The Economist Intelligence Unit

Creative Productivity Index

Analysing creativity and innovation in Asia

A report by The Economist Intelligence Unit for the Asian Development Bank

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Preface

This report presents the results and analysis of the Creative Productivity Index (CPI) for a select number of Asian economies. The CPI was built by The Economist Intelligence Unit (The EIU). The Asian Development Bank (ADB) commissioned the work on developing the CPI as part of an overall study on Asia's knowledge economies. The report provides a benchmarking of a number of economies in Asia on creative productivity, an important attribute for strengthening knowledge-based economic development. This index gives policymakers a unique tool to assess how to foster creativity and innovation in Asia. Innovation-led growth is crucial for developing Asia to maintain and accelerate the pace of growth of its economies. Although the CPI has been analysed for a single point in time, it can be updated regularly based on the interests of policymakers and researchers.

Developing Asian economies have done exceedingly well in terms of growth in recent years and a number of them have also been investing significantly in innovation and research and development (R&D). A unique contribution of the CPI is to raise awareness of the productivity and efficiency of various investments that contribute to knowledge based economic development. While many developing economies of Asia need to increase the quantity of their investments, whether for higher education and training, ICT or R&D, they also equally need to address how effectively their investments and inputs are translating into outputs in the most effective and efficient manner. The CPI provides a valuable tool to measure such productivity.



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Executive Summary

Many Asian countries are suffering diminishing returns from capital investment, cheap labour and natural resources, and having to re-evaluate economic growth strategies as a result. The transition from resource-driven, export-led economies to more sustainable growth models based on human capital development, new technology and innovation will be a key challenge for many Asian countries over the next decade. In more advanced economies, long-term economic growth is ultimately sustained through innovation and creativity. Developing Asian countries must cultivate creativity and innovation if they are to achieve sustainable high-income status.

The Creative Productivity Index (CPI) aims to give policymakers a unique tool to measure progress in fostering creativity and innovation in 22 Asian economies (along with the United States and Finland for comparison purposes). The CPI measures the innovative and creative capacity of economies by relating creative inputs to outputs. On the input side, creative productivity is measured on three dimensions: the capacity to innovate, incentives to innovate and how conducive the environment is to innovation. The output side measures innovations by considering both conventional indicators, such as the number of patents filed, as well as a broader set of measures of knowledge creation.

Unlike other innovation-related indexes, such as the Global Innovation Index published by INSEAD and the World Intellectual Property Organization, the Knowledge Economy Index published by the World Bank and the Global Creativity Index published by the Martin Prosperity Institute, the CPI focuses on *efficiency*. It measures how proficient economies are at turning innovation "inputs" such as skills or infrastructure into innovation "outputs" such as patents or scientific publications. Each economy in the CPI was scored on 36 input indicators and 8 output indicators, and then assigned an efficiency score based upon the ratio between the two to illustrate how well economies are putting their innovation inputs to effective use. The CPI is also unique because it captures elements of creativity that are more important in non-Organisation of Economic Cooperation and Development (OECD) economies, such as agricultural innovation, and includes two agriculture-specific metrics. (See the appendix for a full description of the methodology and list of indicators.)

The CPI's focus on efficiency identifies barriers between inputs and outputs, and allows policymakers in resource-constrained environments to focus on the most effective interventions—to eliminate



barriers or to redouble efforts where current policy is working well. Following are the key findings of the CPI.

1. Japan leads the CPI, followed by Finland and the Republic of Korea

Japan is most effective at turning creative inputs into outputs. Although the country is eighth in the CPI in terms of creative inputs alone, it has employed its resources well to produce innovation. It tops the ranking, for example, for the number of patents filed per capita, an issue the government has prioritised in recent years. Finland is second overall in the CPI. It scores well on inputs such as infrastructure, competition, financial institutions and governance, and outperforms most other economies on outputs, with a particularly strong performance in scientific output. The Republic of Korea is third overall and the second among Asian economies, and the United States; Taipei,China; and New Zealand round out the top six. Table 1 summarises the ranking of economies in the CPI. The ranks (very high, high, medium and low) are assigned according to an economy's relative performance in the CPI.

Table 1: Ranking economies along the Creative Productivity Index, coloured by ranking: Very high, high, medium and low

Very high | High | Medium | Low

Economy	Overall	Input	Output
Japan	1	8	4
Finland	2	6	1
Republic of Korea	3	9	8
United States	4	3	3
Taipei,China	5	7	9
New Zealand	6	5	5
Hong Kong, China	7	2	2
Australia	8	4	7
Lao People's Democratic Republic	9	23	17
Singapore	10	1	6
People's Republic of China	11	11	11
Indonesia	12	21	16
Malaysia	13	10	10
India	14	15	13
Thailand	15	12	12
Viet Nam	16	14	14
Kazakhstan	17	13	15
Philippines	18	17	18
Sri Lanka	19	20	19
Bangladesh	20	22	21
Fiji	21	18	20
Myanmar	22	24	23
Pakistan	23	16	22
Cambodia	24	19	24

Note: Japan and the Republic of Korea are the two leading Asian economies in the Creative Productivity Index (CPI).

2. Cambodia and Pakistan, with much room for improvement, are ranked lowest in the CPI

Although Cambodia scores relatively well for firm dynamics, including relatively flexible labour markets, it lags behind other economies in the CPI in most other indicators. It has the most room for improvement in human capital, infrastructure and competition metrics, and poor governance also remains a problem following a disputed election in 2013. Pakistan is ranked 23rd with weaknesses in

fostering a competitive business environment and it provides little incentive for firms to innovate. Myanmar is third from bottom, as it lags across all three dimensions of creative inputs (knowledge-skills base, creative destruction, and appropriate institutions). Fiji, Bangladesh and Sri Lanka are also among the bottom six economies in the CPI.

3. Singapore leads the CPI for innovation inputs

Singapore provides the starkest example of the importance of efficiency in turning creative inputs into creative outputs. The city-state is far from an innovation laggard: it is ranked first in the level of creative inputs and sixth in the level of creative outputs. However, given its level of creative inputs, Singapore could be achieving even more creative outputs. Japan; Hong Kong, China; and New Zealand all have a lower level of creative inputs than Singapore, yet achieve a higher level of creative output. This is because Singapore is less effective at turning creative inputs into outputs, as evidenced by its ranking of 10th in the CPI. Singapore's high creative input score comes from its strong political institutions, intellectual property (IP) protections, investment protection and contract enforcement. Corruption is also rare and the city-state has a very flexible labour market. Singapore performs relatively poorly in terms of mean years of schooling and the enrolment of students in technical and vocational programmes, where it ranked 13th in the CPI. However, on measures of output, Singapore produces fewer patents than Japan; Taipei,China; and the Republic of Korea, and it is a laggard when it comes to production of books and movies. The reasons behind Singapore's lagging score on outputs are complex, but The EIU believes that democracy and free debate are critical for innovation and, in the 2013 edition of our global *Democracy Index*, we rank Singapore lower than Japan; Hong Kong, China; Taipei,China; the Republic of Korea; Australia; and New Zealand on this measure.

4. Finland and Hong Kong, China are best in the CPI for innovation outputs

Finland is second overall in the CPI, but first based on outputs alone. This is driven by strong showings in the number of scientific publications per capita, its level of export sophistication, agricultural productivity and films produced per capita. Hong Kong, China ranks seventh overall for creative productivity, but is second for outputs among the Asian economies in the CPI. It has high scores for proximity to the total factor productivity frontier (also referred to as the technological frontier, a metric comparing economies' productivity to a benchmark country—in this case the United States), a high level of export sophistication and the number of films produced per capita.

5. Low- and middle-income economies will benefit most from policies to increase creative inputs

The CPI results show two distinct groups of economies: one group of nine mainly higher-income economies has both high innovation inputs and outputs. The second group of 15 mainly lower-income economies shares both low innovation inputs and outputs. However, a deeper analysis of efficiency shows that the economies in the second group have the most to gain from policies to improve inputs. Appropriate investments in these economies will have a higher marginal benefit and could help close the creativity gap between Asian economies. This is partly due to the diminishing marginal returns on creative inputs that richer economies experience, but this remains an encouraging finding for often cash-strapped emerging-market governments. This finding is shown in Figure 2 (The relationship between creative inputs and outputs). The distribution of creative inputs and outputs across the



economies suggests that the impact of creative inputs on outputs is stronger for lower levels of creative inputs. Graphically, this can be seen in Figure 2 where the slope of the line through the poorer economies is steeper than the line drawn through the rich economies. Understanding the causal drivers of this relationship is a subject for future research. However, the CPI does show cases where economies perform worse in these categories relative to others. For example, the Republic of Korea, while ranked consistently high in all sub-dimensions, appears to be lagging in firm dynamics.

