priority. Taking advantage of the wealth of information produced by the Global Innovation Index (GII) over the last years, this chapter compares the innovation performance of specific countries, identifies developing nations that persistently outperform their peers on innovation performance, and analyses how their local efforts have improved their capacity to innovate. This will help other countries look ahead to policy changes they might want to implement themselves.

The chapter first discusses why measuring innovation is important. It then identifies those developing countries that performed persistently above their peers.[1] This is followed by a discussion of innovation achievers—those with scores in the overall GII that are higher than expected for their level of development—and a consideration of their strengths and weaknesses. This is followed by a look at pillar outperformer countries—those that perform above their income-group peers in more than half the pillars of the GII. The next section examines the 11 innovation outperformers this year—these are countries that have attained both innovation achiever and pillar outperformer status—and takes a look at their policy strategies. Finally, the chapter zeros in on the role that education and research systems play for the innovation outperformers. The conclusions that end the chapter note characteristics common to the persistent outperforming countries.

## The importance of measuring innovation performance

Measuring progress in innovation has become essential for policy makers seeking ways to assess the effectiveness of their innovation systems and polices. Interest in innovation measurement has even permeated high-level international development-related discussions. At the global level, the United Nations (UN) Sustainable Development Goals (SDGs), for instance, will set a new development agenda (see Box 1). Innovation has a large role to play in this agenda, both as a means to achieve improvements in health, environmental protection, food security, and so on, and as a goal in itself. The identification of cross-cutting indicators that can capture innovation progress is thus an ongoing process in the respective UN fora as well.

As discussed in Chapter 1, innovation needs to be understood broadly and also to be recognized as the result of complex interactions among various actors, such as firms, education and research organizations, and the public sector. Successful innovation also must incorporate the coevolution of institutions and regulations as well as science, technology, and innovation policies. To produce a comprehensive measure for benchmarking innovation performance, it is necessary to go beyond readily available one-dimensional statistics such as research and development (R&D) expenditure and the number of patents.

## Identifying developing countries with persistently high innovation performance

By comparing respective innovation performances and identifying those developing countries that outperform others at similar levels of economic development, the GII can help identify areas of strengths and weaknesses in innovation efforts and point to priority areas for improvement.

To recap, the GII traditionally relies on two sub-indices: the Innovation Input Sub-Index and the Innovation Output Sub-Index, which have a total of seven pillars between them. Five innovation inputs are used to build the Innovation Input Sub-Index. These capture the characteristics of the enabling environment for innovation and include: (1) Institutions, (2) Human capital and research, (3) Infrastructure,

## Box 1: The Post 2015 Development Agenda: From Millennium Development Goals to Sustainable Development Goals

In September 2015, the Member States of the United Nations (UN) are expected to agree on the various elements that make up the Post 2015 Development Agenda. Central to this agreement will be the adoption of the Sustainable Development Goals (SDGs), which are intended to build on the Millennium Development Goals (MDGs) and will provide the main basis for a comprehensive set of targets that will shape development in the period 2015–30.

The Post 2015 Development Agenda calls for a transformative shift to a low carbon and socially equitable economy that balances economic progress with safeguarding tvhe environment. In a shift from the approach of the MDGs, which focused on developing countries, the SDGs will be universal in their application and implementation.

It is ever more recognized, especially within the UN, that innovation is key for this purpose. The development and transfer of technologies requires an enabling environment: a national innovation system that promotes the development of domestic technological solutions as well as north-south, south-south, and triangular technology transfer and cooperation. Countries able to build and nurture effective national innovation systems are best able to harness technologies—both old and new.

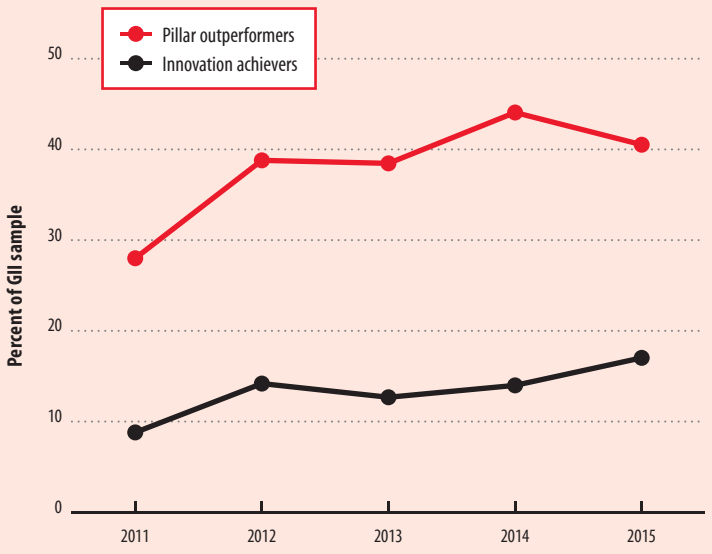
However, as the Global Innovation Index (GII) demonstrates, such systems are highly complex and interactive. Policy makers require evidence to support effective decision making in building such systems. Data are important for monitoring, reviewing, and accountability in terms of SDG progress; they are of even greater significance in guiding policy makers to make the right decisions at the national level. The SDGs will establish 17 Goals with 169 targets. This will provide the framework for monitoring, review, and accountability at the global, regional, and national levels. Technology and innovation as a cross-cutting issue feeds into several of these goals and targets. Goal 9, in particular—'Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation'—makes explicit reference to innovation and refers to several elements that compose the GII, namely infrastructures, access to credit, market access, resource efficiency and environmentally friendly technologies, access to ICT, scientific research, and technological capabilities.

As the indicator framework for the SDGs is developed over the coming months, the GII can provide an important contribution and the critical data required to monitor innovation.

**Source**

UNDESA, 2015.

## Figure 1: Percentage of economies outperforming at the GII score and pillar level, 2011–14




Note: Innovation achievers are those with GII levels higher than expected based on their level of economic development. Pillar outperformers are those performing above their income group in four or more pillars.

(4) Market sophistication, and (5) Business sophistication. Two innovation outputs compose the Innovation Output Sub-Index: (6) Knowledge and technology outputs and (7) Creative outputs.

This chapter benchmarks national innovation performance by taking into account 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) (see Box 2). 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 hereto referred to as 'innovation outperformers'. These