6. There are many different dimensions of creativity that are captured in this report

Key challenges for policymakers are to understand how increasing certain inputs can lead to an increase in outputs, and how to create an enabling environment for the effective transfer of creative inputs into outputs. Policymakers reading this report can focus on three contributions. First, a systematic literature review established for which creative inputs there is real evidence to suggest they contribute to creative outputs. The literature review ensured that each indicator was chosen on a sound intellectual basis. Though taken together in this study to measure creative efficiency, each indicator can also be studied on an individual basis. Second, the focus on the concept of *creative efficiency*, the efficiency with which creative inputs are transformed into creative outputs. The focus on efficiency shows there are some economies where appropriate investments will yield higher marginal benefits. Third, the calculation of the CPI to benchmark economies in Asia on *creative efficiency*, as well as more traditional measures of inputs and outputs. The performance of leading and laggard economies, as well as the common features of economies which are more efficient, point to areas of interest for policymakers and for further research. These are discussed in Chapter 3.

Table 2: Top priority input and output improvements by economy

Economy	Top 3 output dimensions	Top 3 input dimensions
Japan	Books, scientific publications, films	FDI, enrolment ratio of tertiary students in science, trade intensity
Finland	Books, cereal yield, patents	FDI, Mincerian return, trade intensity
Republic of Korea	Scientific publications, books, agricultural value added	FDI, venture capital, enrolment in tech. and voc. programmes
United States	Movies, patents, books	Trade intensity, share of FDI in total investment, enrolment of students in tech. and voc. programmes
Taipei,China	Books, films, scientific publications	FDI, trade intensity, gross enrolment ratio
New Zealand	Patents, books, agricultural value added	FDI, trade intensity, enrolment in tech. and voc. programmes
Hong Kong, China	Patents, cereal yield, scientific publications	Enrolment in tech. and voc. programmes, top-500 universities, R&D
Australia	Cereal yield, patents, films	Trade intensity, FDI, enrolment ratio of tertiary students in science
Lao People's Democratic Republic	Patents, scientific publications, agricultural value added	Enrolment in tech. and voc. programmes, top-500 universities, trading across borders
Singapore	Patents, books, films	Enrolment in tech. and voc. programmes, top-500 universities, FDI
People's Republic of China	Books, agricultural value added, films	Trade intensity, share of FDI in total investment, microfinance penetration rate
Indonesia	Books, patents, scientific publications	Top-500 universities, protection of IP, insolvency
Malaysia	Patents, books, scientific publications	R&D, share of FDI in total investment, enrolment in tech. and voc. programmes
India	Patents, agricultural value added, books	Mincerian return to education, resolving insolvency, enrolment in tech. and voc. programmes
Thailand	Patents, books, agricultural value added	Top-500 universities, microfinance-penetration rate, share of FDI in total investment
Viet Nam	Patents, scientific publications, books	Top-500 universities, microfinance-penetration rate, resolving insolvency
Kazakhstan	Scientific publications, cereal yield, books	Top-500 universities, enforcing contracts, freedom to compete
Philippines	Patents, scientific publications, agricultural value added	Top-500 universities, ease of getting credit, public spending on R&D
Sri Lanka	Films, patents, scientific publications	Top-500 universities, urbanisation rate, ease of labour turnover
Bangladesh	Patents, scientific publications, distance to TFP	Top-500 universities, venture capital, App Gap
Fiji	Patents, scientific publications, agricultural value added	Top-500 universities, protection of IP, venture capital
Myanmar	Patents, scientific publications, films and books	Top-500 universities, fixed broadband subscribers per 1,000, share of credit per GDP
Pakistan	Patents, scientific publications, films and books	Top-500 universities, gross enrolment ratio (secondary), App Gap
Cambodia	Patents, scientific publications, distance to TFP	Top-500 universities, access to electricity, paved roads

Note: The Creative Productivity Index (CPI) demonstrates that each economy is different, requiring varying policy mixes to improve performance. However, almost all economies in the CPI would benefit from marginal improvements in investments in research and higher education.



Chapter 1

Introduction to the Creative Productivity Index

- **Fostering innovation, entrepreneurship and creativity translates into direct and tangible economic outcomes.**
- **As low-income countries approach middle-income status, traditional models of growth will need to be re-examined.**
- **Sustaining growth through innovation is an important area of focus for policymakers to overcome the middle-income trap.**
- **Unlike several existing innovation indicators that only focus on levels of creative inputs or outputs, the key contribution of the CPI is to focus on *efficiency* by relating inputs to outputs.**

1. Introduction

Creativity pervades all aspects of human life: Associated with originality, ingenuity and inventiveness, creativity not only refers to the "formulation of new ideas and to the application of these ideas to produce original works of art and cultural products"; it also refers to the formulation of "functional creations, scientific inventions and technological innovations."[1]

Creativity, as elusive as it may seem, plays an important role in shaping societies and economies. Fostering innovation, entrepreneurship and creativity translates into direct and tangible economic outcomes. In Romer (1990a), for example, technology is embodied in physical capital, which in turn drives growth through positive externalities—in this case, the savings rate (or investment share) not only has an immediate impact on short-run but also long-run growth.[2] In other cases, technology is treated as a part of the human capital stock, and knowledge spill-overs in the accumulation of human capital help overcome diminishing returns.[3] Finally, some models interpret technological progress as the result of innovation, in which case the stock of innovations increases through deliberate investments in research and development (R&D). The invention of new technologies creates new firms and markets and the introduction of new production techniques and organisational structures increases the productivity of existing production processes.[4]

[1] UNCTAD (2008): "Summary: Creative Economy Report 2008", p.11, available from http://unctad.org/en/Docs/ditc20082ceroverview_en.pdf. [Accessed: 13 August 2014.]

[2] Romer, P.M., (1990): "Endogenous Technological Change," in *Journal of Political Economy*, University of Chicago Press, vol. 98(5).

[3] Lucas, R. (1988): "On the mechanics of economic development," in *Journal of Monetary Economics*, vol. 22(1), pp. 3-42.

[4] Burger-Helmchen, T. (Ed.) (2013): *The economics of creativity: Ideas, firms and markets*, London, New York: Routledge.

Re-examining traditional models of growth

As low-income countries approach middle-income status, traditional models of growth will need to be re-examined for the following reasons:

- Diminishing returns to successive increases in the capital stock limit the extent to which investment alone can contribute to economic growth.
- As the supply of cheap labour declines, due to both demographic change and expansion of better-paid jobs, higher wages necessitate a shift away from economic models based on labour-intensive manufacturing exports.
- As emerging countries are approaching the technological frontier the returns from leapfrogging through the adoption of existing technologies decline. A more detailed discussion of the technological frontier indicator is available in the appendix.
- The gradual depletion of natural resources limits the sustainability of resource-driven growth.

Harnessing creativity to overcome the middle income trap

In facing these challenges (often summarised as the "middle-income trap"), sustaining growth through innovation—by harnessing and institutionalising creativity—becomes an important area of focus for policymakers.[5] The Creative Productivity Index (CPI) aims to develop an understanding of the conditions required to harness creativity as a critical ingredient towards establishing an innovation-based knowledge economy, with a focus on measures that are informative for policymaking. A more thorough discussion on the process used to select the indicators for the CPI is available in the appendix.

The CPI measures the innovative and creative capacity of economies by relating creative inputs to outputs and based on a systematic review of academic and policy evidence. On the input side, creative productivity is measured on three dimensions:

1. Capacity to innovate
2. Incentives to innovate
3. Environment conducive to innovation

The output side measures innovations by considering both conventional indicators, such as the number of patents filed, as well as a broader set of measures of knowledge creation.

The CPI: a focus on efficiency

Unlike several existing innovation indicators that only focus on levels of creative inputs or outputs, the key contribution of the CPI is to focus on *efficiency* by relating inputs to outputs: It is not surprising that providing more inputs is likely to increase outputs. Given budget constraints and acknowledging the opportunity costs associated with increased investments, the CPI focuses on how *productive* inputs are put to use to generate creative outputs.

There are a number of existing measures of the level of creativity in different economies, and the CPI has been constructed with a view to adding new information to the debate. In particular, the CPI adds new value in three ways:

[5] Bakshi, H., Hargreaves, I. and Mateos-Garcia, J. (2013): "A manifesto for the creative economy," NESTA, available from http://www.nesta.org.uk/publications/manifesto-creative-economy. [Accessed 14 August 2014.]



Table 3: Key innovations of the Creative Productivity Index

Theory-based	In contrast to existing indicators and driven by the growing awareness of the importance of theory-based composite indices, the CPI is derived from cutting-edge new growth theory, rather than exogenous growth theory .
Efficiency-focused	Unlike existing innovation indicators (for example, the Knowledge Economy Index (KEI) published by the World Bank) that focus on levels of innovation, the key contribution of the CPI is to focus on efficiency by relating inputs to outputs: an economy may have higher levels of inputs and outputs, but may still be less efficient than other economies in the CPI.
Asia-specific	The CPI is aimed at capturing elements of creativity that are more important in non-OECD countries and emerging economies (for example, recent innovations in the agricultural sector) that traditional measures of innovation (for example, number of patents filed or scientific output) often do not account for.

The indices developed permit a direct comparison between the 24 economies on important determinants of innovative capacity, and allow policymakers to identify high and low performers. Since creativity, an intangible concept, is difficult to capture, a one-time snapshot allows for clear cross-economy comparisons, where measurement errors are less severe.

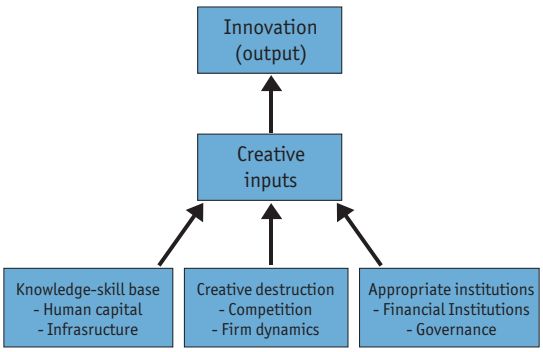
The remainder of the report is structured as follows: Chapter 2 introduces the conceptual framework; Chapter 3 presents the resulting set of indicators, assesses their predictive power and identifies the set of high and low performers, which are then studied in greater detail.

Chapter 2

The production of innovation: Methodology and indicators

- **The CPI has two objectives: to measure the creativity of economies and to measure the efficiency by which inputs are transformed into outputs.**
- **The conceptual framework of the CPI is based on new growth theory and measures creativity on three dimensions: knowledge-skills base, creative destruction and appropriate institutions.**
- **Each economy in the CPI receives a score for inputs and a score for outputs. The final CPI score is the ratio of creative outputs to creative inputs.**

Figure 1: Conceptual framework of the Creative Productivity Index



Note: Based on new growth theory, the CPI encompasses three critical dimensions for generating creative outputs.

2.1 CPI conceptual framework and indicator list

The CPI has two objectives: first, to measure the creativity of economies, defined as the ability to innovate and generate new ideas and blueprints. Second, to measure productivity, defined as the efficiency by which these inputs (for example, skills or investments in R&D) are transformed into outputs (for example, patents or process innovations). The conceptual framework of the CPI is based on new growth theory, and encompasses three critical dimensions for generating creative outputs and sustaining economic growth: knowledge-skills base, creative destruction and appropriate institutions (see Figure 1). The 36 input variables and 8 output variables (see Tables 4 and 5), were included based on clear evidence that they contribute to productivity growth (see the appendix for further details).

2.2 Aggregating the CPI: Calculating the Creative Productivity Index

The CPI's 44 indicators (25 quantitative and 19 qualitative) are grouped into five categories. The variables in each category are assigned scores by normalising them along a uniform scale. Each economy in the CPI receives an input score and an output score. The final CPI score is a ratio of creative outputs to creative inputs.



Table 4: Variables list and dimension for creative inputs (all variables enter with equal weight)

Inputs	Unit	Subdimension	Dimension	Source
Number of top-500 universities	Rating (1-4), where 4 is best			Times World University Rankings, Jiaotong Academic Ranking of World Universities
Mean years of schooling	Years			Barro and Lee
Urbanisation rate	%			World Development Indicators, EIU data
Population aged 15-64	%			World Development Indicators
Mincerian return to education	%	Human capital Weight: 1/2		Psacharopoulos and Patrinos, National sources, EIU calculations
Strength of university-industry collaboration	Rating (1-7) where 7 best			World Economic Forum
Gross enrolment ratio (secondary school)	%			World Development Indicators, national statistics agencies, EIU calculations
Enrolment ratio of tertiary students in science	Ratio		Knowledge-skill base Weight: 1/3	World Development Indicators
Access to electricity	%			EIU data
Infrastructure quality	Rating (1-20), 1 being best			EIU Risk Briefing
Paved roads	%			World Development Indicators
Quality of roads, airports, seaports	Rating (0-12), 0 being best			EIU Business Environment Rating
Internet users per 1,000 people	%	Infrastructure Weight: 1/2		World Development Indicators or EIU forecasts
Fixed-broadband subscribers per 1,000 people	%			World Development Indicators, EIU forecasts
App Gap	Rating (1-16), 16 being best			EIU calculations
Public spending on R&D	%			National sources, EIU calculations
Mobile-phone subscriptions	%			World Development Indicators, EIU forecasts
Starting a business	Rating (1-5), 5 being best			EIU Business Environment Rating
Resolving insolvency	Rating (1-4), 4 being best			World Bank Doing Business 2014, EIU calculations
Employing workers	Rating (1-16), 1 being best			EIU Risk Briefing
Level of price controls	Rating (1-5), 5 being best	Competition Weight: 1/2	Creative destruction Weight: 1/3	EIU Business Environment Rating
Trading across borders	Rating (0-10), 10 being best			EIU Business Environment Rating
Trade intensity	Number			EIU calculations
Share of FDI of total investment	%			World Development Indicators, EIU calculations
Freedom to compete	Rating (0-10), 10 is best			EIU calculations
Net migrant inflow/outflow	Ratio	Firm dynamics Weight: 1/2		CIA World Factbook, National statistical agencies, EIU calculations
Ease of labour turnover	Rating (0-4), 4 being best			World Economic Forum, EIU calculations
Microfinance penetration rate	%			MIX, World Development Indicators, EIU calculations
Average credit share of GDP	%	Financial institutions Weight: 1/2	Appropriate institutions Weight: 1/3	EIU data, national agencies
Availability of venture capital	Rating (1-7), 7 being best			WEF Global Information Technology Report 2013
Ease of getting credit	Rating (0-4), 0 being best			EIU Risk Briefing
Investment openness	Rating (1-5), 5 being best			EIU Business Environment Ranking
Enforcing contracts	Rating (0-4), 0 being best			EIU Risk Briefing
Protection of intellectual property	Rating (0-4), 0 being best	Governance Weight: 1/2		EIU Risk Briefing
Protecting investors	Rating (0-5), 5 being best			EIU Business Environment Rating
Corruption and bureaucracy	Rating (0-12), 0 being best			EIU Risk Briefing

Note: The CPI contains 36 individual input indicators, covering the knowledge and skills base, creative destruction and appropriate institutions.

Table 5: Variables list and dimensions for creative outputs (all variables enter with equal weight)

Outputs	Unit	Subdimension	Dimension	Source
Patents per capita	Number	Micro-level Weight: 1/2	Conventional indicators Weight 1/2	WIPO statistics database
Scientific publications in journals	Number			Scopus
TFP relative to the frontier	Ratio to observed maximum (US)	Macro-level Weight: 1/2		EIU calculations
Export sophistication	Score			UN Comtrade database, EIU calculations
Cereal yield per hectare	Hectograms per hectare	Agricultural sector Weight: 1/2	Indicators relevant to emerging economies Weight 1/2	FAO, EIU calculations
Agricultural value added per worker	USD			FAO, EIU calculations
Films produced per 1,000 people	Number	Creative industry Weight: 1/2		UNESCO
Books published per 1,000 people	Number			Publishers Global

Note: The CPI contains eight output input indicators, including agriculture-related indicators that are relevant to emerging economies.

Calculating the weightings

The category scores are weighted equally, following the conventional, accepted approach when there is no compelling reason to assign different weightings. The advantage of this approach is transparency, and even if there is also no clear theoretical basis for equal weighting it is the best option.

To ensure the CPI weighting is robust, EIU analysts conducted sensitivity analysis on the results, using both principal-component analysis and regression-based approaches (see appendix for further details). The results were largely similar, indicating that the choice of weighting scheme is not driving the CPI rankings.