**Table 1: Innovation achievers and pillar outperformers, 2011–14**

| Economy | Income group | Region | Years as an innovation achiever (total) | Years as a pillar outperformer (total) |
|---|---|---|---|---|
| Armenia | Lower-middle income | NAWA | 2014, 2013, 2012 (3) | 2014, 2013, 2012 (3) |
| Burkina Faso | Low income | SSF | 2014 (1) | 2014, 2013, 2012 (3) |
| China | Upper-middle income | SEAO | 2014, 2013, 2012, 2011 (4) | 2014, 2013, 2012, 2011 (4) |
| Costa Rica | Upper-middle income | LCN | 2013 (1) | 2014, 2013, 2012, 2011 (4) |
| Czech Republic | High income | EUR | 2014 (1) | 2014 (1) |
| Georgia | Lower-middle income | NAWA | 2014, 2013, 2012 (3) | 2014, 2013, 2012, 2011 (4) |
| Ghana* | Lower-middle income | SSF | 2011 (1) | 2014, 2013, 2012, 2011 (4) |
| Gambia | Low income | SSF | 2014 (1) | 2014 (1) |
| Guyana | Lower-middle income | LCN | 2011 (1) | 2013, 2012, 2011 (3) |
| Hungary† | Upper-middle income | EUR | 2013, 2012 (2) | 2014, 2013, 2012, 2011 (4) |
| India | Lower-middle income | CSA | 2014, 2013, 2012, 2011 (4) | 2014, 2013, 2012, 2011 (4) |
| Jordan | Upper-middle income | NAWA | 2014, 2013, 2012, 2011 (4) | 2014, 2013, 2011 (3) |
| Kenya | Low income | SSF | 2014, 2013, 2012, 2011 (4) | 2014, 2013, 2012, 2011 (4) |
| Moldova, Rep. | Lower-middle income | EUR | 2014, 2013, 2012, 2011 (4) | 2014, 2013, 2012, 2011 (4) |
| Mali | Low income | SSF | 2013 (1) | 2013, 2012 (2) |
| Montenegro | Upper-middle income | EUR | 2013, 2012 (2) | 2014, 2013, 2012 (3) |
| Mongolia | Lower-middle income | SEAO | 2014, 2013, 2012, 2011 (4) | 2014, 2013, 2012, 2011 (4) |
| Mozambique | Low income | SSF | 2014, 2012 (2) | 2014, 2013, 2012 (3) |
| Malawi | Low income | SSF | 2014, 2012 (2) | 2014, 2012, 2011 (3) |
| Malaysia | Upper-middle income | SEAO | 2014, 2013, 2012, 2011 (4) | 2014, 2013, 2012, 2011 (4) |
| Rwanda | Low income | SSF | 2014, 2012 (2) | 2014, 2013, 2012, 2011 (4) |
| Serbia | Upper-middle income | EUR | 2012 (1) | 2014, 2013, 2012, 2011 (4) |
| Thailand | Upper-middle income | SEAO | 2014, 2011 (2) | 2014, 2013, 2012, 2011 (4) |
| Tajikistan | Low income | CSA | 2013 (1) | 2013, 2012 (2) |
| Uganda | Low income | SSF | 2014, 2013 (2) | 2014, 2013 (2) |
| Ukraine | Lower-middle income | EUR | 2014, 2012 (2) | 2014, 2013, 2012, 2011 (4) |
| Viet Nam | Lower-middle income | SEAO | 2014, 2013, 2012, 2011 (4) | 2014, 2013, 2012, 2011 (4) |
| Zimbabwe | Low income | SSF | 2012 (1) | 2014, 2013, 2012 (3) |

Note: 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 and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa. * Low income in 2011, lower-middle income in all other years. † Upper-middle income in 2014, high income in all previous years.

outperformers provide the basis of the following analysis.

This approach has some limitations. As with most year-on-year comparisons, movements in and out of the outperformer group can be the result of methodological changes in the GII framework, newly available data, and relative numerator versus denominator changes that do not necessarily correspond to improved or worsened innovation performance (refer to Chapter 1 Annex 2).

With these caveats in mind, this chapter looks into the performance of those countries that do well on either or both these criteria.

This analysis finds that the percentage of countries with above-par performance as defined above exhibits an upward trend (Figure 1). The number of innovation achievers continues to increase through the period under study here, namely 2011–14, and beyond into 2015: This year it reached 24 economies, or 17% of the economies included in the GII sample. This is the highest percentage since 2011, when it reached 9%. The number of pillar outperformers reached 41% in 2015, up from 28% in 2011. An increasing number of countries are thus doing strictly better on innovation than their development levels would suggest. No inference can be made from these data about whether the absolute level of innovation performance globally has increased. Instead, these countries are able to detach themselves from their peer group, leading to a more unequal distribution of innovation performance, at least until their income levels increase to such an extent that they will need to compare themselves with more-advanced country peers.

As Table 1 shows, eight economies (China, India, Jordan, Kenya, the Republic of Moldova, Mongolia, Malaysia, and Viet Nam), signalled

## Box 2: How innovation performance relative to GDP is identified and classified

Since 2012 the process of determining a country's innovation status has relied on both its Global Innovation Index (GII) score and its level of economic development, as measured by gross domestic product (GDP) per capita. Once the GII scores for each country are determined, these are contrasted with their current year's GDP based on per capita purchasing power parity (GDP PC PPP$).[1] To facilitate the comparison between GDP per capita and GII scores (on a scale of 0–100), and given that GDP per capita in PPP$ (ln scale) for each country follows a log-normal distribution, the latter are transformed using natural logarithms. The GII scores (Y axis) for all countries are then plotted against their GDP per capita (X axis).[2] The plotted data points for all countries help define a trend line—a polynomial regression of the form $y = f(x)$—and its equation, which models the relationship between these variables. Using the equation that defines this trend line, the expected GII score for each country can be calculated (the dependent variable), given its degree of economic development as measured by GDP per capita (the independent variable).[3] These expected scores help define the range within which a country's score is perceived as performing in line with its level of economic development.

For each country, the upper bound in this range is determined by increasing its expected score by 10%; the lower bound is determined by decreasing its expected score by 10%. A country is considered to be an 'innovation achiever' if its GII score falls above its upper bound. When a country's GII score falls within bounds it is considered to be performing as expected for its level of development; when a country's GII score falls below the lower bound it is considered to be performing below its level of development. Figure 2.1 shows a close-up of the trend line and bounds for the GII 2015 as well as the data points for three economies: Montenegro (GII 41), an innovation achiever; Costa Rica (GII 51) performing in line with its economic development; and the Islamic Republic of Iran (GII 106), performing below its level of development.

In addition to the above, other conditions help to determine each economy's status with respect to innovation capacity. Table 2.1 summarizes the complete set of conditions. This process locates all innovation achievers above the defined trend line, while those economies identified as innovating below capacity are located below it.

Figure 2.2 shows the distribution of all countries in the GII 2015 once their scores are plotted versus the natural logarithm of their current GDP per capita. The figure also shows the trend line, which defines the relationship between the independent variable (GDP per capita) and the dependent variable (GII score). The trend line's equation and the coefficient of determination ($R^2$), which indicates how well it explains the relationship between these two variables, are also displayed in the figure.

Innovation achievers (shown in red) are identified as performing above their level of economic development and thus are always located above the trend line. Economies performing at levels expected for their economic development (shown in black) are located above, on, or below the trend line. Their distribution is, however, constrained by the bounds set by their expected scores: 10% plus or minus these scores as defined by the trend line's equation. Nations whose innovation performance is noted as being below their level of economic development (shown in grey), are located below the trend line.

**Table 2.1: Rules for determining innovation performance with respect to GDP**

| Status | GII score | Difference between GII score and 10% above trend line ($x$ = ln GDP per capita)(x = LN GDP per capita) | Difference between GII score and 10% below trend line ($x$ = ln GDP per capita) |
|---|---|---|---|
| Innovation achievers | < 50† | > 0* | > 0 |
| Innovators at development | < 50† | < 0 | > 0 |
| Innovators below development | < 50† | < 0 | < 0* |

Note: * A necessary condition; † Not a necessary condition. In some cases, economies with a GII score of 50 or more that are not among the top 25 can be considered innovation achievers.

*(Continued)*

as innovation achievers, outperform their peers on the overall GII score during 2011–14. By excelling in all four years, these countries demonstrate the most persistent innovation performance measured as GII score relative to their GDP. These innovation achievers are all upper- and lower-middle-income countries, with the exception of low-income Kenya.