Economies and data availability

The CPI is calculated for a total of 24 economies. While most economies in the sample are from Asia and the Pacific, the United States and Finland are also included in the sample to enable a direct comparison with Western high-income benchmark countries. In order to achieve a balance between universal data availability and timeliness, CPI data is usually from 2012, with some values from earlier years where 2012 data points were missing. (For a full discussion of the methodology and indicators, please see the appendix.)



Chapter 3

Index results and economy summaries

- The CPI measures the innovative and creative capacity of economies by relating creative inputs to outputs to show which economies are the most effective at turning creative inputs into creative outputs.
- On the input side, creative productivity is measured on three dimensions: the capacity to innovate, incentives to innovate and how conducive the environment is for innovation. The output side measures innovations by considering both conventional indicators, such as the number of patents filed, as well as a broader set of measures of knowledge creation.
- Japan and the Republic of Korea occupy the top two positions overall in Asia, meaning they are the most efficient of all the economies at turning creative inputs into outputs. In contrast, Pakistan and Cambodia are ranked lowest in the sample.
- Singapore leads the list for creative inputs, while Finland and Hong Kong, China are best for creative outputs.
- Economies are clustered in two groups: those with high creative inputs and outputs and those with low creative inputs and outputs: this shows that there is a strong relationship between inputs and outputs across the economies in this index, although within each group some economies are more efficient than others in their use of creativity.
- Of economies with high creative inputs, Singapore and Australia are less efficient at turning those into outputs. Of those with lower creative inputs, Pakistan and Cambodia are less efficient at turning inputs into outputs.
- Japan, Finland, and the Republic of Korea have high creative inputs and are also efficient at turning inputs into outputs. Of economies with low levels of creative inputs, the Lao PDR, the People's Republic of China and Indonesia are the more efficient at transforming them into creative outputs.

- **The impact of increasing creative inputs appears to be larger in low- and middle-income economies, suggesting that policies to increase creative inputs in those economies will yield a larger marginal benefit.**

3.1 Index results

How do Asian economies perform in terms of creative productivity? Table 6, below, provides a ranking for all economies based on overall creative-productivity score, in descending order. Economies are classified into four groups, based on the distribution in the sample: Very high (ranks 1-6), high (7-12), medium (13-18) and low (19-24). In the overall ranking of creative productivity, Japan and the Republic of Korea occupy the top two positions in Asia. In contrast, Pakistan and Cambodia are ranked lowest in the sample.

Table 6: Ranking economies along the Creative Productivity Index, coloured by ranking: Very high, high, medium and low

Very high | High | Medium | Low

Economy	Overall (Output/input)		Input								Output	
			Knowledge-skill base		Creative destruction		Appropriate institutions		Average input		Innovation/Avg. output	
	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score
Japan	1	1.114	9	0.619	8	0.484	7	0.675	8	0.593	4	0.661
Finland	2	1.076	8	0.69	6	0.536	4	0.868	6	0.698	1	0.752
Republic of Korea	3	1.049	6	0.718	13	0.396	10	0.584	9	0.566	8	0.594
United States	4	0.904	4	0.719	3	0.716	3	0.884	3	0.773	3	0.699
Taipei,China	5	0.901	3	0.74	7	0.503	9	0.655	7	0.632	9	0.57
New Zealand	6	0.892	7	0.718	4	0.585	6	0.818	5	0.707	5	0.631
Hong Kong, China	7	0.863	5	0.719	2	0.817	2	0.895	2	0.81	2	0.704
Australia	8	0.824	2	0.752	5	0.572	5	0.849	4	0.725	7	0.597
Lao People's Democratic Republic	9	0.723	24	0.169	21	0.288	23	0.139	23	0.199	17	0.144
Singapore	10	0.693	1	0.779	1	0.892	1	0.938	1	0.87	6	0.603
People's Republic of China	11	0.552	10	0.516	15	0.379	11	0.469	11	0.464	11	0.256
Indonesia	12	0.526	15	0.363	23	0.221	19	0.243	21	0.276	16	0.145
Malaysia	13	0.511	11	0.515	12	0.415	8	0.658	10	0.529	10	0.27
India	14	0.459	19	0.297	14	0.384	13	0.379	15	0.354	13	0.162
Thailand	15	0.44	13	0.392	11	0.435	12	0.419	12	0.416	12	0.183
Viet Nam	16	0.404	14	0.386	17	0.357	15	0.345	14	0.363	14	0.146
Kazakhstan	17	0.394	12	0.413	9	0.477	22	0.22	13	0.37	15	0.146
Philippines	18	0.386	18	0.333	20	0.306	18	0.288	17	0.309	18	0.119
Sri Lanka	19	0.37	16	0.359	24	0.212	16	0.309	20	0.294	19	0.108
Bangladesh	20	0.336	23	0.171	18	0.344	21	0.224	22	0.246	21	0.083
Fiji	21	0.326	17	0.35	19	0.331	20	0.242	18	0.308	20	0.1
Myanmar	22	0.262	21	0.197	22	0.282	24	3.125	24	0.17	23	0.044
Pakistan	23	0.191	20	0.21	16	0.376	14	0.371	16	0.319	22	0.061
Cambodia	24	0.105	22	0.173	10	0.436	17	0.29	19	0.3	24	0.031

Note: Japan and the Republic of Korea are the highest-scoring economies in the CPI, with Cambodia and Pakistan occupying the last two positions. CPI results have been divided into four groups of economies: very high, high, medium and low. The table also shows where each economy places if only input indicators or output indicators are considered.

Singapore leads the list for creative inputs

The CPI can be broken down into its two components and economies can be ranked in absolute terms for creative inputs and outputs. In terms of creative inputs, Singapore leads the list, with strong performances in all three input sub-dimensions of *knowledge-skill base*, *creative destruction* and *appropriate institutions*. The high scores are driven by top scores for nearly all indicators of *infrastructure* (sub-dimension of *knowledge-skill base*), firm dynamics (sub-dimension of *creative*



destruction), *financial institutions* and *governance* (sub-dimensions of *appropriate institutions*). Despite this stellar performance, the indicators reveal several dimensions for which further improvement is possible: the lowest score on individual indicators is the 0.19 score for enrolment of *students in technical and vocational programmes* (*human capital* in the sub-dimension *knowledge-skill base*), and the 0.33 score on the number of top-500 universities.

Finland is ranked first for outputs, followed by Hong Kong, China

Finland's success is mainly attributable to the *number of scientific publications per capita*, the high level of *export sophistication*, *agricultural productivity* and *films produced per capita*. Similarly, the success of Hong Kong, China as the top economy in terms of creative output in Asia is attributable to its *proximity to the total factor productivity (TFP) frontier*, the high level of *export sophistication* and the *number of films produced per person*. (The *distance to the TFP frontier*, an outcome of creative production in the CPI, tracks the relative distance in productivity of a given economy to the technologically leading country, conventionally equated to the United States.)The breakdown, however, also reveals scope for improvement in the two top-ranking economies: Finland lags behind in terms of *numbers of books published* (0.08 score) and Hong Kong, China lags behind in terms of *patents per capita* (0.15 score).

The CPI measures the efficiency of outputs

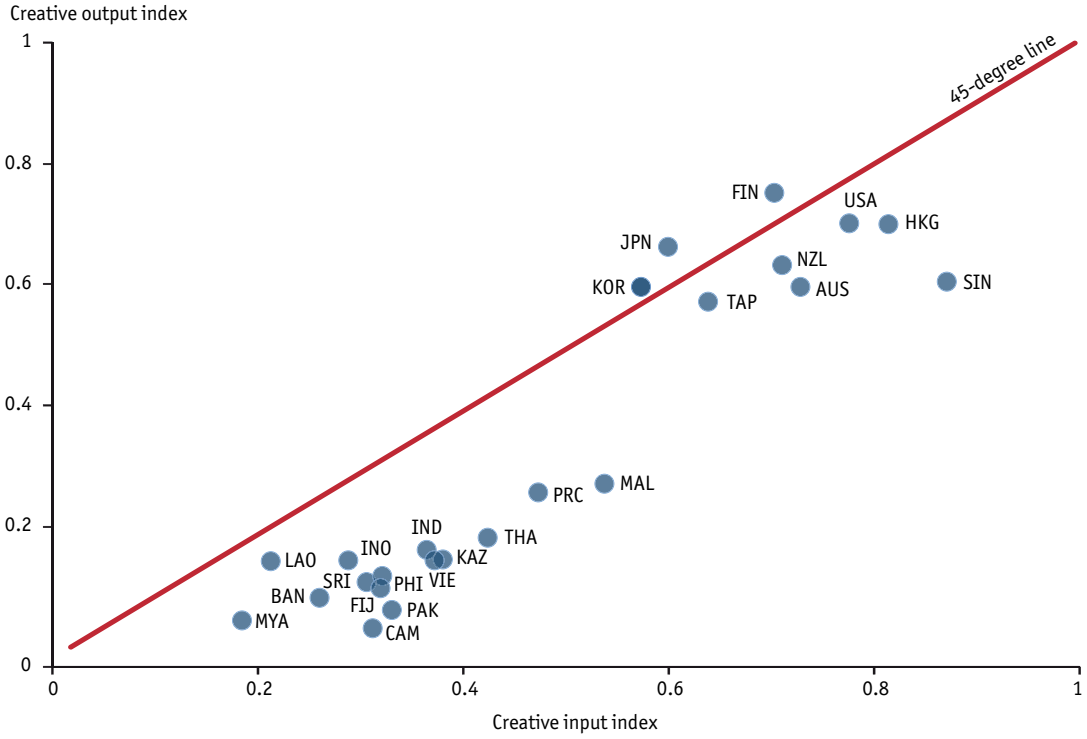
The ranking of creative productivity reveals several surprising findings: the United States, for example, despite being one of the most advanced economies, is only ranked fourth, below Japan, Finland and the Republic of Korea. The reason for this lies in how efficiently the given level of inputs are used to generate outputs: while the United States indeed outperforms Japan—the top country, based on the CPI—on all dimensions (for example, Japan is ranked ninth in *knowledge-skill base*, compared with fourth for the United States, fourth in *innovation* versus third for the United States), Japan's final output/input ratio is higher and the country is therefore more efficient in producing a very high level of creative outputs with a relatively low level of inputs.

Another intuitive way in which to illustrate the relationship between absolute levels of output and input, as well as the final ratio—the CPI—is to plot the absolute levels of output against input (Figure 2).

More marginal benefits for low- and middle-income economies

There is a clear and strong positive relationship between creative inputs and the resulting outputs. The correlation coefficient is 0.93 and variations across economies explain up to 86% of the variation in creative outputs. Economies are clustered in two groups: those with high creative inputs and outputs and those with low creative inputs and outputs. The impact of increasing creative inputs appears to be larger in low- and middle-income economies, suggesting that policies to increase creative inputs in those economies will yield a larger marginal benefit. It is important to highlight the heterogeneity across Asia: The range in Asia spans from Japan (1.1) to Cambodia (0.11). Given the vast dispersion, it is clear that the effect of creative productivity will manifest itself in different ways in different economies. Identifying and testing the underlying drivers of creative efficiency is a subject for further research which controls for economy-specific factors. Another approach to study underlying drivers would be to repeat the CPI over a number of years to allow for a more robust investigation of creative efficiency.

Figure 3: The relationship between creative inputs and outputs



Note: Economies in the CPI are clustered in two groups: those with both high creative outputs and inputs, and those with both low creative outputs and inputs. The position of economies relative to the 45-degree line, indicates how productively economies are employing their inputs to produce output. The steeper the slope of a line from the origin to the dot marking the position of an economy, the higher the CPI score. Economies above the line are performing the best on this metric.

The position of economies relative to the 45-degree line indicates how productively they are employing their inputs to produce output. The three economies above the 45-degree line, Japan, Finland and the Republic of Korea, are able to produce relatively more with their given level of input, and their resulting overall creative-productivity score is, therefore, above 1 (see Table 7). Economies further away from the 45-degree line, such as Cambodia (CAM), are ranked lower, as they are not able to put their existing inputs to efficient use. In those economies, increasing the level of inputs is not sufficient, it is also necessary to undertake case studies to understand the barriers preventing the conversion of creative inputs to outputs in the particular economy.



Box 1: Focusing on efficiency: Lao People's Democratic Republic versus Singapore

The Lao People's Democratic Republic (ranked 9th) and Singapore (ranked 10th) highlight a key innovation of the creative productivity index. Unlike existing innovation indicators, which only focus on levels of creative outputs (for example, innovations) or inputs (for example, schooling), the key contribution of the CPI is to focus on efficiency by relating outputs to inputs. The Lao People's Democratic Republic is not a leading knowledge economy in Asia but it does put what little creative inputs it does have to effective use. This suggests that the Lao People's Democratic Republic may be one country where well-targeted policies to increase creative inputs could have a larger effect.

Singapore has both high levels of creative inputs and outputs but, compared to other high-income economies in the region, its production of output is relatively low. Singapore, in fact, has the highest level of creative inputs in the sample, while the Lao People's Democratic Republic is ranked 23rd. Similarly, Singapore is ranked higher in creative outputs, occupying sixth position, while the Lao People's Democratic Republic is ranked 17th.

Given that it has the highest level of inputs, it is perhaps not surprising that Singapore manages to produce more creative outputs than the Lao People's Democratic Republic. What is surprising, however, is that the Lao People's Democratic Republic's output is relatively high *despite* the low levels of inputs. Since the CPI focuses on efficiency by relating outputs to inputs, the relative performance gives the Lao People's Democratic Republic an overall ranking that is comparable to that of Singapore.

Given its level of income, the Lao People's Democratic Republic performs exceptionally well in a number of dimensions of creative outputs, such as its degree of *export sophistication* (see Box A5: Export sophistication) and *cereal yield* (as a proxy for agricultural productivity).

What creative resources the Lao People's Democratic Republic does put to use, it does so in a highly productive manner; this is likely partly due to diminishing marginal returns on creative inputs, but also indicates that enabling more creative inputs in the Lao People's Democratic Republic could bring large benefits. Some of the areas of creative output where the Lao People's Democratic Republic scores highly—such as *agricultural productivity* and *export sophistication*—have not been incorporated into previous measures. An important caveat here is that measurement error is likely to be a larger issue in the Lao People's Democratic Republic, due to the poorer quality of statistics. In particular, given that the CPI is measured as a ratio of outputs to inputs and the level of inputs for the Lao People's Democratic Republic is small, small changes in the level of measured inputs will have a large influence on the CPI score. It would only take a 5% measurement error in the Lao People's Democratic Republic's creative inputs to put it behind Singapore.

Other measures of innovation have also found that Singapore is less efficient in its use of creative inputs. The INSEAD Global Innovation Index likewise ranks Singapore highly for its level of inputs—being ranked 7th out of 142 countries—but only 121st out of 142 on the Innovation Efficiency Ratio.

3.2 Examining economy performance at the sub-dimension level

For the input side, the CPI can be further broken down into its sub-dimensions (see Table 7) to reveal with greater specificity areas where further improvements are needed.

The table suggests that some economies are consistently ranked highly across all sub-dimensions of input. Singapore, for example, is ranked first in *firm dynamics*, *infrastructure* and *governance*, second in *financial institutions* and *competition* and fourth in human capital. Other consistently high-performing economies include Australia; the United States; Finland; Hong Kong, China; and New Zealand; all of which are found to be in the top 10 of the overall creative productivity ranking.

There are, however, also several interesting outliers. The Republic of Korea, while being ranked consistently highly in all sub-dimensions, appears to be lagging substantially behind in *firm dynamics*, positioned between Fiji (ranked 19th) and the Lao PDR (ranked 21st). This is mostly driven by rigid labour market conditions, evidenced by slow labour turnover and low migrant flows. Kazakhstan, in contrast, is ranked mid-table overall, but is characterised by an above-average score on *firm dynamics*, arguably as a result of recent efforts to remove administrative barriers and regulatory hurdles for

Table 7: Ranking economies along the input sub-dimensions of the Creative Productivity Index, coloured by ranking: Very high, high, medium and low

Very high | High | Medium | Low

Economy	Overall input	Knowledge-skill base		Creative destruction		Appropriate institutions	
		Human capital	Infrastructure	Competition	Firm dynamics	Financial institutions	Governance
Japan	8	10	8	8	12	7	9
Finland	6	9	2	4	11	5	2
Republic of Korea	9	6	4	9	20	10	10
United States	3	5	5	3	3	3	4
Taipei,China	7	1	9	7	10	8	8
New Zealand	5	3	7	6	6	4	5
Hong Kong, China	2	7	3	1	2	1	6
Australia	4	2	6	5	7	6	3
Lao People's Democratic Republic	23	23	21	14	21	21	23
Singapore	1	4	1	2	1	2	1
People's Republic of China	11	8	11	13	15	11	13
Indonesia	21	13	16	23	22	18	19
Malaysia	10	11	10	11	17	9	7
India	15	21	15	21	8	13	15
Thailand	12	17	14	10	13	14	12
Viet Nam	14	19	12	15	16	17	14
Kazakhstan	13	15	13	18	4	20	20
Philippines	17	16	17	12	23	19	16
Sri Lanka	20	12	18	16	24	23	11
Bangladesh	22	20	23	17	18	22	18
Fiji	18	14	19	19	19	16	22
Myanmar	24	18	24	24	14	24	24
Pakistan	16	24	20	20	9	12	17
Cambodia	19	22	22	22	5	15	21

Note: The CPI allows for deeper analysis at the input dimension level. Here economies are compared in their overall score, but also on each dimension (knowledge-skill base, creative destruction and appropriate institutions) and sub-dimension (human capital, infrastructure, competition, firm dynamics, financial institutions and governance).

private firms. A similar pattern is observed in Cambodia, which is ranked lowest in the overall rankings, but is ranked fifth in terms of *firm dynamics*. While this high score on *firm dynamics* reflects progress in providing an environment conducive to creative destruction, the poor *human capital* and infrastructure base, as well as the lack of finance and challenges in governance, nevertheless point to scope for further improvement. The remainder of this sub-section discusses the six sub-dimensions in greater detail.