The table also shows that 15 economies (China, Costa Rica, Georgia, Ghana, Hungary, India, Kenya, the Republic of Moldova, Mongolia, Malaysia, Rwanda, Serbia, Thailand, Ukraine, and Viet Nam) qualify as pillar outperformers—that is, they outperform their peers in at least four innovation input or output pillars for all four years during 2011–14. There is some overlap between the eight innovation achievers listed above and these

## Box 2: How innovation performance relative to GDP is identified and classified

**Figure 2.1: Innovation capacity of three countries: Trend line, upper and lower bounds**

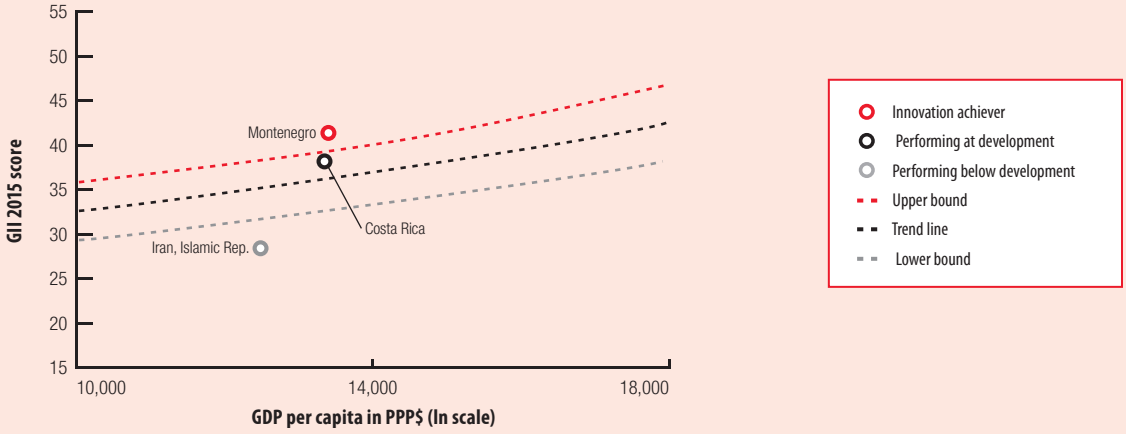
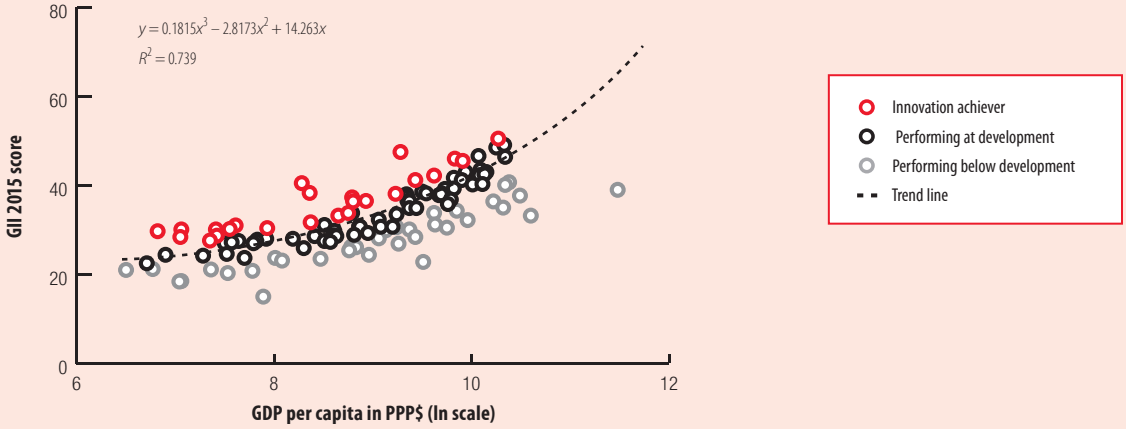



**Figure 2.2 Distribution of innovation performance in the GII 2015**




### Notes

1 Population is also considered in this process (illustrated by the size of the data point in Figure 6 of Chapter 1). This is done to provide an additional dimension. This parameter, however, does not influence either the distribution or the resulting plotted trend line, and it is therefore not considered in Figure 2.2

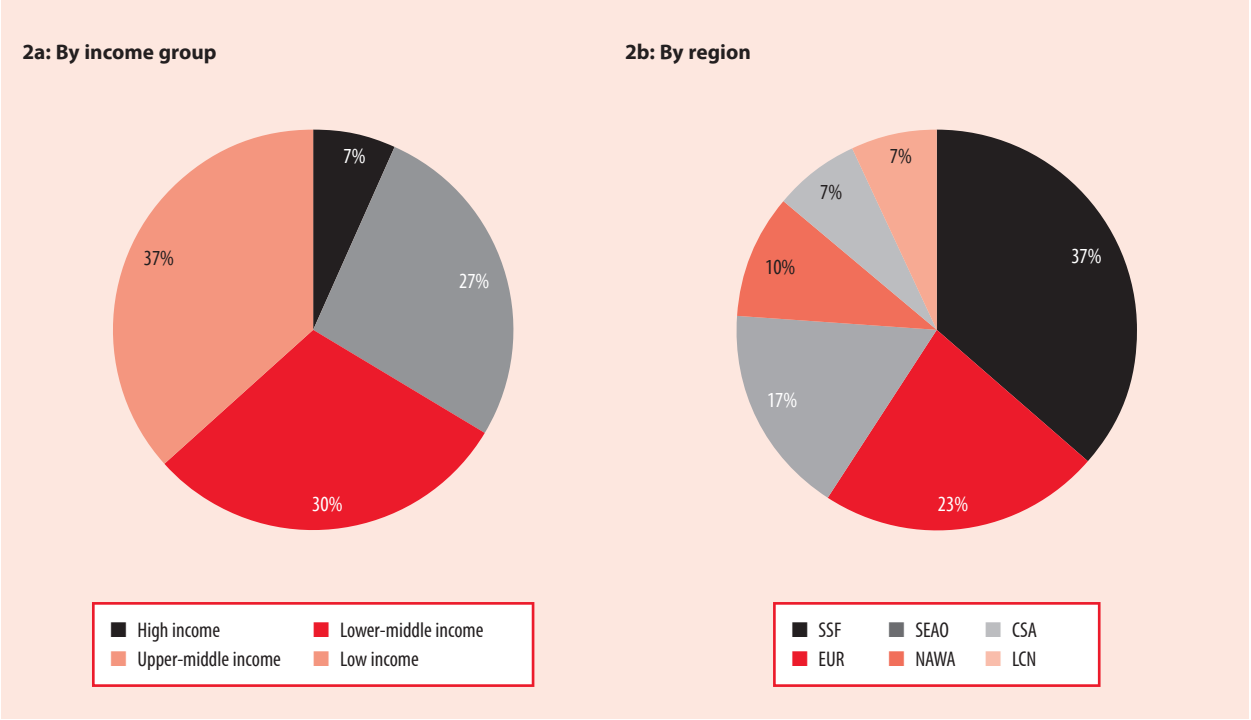
2 Each year since 2013 the trend line has been defined as a polynomial regression of degree 3 with intercept. For the year 2012, the trend line was defined as a polynomial of degree 4 without intercept, which is why it was re-calculated for this exercise.

3 The high-income economies that lead the GII rankings (see Figure 3 in Chapter 1) are not considered in Chapter 2.

pillar outperformers. The table also includes countries that qualify in either category for fewer than all four years.

Going further, 11 developing countries—Armenia, China, Georgia, India, Jordan, Kenya, Malaysia, the Republic of Moldova, Mongolia, Uganda, and Viet Nam—are labelled 'innovation outperformers' because they conform to both rules: (1) being an innovation achiever for two or more recent years (including 2013 and 2014), and (2) being a pillar outperformer for two or more years (including 2013 and 2014). Countries that outperform on one of these two criteria are discussed in the following sections.

**Figure 2: Innovation achievers, 2011–14**




Note: Regions are based on the United Nations Classification: CSA = Central and Southern Asia; EUR = Europe; LCN = Latin America and the Caribbean; NAWA = Northern Africa and Western Asia; SEAO = South East Asia and Oceania; SSF = Sub-Saharan Africa.