A summary of results in each sub-dimension

Human capital: As part of the *knowledge-skill base*, *human capital* determines the capacity of an economy to innovate. Taipei,China leads the ranking, performing well in the extensive margin, with mean years of education of 11.34 and a science-oriented composition of its human capital, with 56.39% of the students enrolled in applied technical and vocational programmes. Taipei,China is closely followed by Australia (second), New Zealand (third), Singapore (fourth) and the United States (fifth). Finland, well-known for its high performance in the education sector (for example, in the OECD PISA tests),[6] is ranked only 9th as the *human capital* dimension extends beyond direct measures of human capital). Although performing well in *enrolment ratio* and *years of schooling*, the low *Mincerian returns on education* score is suggestive of the inability of the domestic labour market to absorb skilled

[6] OECD (2014): "PISA 2012 results in focus: What 15-year-olds know and what they can do with what they know," available from www.oecd.org/pisa/keyfindings/pisa-2012-results-overview.pdf. [Accessed: 14 August 2014.]



workers. In addition, Finland's relatively low *working-age population* (65%) and low *enrolment of tertiary students in science* (10%) may limit the country's capacity to innovate.

The bottom of the list comprises Pakistan (24th), the Lao PDR (23rd), Cambodia (22nd), India (21st), and Bangladesh (20th). While the priority in the top-ranked economies is to improve the intensive margin of the human-capital base, the main challenge in the lagging economies remains in expanding education in the extensive margin, with *mean years of schooling* about half of the years observed in the leading economies (for example, Pakistan: 5.5 years, compared with Taipei,China: 11.3 years). That does not mean that lagging economies can ignore the intensive margins however, they need to improve on those margins accordingly in order to ensure that they have suitable human capital for their level of development.

Infrastructure: As with *human capital*, *investment in physical infrastructure* is a critical input that determines the capacity to innovate. The leading economies in terms of infrastructure are Singapore, followed by Finland (second), Hong Kong, China (third), the Republic of Korea (fourth) and the United States (fifth). Singapore leads in *infrastructure* on nearly all dimensions, with top scores on the provision both in the extensive (for example, *access to electricity*, *paved roads*) and the intensive (*quality of infrastructure*, *such as roads*, *airports and seaports*) margins.

The bottom countries comprise Myanmar (24th), Bangladesh (23rd), Cambodia (22nd), the Lao PDR (21st), and Pakistan (20th). As with *human capital*, the main challenge in the lagging economies remains the lack of investment in infrastructure on the extensive margin. While leading economies provide universal coverage of electricity, electricity coverage remains low in the lagging economies; only half of the population in Myanmar has access to electricity, for instance. In comparison to Finland's 91% Internet coverage, only 1.1% of people in Myanmar have access to the Internet. According to a review of the academic evidence, investment in human capital needs to be matched by investment in infrastructure to provide a strong knowledge-skill base. Infrastructure determines the extent and speed to which existing knowledge can be disseminated. For example, the penetration rate of roads and the Internet, gives an indication of how widely infrastructure is spread across the population, while measures of quality, such as the quality of roads and broadband availability, act as a proxy for infrastructure in the intensive margin. Furthermore, access to electricity is essential in employing mechanised and digital devices in production processes and mobile phone subscription helps disseminate information, facilitating the integration of markets.

Competition: Not only is the capacity to innovate important, but so is the incentive to innovate. Competition induces an environment favourable to creative destruction. For this sub-dimension, Hong Kong, China leads the ranking, followed by Singapore (second), the United States (third), Finland (fourth) and Australia (fifth). The dynamism of Hong Kong, China's business environment is reflected in its top scores on the World Bank's *Doing Business* report measures, with high scores for both *ease of entry* and *ease of exit for businesses*. Similarly, low levels of price controls and openness in trade across borders induce a high level of competition, conducive to creative destruction.

The lagging countries in this sub-dimension include Myanmar (24th), Indonesia (23rd), Cambodia (22nd), India (21st) and Pakistan (20th). In these countries, high regulatory hurdles often impose prohibitively high entry barriers, giving incumbents—often state-run enterprises with low

productivity—little incentive to streamline their production processes, become more productive and foster innovation.

Firm dynamics: Another necessary condition for ensuring a high level of incentive to innovate is *firm dynamics*, which captures the flexibility and vitality of the labour market and workforce. Here, Singapore (first) leads the list, followed by Hong Kong, China (second), the United States (third), Kazakhstan (fourth) and Cambodia (fifth). While Singapore's performance, with top scores in ease of *labour turnover* and *net migrant inflow/outflow*—proxies for the vitality of the labour market—is in line with its high overall performance, Cambodia and Kazakhstan highlight more recent success in their attempts to deregulate the labour market (see country snapshots). Cambodia, in particular, while continuing to be ranked poorly (22nd) in the *competition* sub-dimension, ranks among the top performers for *firm dynamics*. Countries that continue to fall behind are Sri Lanka (24th), the Philippines (23rd), Indonesia (22nd), the Lao PDR (21st) and the Republic of Korea (20th). The Republic of Korea, in particular, is an outlier, as it performs consistently above average in other dimensions, while lagging behind in *firm dynamics*.

Financial institutions: *Appropriate institutions*, as captured by *financial institutions* and *governance*, provide an external environment conducive to innovation. For the sub-dimension of *financial institutions*, Hong Kong, China (first) leads the list, followed by Singapore (second), the United States (third), New Zealand (fourth) and Finland (fifth). Hong Kong, China's financial institutions top the list in nearly all dimensions, with the highest scores in the *availability of venture capital*, the *ability to obtain credit*, the *microfinance penetration rate* and *investment openness*. These features are critical for sustaining an environment where high-risk-high-return projects can flourish.

Countries where access to finance is a major barrier are Myanmar (24th), Sri Lanka (23rd), Bangladesh (22nd), the Lao PDR (21st) and Kazakhstan (20th). Myanmar, in particular, is the country that lags behind on all dimensions of *financial institutions*. Overcoming these credit frictions, for example through the recent efforts made to liberalise the financial market, may have a significant effect in facilitating the emergence of more private businesses.

Governance: In terms of *governance*, Singapore (first) leads the ranking, followed by Finland (second), Australia (third), the United States (fourth) and New Zealand (fifth). Singapore's leading position is driven by top scores in *enforcing contracts*, the *protection of IPR* and *investors*. Having joined the ADB-OECD Anti-Corruption Initiative for Asia-Pacific in 2001, there have been effective efforts to reduce corruption through civil service and anti-corruption reforms.[7] These dimensions provide an environment conducive to innovation, which ensures that private firms and investors are able to reap the benefits of their R&D efforts.

There exists, however, great heterogeneity in *governance* quality across the sample. Countries such as Myanmar (24th), the Lao PDR (23rd), Fiji (22nd), Cambodia (21st) and Kazakhstan (20th) occupy the bottom positions in the rankings. While it takes 150 days and costs 25% of the claim to enforce a contract in Singapore on average, it takes 1,160 days[8] and 51.5% of the claim's value to enforce a contract in Myanmar. As the remainder of this report shows, removing these large disparities may yield high returns and contribute substantially to closing the creative-productivity gap across developing Asia.

[7] Chua, C.Y. (2001): "Singapore's three-pronged program to combat corruption: enforcement, legislation and adjudication," available from http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan047818.pdf. [Accessed 14 August 2014.]

[8] World Bank, Doing Business Indicators (2013).