## Innovation achievers by income group and region

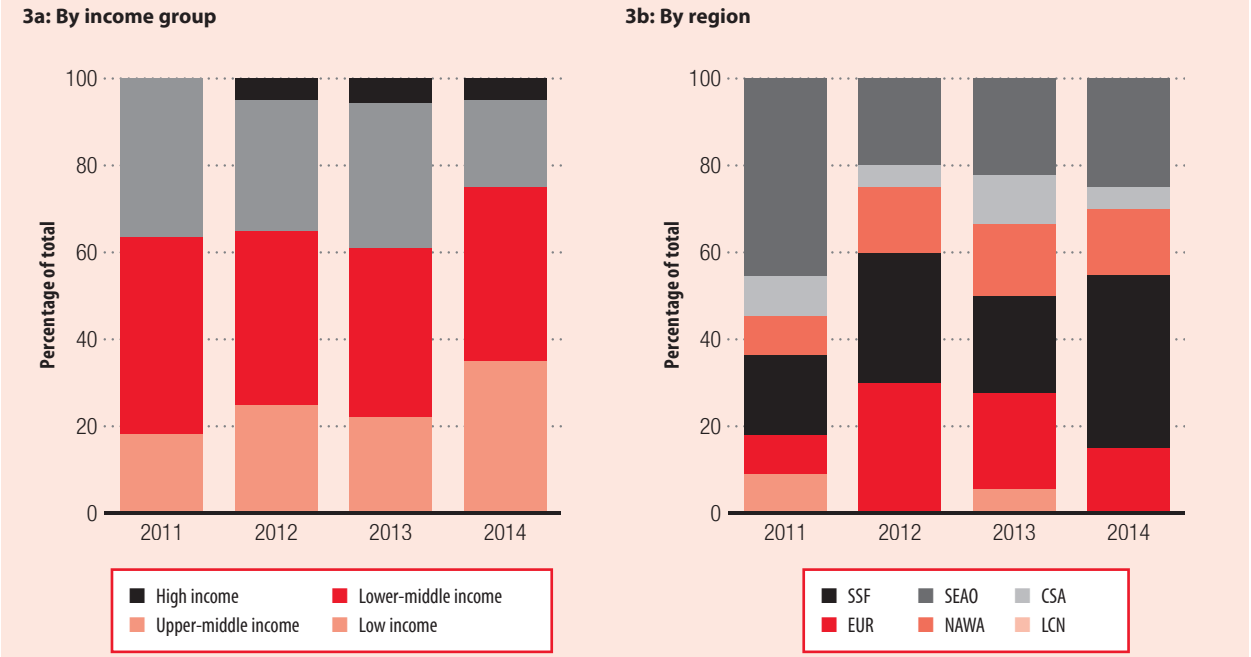
Since 2011, innovation achievers—countries that outperform in their overall GII score relative to their level of development—are mostly found in the low (11 countries), and lower-middle (9 countries) income groups. In regional terms, they are mostly from Sub-Saharan Africa (11 countries), followed by some countries in Europe (7): namely the Czech Republic, Hungary, Latvia, the Republic of Moldova, Montenegro, Ukraine, and Serbia. The European economies are all transition economies, currently implementing various strategies to improve their innovation performance and bring it closer to that of other European countries. Naturally, this suggests that producing above-par innovation capacity—that is, breaking out from the group of innovation peers—is relatively easier at lower income levels (Figures 2a and 2b).

During 2011–13 the number of innovation outperforming countries as measured by innovation achiever status among lower-income countries initially remained quite stable. However, this group increased considerably in 2014, pointing to a homogeneous innovation performance in the past but an increasing number of excelling countries more recently (Burkina Faso, Gambia, Kenya, Mozambique, Malawi, Rwanda, and Uganda) (see Figure 3a). The decrease in the percentage of upper-middle-income innovation achievers, especially from 2013 to 2014, is mainly the result of more low-income economies—particular those from Sub-Saharan Africa—attaining innovation achiever status. Indeed, the number of Sub-Saharan African innovation achievers has expanded more than other groups over recent years (see Figure 3b). Among these countries, some have consistently reached innovation achiever status (Uganda since 2013, Senegal since 2012, Kenya over the whole period). Others (e.g., Rwanda and Mozambique), however, have qualified as innovation achievers only sporadically.

## Strengths and weaknesses of innovation achievers

This section identifies the GII strengths and weaknesses of innovation achievers relative to their peers in the same income group. Certain technical issues, such as consistency and availability of data, normalization, and the inclusion of new indicators bias the reliability of these results, however, and need to be kept in mind.

**Figure 3: Percentage of innovation achievers, 2011–14**




Note: The income group for each economy is that of the reported year. Regions are based on the United Nations Classification: CSA = Central and Southern Asia; EUR = Europe; LCN = Latin America and the Caribbean; NAWA = Northern Africa and Western Asia; SEAO = South East Asia and Oceania; SSF = Sub-Saharan Africa.

### Low-income innovation achievers

Relative to the other low-income economies, innovation achievers in this group perform particularly well in the Market sophistication and Business sophistication pillars. Access to credit and innovation linkages are their areas of strongest performance. These are key inputs in the innovation process of developing countries, particularly given the financial constraints faced by their local firms and the fragmentation of their local innovation systems.

As discussed in Chapter 1, the innovation system literature puts great emphasis on the role of human capital and institutions for innovation and development. Yet these innovation input factors seem to be the most difficult of all inputs in which to achieve good scores, both in general and for low-income countries in particular. Two low-income countries that show good scores in the Institutions pillar (Burkina Faso and Malawi in 2012) score the highest in Regulatory environments and, in particular, labour market flexibilities. Only a few low-income economies outperform in Human capital and research: Kenya, Mozambique, Rwanda, Tajikistan, Uganda, Burkina Faso, Malawi, and Zimbabwe.

### Lower-middle-income innovation achievers

Lower-middle-income innovation achievers also perform well in Market sophistication, thanks either to their relatively more developed financial systems (India) or to effective credit markets (e.g., Armenia, Georgia, and Mongolia). Most of these countries have their highest scores in Knowledge and technology outputs, in the form of Knowledge creation through utility models (the Republic of Moldova and Ukraine), Knowledge diffusion through communications, computer and information services exports (India), or Knowledge impact through ISO certifications (Viet Nam). Despite these heterogeneities—which often relate to the different innovation strategies adopted—this finding hints at innovation systems that are more highly developed.

Similarly, few lower-middle-income innovation achievers excel in Institutions. When they do so, their performance is driven by high scores in labour market flexibilities. Ukraine is the sole country to perform exceptionally well in Human capital and research, thanks to its performance in Tertiary education, in particular tertiary enrolment; other lower-middle-income innovation achievers find it difficult to excel in this area.

### Upper-middle-income innovation achievers

A different story emerges when looking at upper-middle-income innovation achievers, which present a persistently strong performance in the Knowledge and technology outputs and Human capital and research pillars. As the data show, high scores in Knowledge and technology outputs can be either the result of efforts in boosting labour productivity, patent activity, and use of utility models (China) or the result of surges in ICT exports (Costa Rica in 2013).[2] Results such as these illustrate why some countries manage to be persistent innovation achievers while others do not, and how some strategies can be greatly effective in producing tangible results. Furthermore, countries adopt different strategies to support human capital and research, which results in different areas of excellence. For example, relative to their income-group peers, Malaysia and Thailand excel in the number of graduates in science and engineering, while China excels at improving basic education and the quality of universities.

Another important area of strength for upper-middle-income innovation achievers is found in the Business sophistication pillar, particularly in Knowledge workers and Knowledge absorption. Innovation achievers at higher levels of GDP focus on improving their share of knowledge workers. Knowledge absorption seems to still play a role at higher income levels. This is not surprising considering that most innovation achievers identified here are heavily embedded in global value and innovation networks. These offer great learning opportunities for local firms interacting with global market leaders.

### Conclusions and possible policy implications

A few conclusions from this analysis emerge: First, innovation achievers seem to perform the most strongly in Market sophistication and Knowledge and technology outputs. At lower income levels, countries that outperform their peers focus on removing structural obstacles to innovation, such as poor access to finance and poor linkages within the innovation systems. At higher income levels, efforts concentrate on increasing investments, spurring growth in innovation outputs, and improving human capital.

Second, although the literature emphasizes the important role of human capital and institutions in development and innovation, low- and lower-middle-income innovation achievers are progressing slowly in these areas (especially in Human capital and research). These results do not necessarily imply a lack of policy interest on the part of these countries in these areas; rather, in contrast to other innovation input factors, pursuing and excelling in these elements takes more time. While efforts in certain areas bring more immediate benefits, however, longer-term objectives should not be neglected, and persistence is key.

## Countries with above-par performance on innovation input or output factors

Another way to look at global progress in innovation is to analyse the pillar outperformer economies—those that perform above their income-group peers in more than half the innovation input and output pillars. Because of the structure of the GII, monitoring performance at the pillar level helps capture the outcome of policy efforts in particular areas known to be associated with innovation. Noting progress in at least four pillars demonstrates a positive performance in over half of the areas in which the GII focuses to measure innovation.

The number of economies with above-par performance in at least four innovation inputs or outputs has witnessed a steady expansion during 2011–14, increasing from 28 economies in 2011 to 52 economies in 2014.[3] Overall, 67 economies can be identified as outperforming their peers in four or more innovation inputs or outputs in at least one year during 2011–14. Although percentages show a small drop in 2013, the sheer number of countries remained above its 2011 level, confirming the upward trend in outperforming countries (Figure 4). This increase is attributable mainly to more upper-middle- and low-income countries joining the group.

The majority of these economies are from the upper- and lower-middle-income groups (37% and 34%, respectively); only 24% are from the low-income group.

Reviewing the pillar outperformers sheds light on the areas for which countries across different income levels can more easily outperform their peers. The high-income economies in this group outperformed in Human capital and research, implying large differences in educational and research systems among these countries. Results for upper- and lower-middle-income countries are more difficult to interpret, and they point to a frequency of outperformance in Creative outputs for upper-middle-income economies and in Creative outputs as well as Infrastructure for lower-middle-income ones. Low-income economies with above-par performance in at least four innovation inputs or outputs outperform most frequently in Business sophistication; some of them face obstacles to improving in Human capital and research. Finally,

as suggested in the previous analysis of innovation achievers, Knowledge and technology outputs appears to be the most challenging pillar for achieving the outperformance status, given the difficulties of transforming innovation efforts into outputs.

## Identifying innovation outperformers and their policy strategies

As indicated earlier, 11 developing countries can be labelled 'innovation outperformers' because they conform to the following two more stringent rules: namely, (1) their GII score relative to their GDP is significantly higher than that of other economies for two or more recent years (including at least 2013 and 2014), and (2) they outperform their income-group peers in a minimum of four innovation inputs or outputs pillars for two or more years (including at least 2013 and 2014). By setting a minimum number of years in which countries have to outperform their peers, the importance of perseverance in innovation policy is emphasized (see Chapter 1).[4] According to the GII database 2011–14, these innovation outperformers are from five regions:

*Southeast Asia and Oceania*
- China
- Malaysia
- Mongolia
- Viet Nam

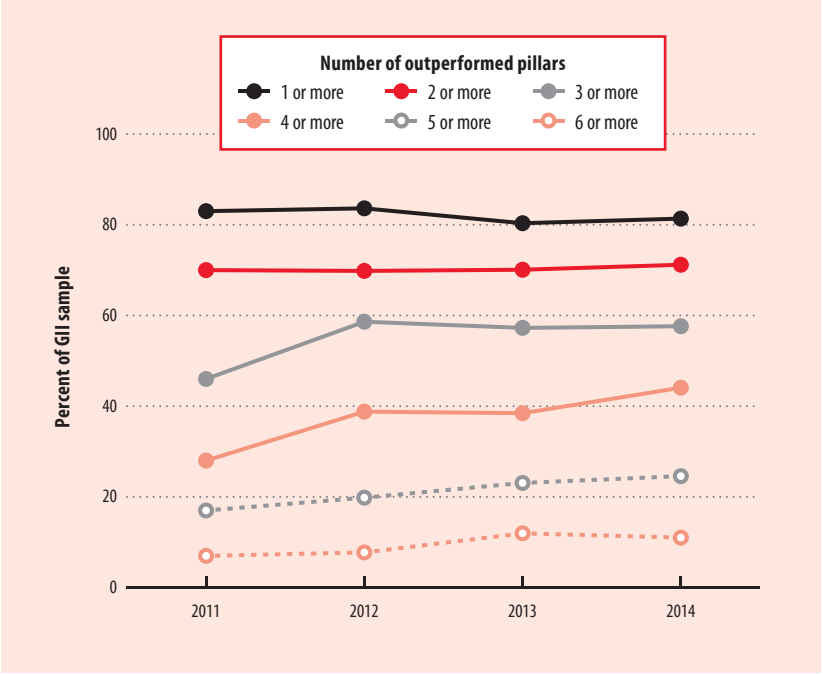
*Northern Africa and Western Asia*
- Armenia
- Georgia
- Jordan

*Sub-Saharan Africa*
- Kenya
- Uganda

*Central and Southern Asia*
- India

*Europe*
- Republic of Moldova

**Figure 4: Pillar outperformers, percentage of GII sample, 2011–14**




Note: This figure does not include the GII top 25 economies in each year.

The group of countries identified above is quite heterogeneous. This section presents a brief review of policies and their outcomes in each of these countries. Some of them—namely China (Chapter 6), Georgia (Chapter 7), India (Chapter 8), Kenya (Chapter 9), Malaysia (Chapter 10), and Uganda (Chapter 11)—are reviewed in more detail in the corresponding country chapters.

**Armenia,** from the lower-middle-income group, was both an innovation achiever and a pillar outperformer in all seven pillars during 2012–14. Armenia is making considerable efforts to strengthen its innovation system, which has become one of the strategic priorities of the Armenian authorities. Its strongest performances are in Institutions, thanks to its favourable business environment and labour market flexibilities; and in Knowledge and technology outputs, the result of high scores in domestic patent and utility model applications, scientific publications, and communications, computer and information services exports. High scores in ICT exports might be explained by the narrow strategic focus adopted by the Armenian innovation strategy. Many new initiatives—such as incubators, initiatives to revert the diaspora, and a strategy for the growth of export-oriented industries—explicitly target the ICT industry. Although this policy seems to have been quite successful (Armenia was ranked 91st in ICT service exports in 2012 and jumped to 30th position in 2013, 23rd in 2014, and 21st in 2015), these policies could usefully be extended to other industries. Poor linkages, especially between universities and industry, reduce the innovation performance of the country. This weakness is related to the narrow interpretation of innovation adopted by Armenian authorities, who are focusing on frontier

technological innovations while leaving aside other aspects of the innovation system such as linkages. Science and innovation are separately managed even at the highest levels of government, split between the State Committee of Science and the Ministry of Economy.[5]

**China** is the only country that has moved rapidly closer to the group of top 25 countries of the GII, a sign of its exceptional policy persistence in science, innovation, and intellectual property matters. It scored above the average of the upper-middle-income group in five to six innovation inputs and outputs for each of the years 2011–14. By 2014, taking account of the various scaling factors used in the GII, China excelled above almost all other economies in Knowledge and technology outputs, ranking 2nd worldwide, after Switzerland. China placed in the top three positions in the number of domestic resident patents and labour productivity growth. Its scores in utility model applications and high-tech exports also contributed to its strong performance in Knowledge and technology outputs. Despite the evident progress in the quantity of innovation outputs, the quality of these outputs has been questioned (see Chapter 6 by Chen et al.). In recent years, China has significantly improved the quality of its universities, but improvements in the other two indicators are limited (see Box 3 in Chapter 1).