Box 2: The 'App Gap' in Asia: A platform for creativity

The spread of superfast broadband and mobile devices has already transformed commerce, media and entertainment globally, and has huge potential to change the way vital services, such as healthcare and education, are delivered. For consumers, broadband opens up the possibility of receiving vastly improved services more conveniently and cost effectively. For governments, broadband holds the promise of more efficient delivery of public services to a wider population; and, in some developing markets, building a mobile-based service from the ground up.

The *App Gap* indicator in the CPI—based on The EIU's App Gap Index from 2013—measures this potential for vital services to be delivered to the customer over fixed and mobile broadband networks "anytime and anywhere," whether in the home, at work or on the move. Here, the *App Gap* results in Asia are examined, including how the *App Gap* supports innovation and creativity, and, specifically, how the Republic of Korea and the People's Republic of China are moving forward with next-generation Internet services.

What does the App Gap measure?

Each country in the CPI was assigned an *App Gap* score from 1 to 16, based on the sum of scores for four sub-indicators: *international Internet bandwidth*, the *percentage of the population covered by a 3G* or *4G network*, *wireless-broadband-subscription penetration* and the economy's *performance in the UN E-Government Survey*. Taken together, these indicators provide a comparative metric for how prepared economies are to adopt broadband applications for next-generation services. Implicit in the *App Gap* formulation is a belief in the transformative power of broadband networks to deliver traditional services in more innovative, efficient ways.

The App Gap in Asia

Asia is unique in that it contains a mix of highly technologically advanced markets, such as Singapore; Hong Kong, China; the Republic of Korea; and Japan, along with developing markets that are currently behind the leaders, but are witnessing astronomical growth in mobile connectivity, such as the People's Republic of China and India.

The CPI scores reflect this divide between developed and developing markets. Australia and Singapore, for example, score most highly overall for the *App Gap* among the Asia-Pacific economies, tying with the United States and Finland. Singapore has the highest penetration rate in the world for wireless broadband, at 125% (reflecting the fact that some customers have multiple subscriptions) and almost all of the country has access to at least a 3G network. Likewise, Australia has near-ubiquitous 3G coverage and a wireless-broadband-penetration rate of more than 100%. The other two leaders, the Republic of Korea and Hong Kong, China, score nearly as well on these metrics. At the other end of the scale, the countries that do least well in the CPI lack vital infrastructure. Bangladesh, the Lao PDR and Pakistan, for example, are tied in last position and all share the predicament of very little bandwidth and no significant 3G networks.

Broadband potential in all markets

Although broadband infrastructure is yet to be built in many developing markets, in actuality, both groups

Score on App Gap indicator

Economy	App Gap score*
Australia	15
Singapore	15
United States	15
Finland	15
Hong Kong, China	14
Republic of Korea	14
Japan	13
Taipei,China	13
New Zealand	12
Kazakhstan	11
Fiji	10
Malaysia	10
Indonesia	9
Viet Nam	9
People's Republic of China	8
Cambodia	7
Philippines	7
Thailand	7
Sri Lanka	6
India	5
Myanmar	5
Bangladesh	4
Lao People's Democratic Republic	4
Pakistan	4

*Sum of indicator scores for international internet bandwidth, % population covered by at least a 3G network; wireless broadband subscription penetration; UN e-Government Development Index.

of economies—developed and developing—have the potential to adopt next-generation broadband services, but in different ways, and for different reasons. The drivers in developed markets are based on the ubiquity of networks. Increasingly well-connected online consumers will select from among continual upgrades and innovations in software, in app stores and other online offerings. Large telecoms operators and device makers in these markets will also "push" services to their large base of customers. Governments will see how efficiencies can be made by incentivising take-up of broadband applications, especially in budget-stretched departments, such as health and education.

Developing markets are most exciting for their potential. Right now, 2G infrastructure predominates across developing markets, but there is a huge opportunity in countries such as the People's Republic of China to leap from 2G directly to 4G. In these markets, next-generation services can be rolled out in tandem with networks.

Another key factor in these markets is the development of networks in cities, where connectivity is racing ahead to match or overtake cities in developed markets. In addition, the most interesting opportunity in developing markets—if governments and other stakeholders seize it—is to close the *App Gap* in areas such as healthcare, education and banking, by building broadband-based services where traditional infrastructure is currently lacking.

Closing the App Gap: Creativity and innovation in action

Widespread broadband networks set the stage for creativity, providing a platform on which individuals, small businesses, large corporations and governments can innovate. There is a role for all stakeholders in this process, large and small, and the evidence from existing next-generation services in Asia suggests that the partnership model works best.

In the super-connected Republic of Korea, for example, leading mobile operator, SK Telecom, with 27m subscribers, runs several m-health initiatives in partnership with others. One of these, Health-On, is a personalised fitness service, offered through a joint venture with Seoul National University Hospital. Customers receive a physical check-up at the hospital, supported by a smart-phone app and wearable sensors that track progress on diet and fitness. The operator also has other ideas in the pipeline, including a service to help patients to manage chronic diseases.

China Telecom, the People's Republic of China's third-largest operator, with 160m subscribers, recently announced a deal with Lifewatch, a Swiss technology company that produces remote-cardiac-monitoring equipment. Lifewatch will provide China Telecom with a health-related smart phone and other remote-monitoring services. China Unicom, the second-largest mobile operator in the People's Republic of China, with 273m subscribers, is also exploring the m-health space, through a partnership with Ideal Life, a medical-monitoring-device company, and Novatech, a technology company, to run mobile kiosks in remote regions that allow patients to send medical details and receive advice about whether a hospital appointment is required.

Conclusion: Driving individual creativity

Although these product launches are often driven on a large scale by corporations, the technology behind them frequently comes from small start-ups and entrepreneurs. In addition to supporting the roll-out of broadband infrastructure, policymakers must consider how they can nurture home-grown creativity through education and incentives, so software designers, app inventors and entrepreneurs of the future can create local, relevant content and services on the platform that broadband networks provide.



Box 3: University-industry collaboration

University and industry have been collaborating for over a century. However, the rise of the global knowledge economy has intensified the need for strategic partnerships that will eventually become powerful engines for innovation and economic growth.[1]

Types of collaboration

Several authors have attempted to define the different types of university-industry (U-I) relationship. This co-operation can take various forms, such as financial research at the university, supported by industry; co-operative research that includes contractual relationships with faculty associates on industrial projects; and knowledge and technology transfer that includes collaborative research, curriculum development, technology-related consulting, staff and student mobility, vocational training for employees, use of IPR by public scientific organisations and personal networks, among other forms.[2]

It is difficult to quantify the deepening of the U-I relationship, owing to the lack of standardised international data. The most reliable indicator is the *science link*, which measures the number of academic papers cited in patent applications filed to the United States Patent and Trademark Office. This number rose from 0.5 in 1985 to 3 in 1998. Meanwhile, in Japan, this indicator rose from 0.2 to 0.6 over the same period, indicating the large gap between U-I collaboration in Japan and the United States. In the Republic of Korea, science linkage was lowest among OECD countries, despite the fact that it allocates a high level of public spending to R&D as a proportion of its GDP. This was primarily owing to the fact that universities in Japan and the Republic of Korea were state-owned and were not allowed to operate as independent entities. In the 1990s both of these economies realised that they were lagging behind in their competitiveness relative to the United States in key sectors such as ICT, high-tech machinery and biotechnology, and decided to strengthen their U-I links.

Public policy drives U-I expansion in Asia

The development and expansion of U-I links in Asia is a result of goal-oriented and deliberate public-policy efforts. The areas of focus have included defining the legal status of universities, relaxing regulations that prevent faculty from collaborating with industry, developing policies on IPR, creating funding schemes and ensuring adequate financial resources for R&D activities at universities. Different countries have varying degrees of autonomy for universities, which engage in contractual arrangements with the private sector. The recent rise in university spin-offs and patent applications in Japan and the Republic of Korea is a result of legislation similar to the United States' Bayh-Dole Act (1980), which confers independent status upon universities. Consequently, income from cases of technology transfer in the Republic of Korea increased from W473m (around US$440,000) in 2001 to W1.9bn (US$1.3m) in 2003, while the number of cases of technology transfer over the same period rose from 58 to 133. Meanwhile, in Japan, the number of university-spawned ventures, another measure of U-I co-operation, increased by 400% between 1998 and 2003 (Ministry of Education, Culture, Sports, Science and Technology Survey, Japan). By contrast, the People's Republic of China's legislation allows universities to act as corporations and commercialise their technologies through enterprise incubation. Today, science-related companies account for nearly 2.3% of total sales in the People's Republic of China's high-tech industry. However, although the Philippines also provides a similar level of autonomy to its universities, it has not been able to make concrete contributions to industry, as U-I relations are typically with foreign subsidiaries that rely on R&D transferred from their parent companies.