**Georgia** has consistently outperformed its peers in Institutions, Human capital and research, and Knowledge and technology outputs during the period under consideration. In Chapter 7, Chaminade and Moskovko suggest that radical reforms beginning in the early 2000s were successful at developing a more business-friendly regulatory environment and reducing corruption. These efforts facilitated business operations and attracted foreign direct investment (FDI). Although Georgia outperformed its peers in Human capital and research and Knowledge and technology outputs as well, these results seem to be the consequence of extraordinarily high scores in a few indicators only, namely the pupil-teacher ratio in secondary education and labour productivity growth. Improving the quality of its education and research systems is indeed among the biggest challenges ahead for Georgia.

**India** is the only country from the Central and Southern Asia region to appear in this group. During 2011–14, India performed above the lower-middle-income group average in Infrastructure, Market sophistication, Knowledge and technology outputs, and Creative outputs. In some of these inputs and outputs, the Indian performance can be explained by the singularity of the Indian case. Despite being a lower-middle-income country, India is considered an influential global player and an emerging industrializing economy. For its level of development, India has a strong specialization in software, a high-tech industry, and an impressive set of clusters of excellence (see the chapter 'Innovation Clusters Initiative: Transforming India's Industry Clusters for Inclusive Growth and Global Competition' in the GII 2013).[6] This partially explains the country's performance in Knowledge and technology outputs, where its highest score is in communications, computer and information services exports. As Chapter 8 by Gopalakrishnan and Dasgupta discusses, a long series of innovation policies contributed to create the necessary conditions for transforming India into a knowledge-based society. Despite its remarkable performance, however, India is still facing a number of challenges. Among others, its huge and young population puts the education system under stress and its regulatory environment discourages entrepreneurs from starting new businesses.

**Jordan** is one of three economies from the Northern Africa and Western Asia region and the only one that is signalled as an innovation achiever in all four years. Its performance was particularly strong in Institutions, thanks to its scores in Regulatory environment: Jordan has ranked 1st since 2012 in labour market flexibilities and the Creative outputs pillar. Despite being an innovation achiever every year since 2011, Jordan's overall ranking in the GII fell from 41st in 2011 to 64th in 2014 (and now 75th in 2015). Between 2012 and 2014, Jordan's main challenges related to its poor performance in Market sophistication, in particular in the indicators measuring ease of getting credit and protecting investors. Performance in this area improved in 2015, but not enough to compensate for the lower rankings in almost all other areas (except for Infrastructure). For example, although Jordan performed well in Business sophistication in the past because of solid improvements in innovation linkages, in 2015 it lost 34 spots in this area. Similarly, in Knowledge and technology outputs Jordan lost 23 positions in the 2015 rankings, almost reaching again the position it held in 2012. Limited evidence, however, exists to determine which policies can explain this performance.

**Kenya** is one of the two Sub-Saharan Africa nations identified in the group of innovation outperformers. In the most recent years Kenya obtained its highest scores in access to Credit and Trade and competition. Kenya is also performing well in Education as a result of

consistently high investments in education. As suggested in Chapter 9 by Ndemo, efforts by Kenya's local government and numerous entrepreneurial initiatives have activated a previously stagnant innovation system. Kenya is a country that is producing exciting new innovations by using modern technologies—mainly ICT-based ones. This new innovative spirit is converting Kenya into one of Africa's leaders in ICT and attracting multinational corporations to set up research laboratories in the country (the success of this attraction is also evidenced by the increasingly high scores in percentages of R&D financed by foreign firms). A comprehensive policy for science, technology, and innovation focused on stimulating entrepreneurship via incubators, technology parks, and other research infrastructure is expected to further encourage entrepreneurship. These efforts are also aimed at stimulating collaborations and partnerships, especially between universities and firms. Despite the existence of a policy framework, however, innovation is still not acknowledged as a key driver of economic growth. As a consequence, resource allocation to R&D is often not guaranteed and the little that is allocated to research organizations is spent on recurrent expenditures.

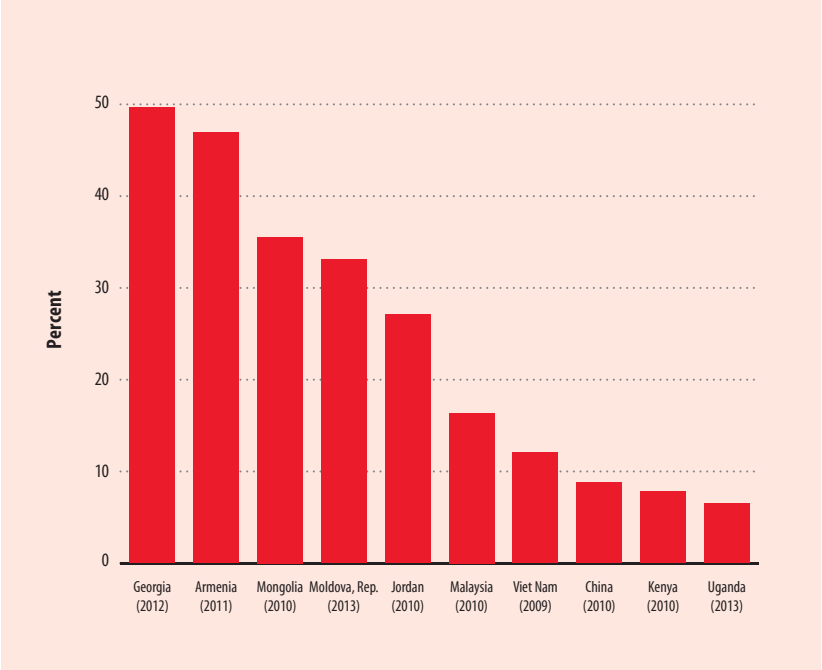
**Malaysia** is the only economy out of the 11 identified that outperformed consistently and in all innovation inputs and outputs throughout the whole period. In 2014 it performed better than 75% of the countries included in the entire GII sample in Human capital and research, Infrastructure, and Market and Business sophistication. In Human capital and research, Malaysia improved the most in R&D, moving from 54th position in 2011 to 32nd in 2014. The country also made considerable gains in Institutions, improving especially its business environment. Since 2012 Malaysia has ranked 1st in ease of getting credit and very highly in investment-related variables. Apart from creating a favourable business environment, policies have focused on increasing the number of graduates in science and engineering, a variable in which the country has ranked persistently high. Between 2011 and 2014, Malaysia ranked in the top three positions also in high-tech imports and exports, reflecting its successful integration in global value chains. As discussed in Chapter 10 by Rasiah and Yap, such an extraordinary performance is the fruit of large public investments and policy coordination between the various government agencies in charge of science, technology, and innovation. Malaysia still needs to make considerable progress in fostering knowledge-based activities and reducing technological dependence, as confirmed by its low scores in Knowledge workers, Innovation linkages, and Knowledge creation. These are typical issues for net importers of technology; in these cases, developing domestic innovation capabilities is needed to move from absorbing foreign knowledge and technology to creating domestic new knowledge and technologies.

**The Republic of Moldova** has been identified as one of the rising innovators in Europe. Its performance has been consistent in almost all innovation inputs and outputs during 2011–14. It performed above 75% of the economies in the GII in Knowledge and technology outputs and Creative outputs. These high scores are the result of high numbers of utility model applications and trademark registrations. Indeed, government efforts towards increasing intellectual property rights awareness and encouraging its use led to the establishment of the State Agency on Intellectual Property and the implementation of a National Intellectual Property Strategy, which have been in place since 2011 and 2012, respectively. These efforts may at least partially explain the country's high scores in these indicators. The Republic of Moldova performs poorly in Business sophistication, however, because of weak innovation linkages—in particular its limited cluster development and university-industry collaborations.

**Mongolia** scored above its lower-middle-income peers in all input-side variables during 2011–13, and in 2014 it outperformed its peers in all seven innovation inputs and outputs covered by the GII.[7] In 2014 the country performed higher than 77% of all economies in the GII in Market sophistication. This signals improvements in access to credit. Mongolia performs well also in Infrastructure, more specifically in gross fixed capital formation. This is not surprising given the country's extremely high growth rates over the last few years. Despite being an innovation achiever also in 2015, Mongolia lost some positions in the GII ranking. This can be explained in part by the country's slowdown in economic performance and its lower position in FDI inflows (Mongolia ranked 1st in this indicator in 2014 but dropped to 6th this year). The next months will be critical to deciding Mongolia's future innovation path. The country lacks the financial resources to exploit new knowledge and it lacks adequate infrastructure to either guarantee supply or ensure logistical and technical support. It is therefore difficult for Mongolia to fully exploit its innovative potential.[8]

**Uganda** is the second country from Sub-Saharan Africa and the one that presents the least robust

**Figure 5: Percentage of population aged 25 years and older with post-secondary education, by year**




Source: UNESCO Institute for Statistics database, June 2015.
Note: 'Post-secondary education' refers to UNESCO's International Standard Classification of Education (ISCED) level 4 or higher.

innovation performance in this group of innovation outperformer countries. Between 2011 and 2014, Uganda outperformed its low-income peers in Institutions and Creative outputs and showed a strong performance in Business sophistication, in particular in innovation linkages (thanks to high R&D financed from abroad) and Knowledge absorption (thanks to high FDI inflows and high-tech imports). As detailed in Chapter 11 by Ecuru and Kawooya, Uganda has maintained political stability since 1986 and has accompanied this stability with institution-building reforms. These efforts may explain the country's performance in Institutions and FDI inflows. Uganda's main weaknesses relate to its Regulatory environment, which discourages entrepreneurship, and its poor performance in Tertiary education and R&D. The implementation of the Strategic Investment Plan for 2012–17 is expected to mainstream business registration, thus improving Uganda's current low scores on the ease of starting a business. The policy focus on STEM (science, technology, engineering, and mathematics) might positively affect results on Tertiary education, improving especially the indicator on the number of graduates in science and engineering. The challenge in this area will be to match the policy commitments to STEM promotion with financial resource allocations.

**Viet Nam** is one of the four South East Asia and Oceania countries identified in this list. Its performance has been consistently high in Infrastructure, Knowledge and technology outputs, and Creative outputs. Viet Nam has been working towards developing its national innovation system by improving its regulatory framework and engaging in institution building.[9] Integration in global trade via global value chains and the attraction of FDI is creating opportunities for learning and upgrading. This is well captured by the GII, which evidences a good performance in Business sophistication, in particular in Knowledge absorption (through high-tech imports and FDI inflows) and Innovation linkages (via clusters). Improvements in these innovation inputs are also likely to have influenced Viet Nam's performance in Knowledge and technology outputs, as shown by its higher labour productivity and improved quality of production through ISO certifications. Viet Nam is performing weakly and having difficulty in improving all the dimensions of the Institutions pillar in addition to Research and development. It is also facing hurdles in its investment environment as well as trade and competition (Market sophistication).

## Improved education and research systems: Benefitting innovation outperformers

Overcoming a poorly educated population is a crucial to improving innovative performance (see Chapters 1 and 2 of the GII 2014).

As previous sections have shown, developing countries with above-par performance in innovation often still perform poorly in Human capital and research. Are these 11 countries doing better in this regard? The analysis in this section shows to what extent continued poor performance in this pillar applies to the 11 countries identified as outperformers.

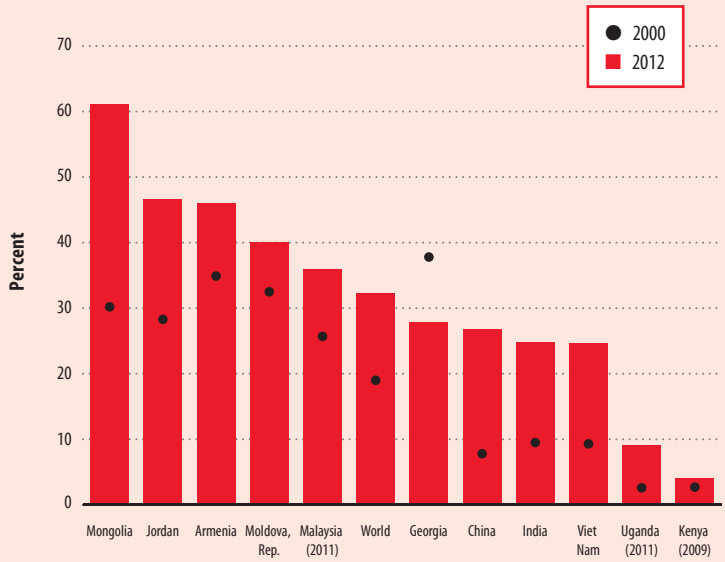
Figure 5 illustrates the educational attainment of the population, which provides an important context for innovation performance. Without a skilled workforce, proxied here by the level of qualification achieved, it is difficult to innovate in a significant way. The figure shows a

mixed picture for 10 of the innovation outperformers.[10] Out of the 95 countries in the UNESCO Institute for Statistics database for which there are data, Georgia occupies 5th place, with half its population having attained a post-secondary degree, closely followed by Armenia in 8th place (47%). Mongolia, the Republic of Moldova, and Jordan are in the top half of the rankings, but the percentages of post-secondary graduates in Malaysia, Viet Nam, China, Kenya, and Uganda are rather low.

All the outperformer countries except Georgia have improved on their gross enrolment ratio (GER),[11] charted in Figure 6, since 2000. Five of the eleven are doing so in percentages above the global average. In Mongolia, the GER stood at 61.1% in 2012, up from 30.2% in 2000. For eight of the countries, the annual average growth rate was higher than the growth rate for the GII sample average. Uganda (12.0%) and China (10.8%) experienced double-digit growth rates, ahead of Viet Nam (8.4%) and India (8.3%). Lower-than-average growth rates were observed in Armenia, the Republic of Moldova, and Georgia.

Proposing and implementing policies that support R&D is one of the key strategies needed to secure technological potential and, therefore, innovation and economic growth. In order to reach the income levels of high-income countries, low- and middle-income countries need to expand their access and capacity to use technology. Domestic R&D is also critical to the process of 'catching up' and adapting technologies developed abroad.[12] In the absence of a sufficient level of R&D, the absorptive capacity needed to take full advantage of technology transfer is often lacking, as is the capacity to design new pathways to production and establish new markets.[13]

**Figure 6: Gross enrolment ratio in tertiary education, 2000 and 2012**



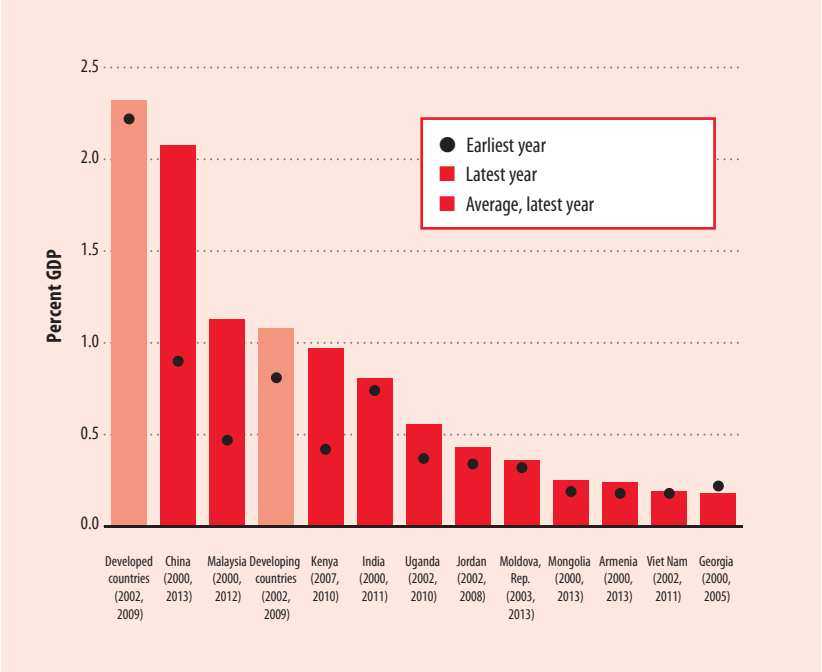

Source: UNESCO Institute for Statistics database, January 2015.
Note: Years in parentheses refer to the year of the latest available data.

Figure 7 shows the expenditure on R&D (expressed as a percentage of GDP) of these 11 economies. China's progress has been remarkable: It is the only one that comes close to the developed countries' average and, indeed, is poised to soon overtake it. However, only one innovation achiever—Malaysia—performs above the developing countries' average. Kenya is close to the developing countries' average and the 1% threshold that many governments have set as target. India's R&D expenditure stands at 0.8%. The other countries, however, display lower R&D investment expenditures.

The number of researchers (expressed per million inhabitants) illustrates a somewhat different picture. Most of the innovation achievers are now above the developing countries' average, led by Malaysia (see Figure 8). Especially Kenya, but also India and Uganda, which are doing relatively well in terms of R&D expenditure, are doing much worse in terms of the number of researchers. This discrepancy is posing a bit of a puzzle, because wages and salaries of researchers are an important component of R&D expenditure, and therefore the two concepts are closely linked. Most likely it is a result of the methodological procedures adopted when collecting the data; these procedures present a reason for concern, and are something that should be addressed by these countries.

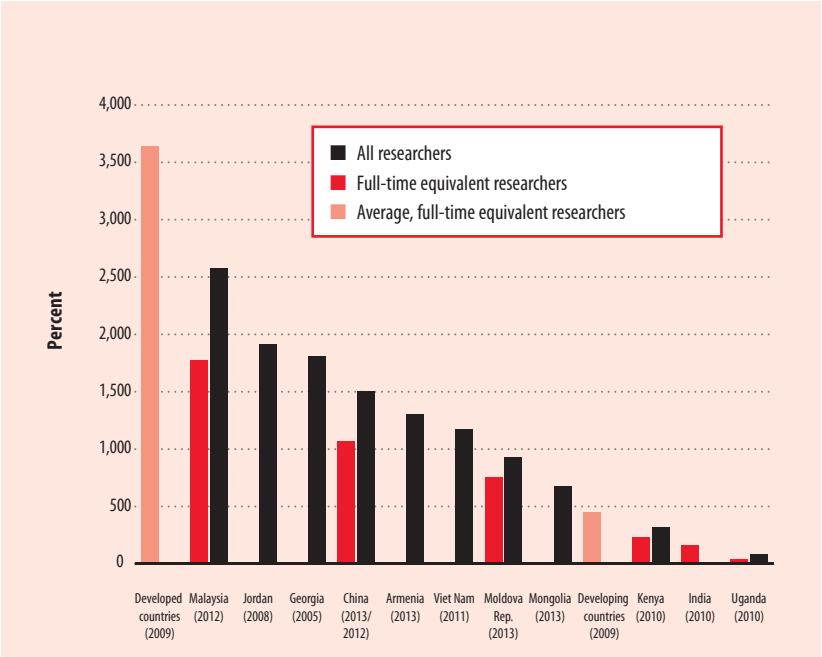
This section of the chapter has shown that the 11 economies identified in this report as persistent innovation outperformers do not show a homogeneous performance in indicators of Human capital and research. Countries such as Georgia, Mongolia, the Republic of Moldova, Jordan, and Malaysia have a more developed tertiary education system; others, like China and Malaysia, are stronger in R&D.

**Figure 7: R&D expenditure as a percentage of GDP, around 2000–13**




Source: UNESCO Institute for Statistics database, January 2015
Note: Years in parentheses refer to the year of the latest available data.

**Figure 8: Researchers per million inhabitants, latest year available**




Source: UNESCO Institute for Statistics database, January 2015.
Note: The year in parentheses is the year of the latest available data. Jordan, Georgia, Armenia, Viet Nam, and Mongolia have data only for the headcount number of all researchers (full and part time); data for full-time equivalent researchers are not available for these countries. India has data for only the full-time equivalent researchers.

## Conclusions

In spite of the often fragmented innovation systems (which often depend on external sources of knowledge and technology), developing countries are capable of making strides in innovation.

Among the 11 outperforming economies, this chapter identifies some persistent outperformers. Relative to their peers, these countries have sustained a strong innovation performance over the last years. The degree of heterogeneity among these countries is significant: They range from relatively small European and Western Asian countries such as Georgia, the Republic of Moldova, and Jordan to important global players such as China and India. One commonality among them is their relatively stronger performance in production of knowledge and technologies.

Just how developing countries can further boost their innovation performance is the subject of policy debate (see Chapter 1). Improving innovation linkages and knowledge absorption is crucial for developing countries to outperform in innovation. Building critical strengths in innovation inputs such as institutions, education, and research takes time and is more difficult to achieve. Yet, in the more medium run, these factors will be essential to allowing developing countries to more effectively translate innovation efforts into knowledge and technology outputs.

## Notes

1 The 25 high-income economies that lead the GII rankings (see Figure 3 in Chapter 1) are not considered in Chapter 2.

2 The high score of Costa Rica in Knowledge and technology outputs reflects the effect of foreign direct investment (FDI) and the country's integration in global value chains.

3 These figures exclude the top 25 innovation performers.

4 With the exception of Georgia, which this year is identified as performing at development level, all other economies remained innovation achievers in 2015. Jordan did not show above-par performance in four or more innovation inputs and outputs. While Georgia remained quite close to the achiever 'borderline' and could easily become part of this group in upcoming years, Jordan will require additional efforts to sustain innovation.

5 See also UNECE, 2014.

6 Mitra, 2013.

7 It has to be noted that for various indicators within pillar 6 (Knowledge and technology outputs) Mongolia has no available data. This happens mainly in sub-pillar 6.2, Knowledge impact.

8 The authors thank Mike Turner, Chair of the Business Department at Broward College HCMC, Viet Nam Campus, for his contribution on the innovation system in in Mongolia.

9 See also OECD and World Bank, 2014.

10 No data exist for India.

11 The 'gross enrolment ratio' is defined as the number of students enrolled in a given level of education, regardless of age, expressed as a percentage of the official school-age population corresponding to the same level of education. For the tertiary level, the population used is the 5-year age group starting from the official secondary school graduation age.

12 Archibugi and Pietrobelli, 2003.

13 UIS, 2014.

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