Expressing political will to increase U-I collaboration is equally important. For example, Japan, the Republic of Korea and India have incorporated this factor in their "basic plans", which lay down the countries' long-term priorities and funding policies. In determining its priorities and allocation of resources, Japan was seen to be less responsive to the demands of the dynamic environment that required it to transfer research funds from mature science fields to biotechnology and healthcare. When the number of students in biotechnology in the United States increased by 70% from 1991 to 2000, for example, this figure, surprisingly, remained unchanged in Japan. A high level of leadership is required to expand resources for emerging areas at the expense of another sector, but the Republic of Korea is adept at this. Hence, although countries such as the Republic of Korea, the People's Republic of China, India and Japan have involved high levels of government interaction to shape U-I co-operation, countries such as Singapore have framed their U-I relations on the basis of civil laws and other rules governing business and contracts.

Commercialising research

Patenting research results is seen to be an incentive for universities and business to commercialise the research produced by tertiary institutions. However, the management of IP is a recent phenomenon for

many Asian countries. For example, unlike Japan and the Republic of Korea, India does not have a law that dictates the licensing, technology transfer or ownership of inventions from publicly funded R&D, and so this is dealt with on a case-by-case basis. Moreover, since the U-I relationship in Thailand has evolved on the basis of personal networks, the Thai government also does not lay down such rules. Even in the Republic of Korea and Japan, information regarding technology transfer is incomplete and inadequate, and they prefer to follow a non-exclusive licensing policy, with potentially negative connotations in the case of risky start-ups, which require heavy investment to take their results to the market. The United States model, in contrast, based on the Bayh-Dole Act, allows universities to file for patent results and grant licences to third parties. However, only a few countries, such as Finland and Italy, grant ownership to inventors. Many Asian economies have relied on Technology Transfer Offices (TTO) to counter the lack of a strong IPR policy. Singapore's emergence as the top-rated country for IP protection and U-I collaboration has been attributed to the role of the TTO (known as the Industry and Technology Relations Office in the city-state), which plays the multi-faceted roles of marketing the technology, licensing, finding partners and securing funds.

Having realised the potential of research activities as a resource that can be tapped for U-I collaborations, Asian governments have prioritised the adequate allocation of research funding and grants. Public funding is the main source of finance for such universities. However, compared with other OECD economies, the Republic of Korea's and Japan's public funding account for the smallest proportion of total research funding (around 25%, compared with 40% among OECD countries). Chinese universities are particularly successful in receiving funds: Rmb1bn (US$165m)-Rmb2.2bn between 1999 and 2002. The public and private sectors contributed equally to this funding. The People's Republic of China has also encouraged other forms of funding, such as incubation facilities, science parks and soft loans. Singapore has set up agencies and centres that form the major source of government funding and, in particular, have been successful in supporting start-ups of small- and medium-sized enterprises (SMEs) by offering equity-matching funds.

Importance of human capital

Finally, Asia's governments are slowly becoming aware of the importance of developing a trained workforce that is capable of handling the complex and multi-disciplinary work associated with U-I collaborations. Singapore and India run programmes to train young science students, although, compared with the United States, these schemes are largely inadequate. Employment practices, wage systems and *pension portability* are important issues that need to be considered for the success of U-I collaborations. In the United States, for example, engineers change jobs once every four years, whereas, in Japan, owing to life-long employment, only 20% of engineers are found to change jobs during their entire career. This low rate of labour mobility is a major obstacle in improving U-I linkages, as it hinders the free flow of researchers and research, and thereby jeopardises the way in which a national innovation system operates. National policies should also encourage greater recruitment of foreign researchers in order to create a *global knowledge economy*.

[1] Brockliss, L. (2000): "Gown and town: the university and the city in Europe, 1200– 2000," in *Minerva*, vol. 38, pp. 147-170;

Etzkowitz, H. and Leydesdorff, L. (2000): "The dynamics of innovation: from national system and mode 2 to a triple helix of university-industry-government relations," in *Research Policy*, vol. 29, pp. 109-23.

[2] Santoro, M. (2000): "Success breeds success: the linkage between relationship intensity and tangible outcomes in university-industry collaborative ventures," in *The Journal of High Technology Management Research*, vol. 11(2), pp. 255-273;

Chakrabarthi, A. (2002): "Role of universities in the product development process: strategic considerations for the telecommunications industry," from MIT Industrial Performance Centre's special working paper series on local innovation systems;

Polt, W., (2001): "Benchmarking industry science relations: the role of framework conditions," final report prepared for EC, DG Enterprise.

3.3 Economy summaries

Section 3.3 consists of economy summaries for India, Indonesia, Kazakhstan and the People's Republic of China. These summaries provide more detail on how these economies perform on several indicators. For summaries for the other economies in the CPI, please refer to the appendix.

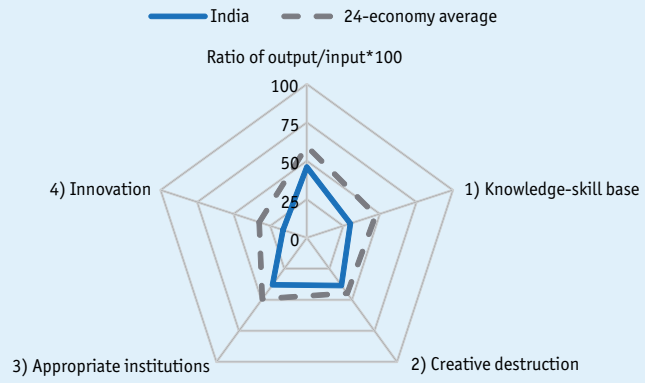
India — Rank: 14

India is ranked 14th out of 24 economies overall, with a medium level of *creative productivity*. In terms of inputs, India lags behind in the *knowledge-skill base*, which reflects the need for further investments in physical infrastructure and human capital. Despite recent productivity gains, India still lags behind in terms of output, with a low score on *agricultural productivity* indicating the need for further rural innovations.

Relative to other economies in the index, India has solid *firm dynamics*. However, although it is ranked sixth in the index for *ease of labour turnover*, the country's labour laws are overlapping and cumbersome, and employers face difficulties in making workers redundant. For example, firms with more than 100 employees are obliged to obtain government authorisation to lay off workers or to close unprofitable business units.[1] Nevertheless, most of India's labour laws apply only to the (less productive) organised sector, which does not include small-scale manufacturing and services, agriculture and most construction work. The country's relatively high ranking for this indicator is likely to reflect the fact that only a small minority of India's 500m workers are employed under formal contracts.

India languishes in 21st place for both *competition* and *human capital*. For *human capital*, the country scores well for the *number of top-500 global universities*, but the overall ranking is dragged down by its low scores for its *rate of urbanisation*, *mean years of schooling*, and *technical and vocational enrolment of students in secondary school*. This suggests that, although India's tertiary institutions are sound, more investment is needed in primary and secondary schooling.

Nevertheless, on the whole, India has a solid pool of skilled, English-speaking graduates, which will continue to aid in the expansion of the country's services sectors, such as ICT. Elsewhere, larger productivity gains are needed in the agricultural sector. Among other things, India's agricultural productivity is hindered by the small size of average land holdings;[2] the lack of adequate irrigation systems, leaving farmers at the mercy of the weather (India is the most rain-dependent agricultural economy in the world);[3] and ineffective government policies and institutions, which hurt competitiveness and constrain diversification.[4]



Top quartile	2nd/3rd quartile		Bottom quartile	
	Infrastructure	37.3	Human capital	22.3
	Firm dynamics	53.2	Competition	23.8
	Financial institutions	44.6		
	Governance	31.3		

Although the establishment of the National Innovation Council in 2010 has shifted the policy focus towards "a decade of innovation," India lags behind emerging countries such as the People's Republic of China. While R&D expenditure has risen sharply and is set to be increased to 2% of GDP as part of the Science, Technology and Innovation (STI) Policy announced in 2013, the gap with countries such as the People's Republic of China is widening. Over the period during which India's scientific output doubled, the People's Republic of China's grew sevenfold.[5] Challenges in the *knowledge-skill base* persist, and regulatory hurdles, red-tape and corruption provide little incentive for the private sector to invest in innovation.

The case of India, however, also highlights the importance of capturing Asia-specific measures of innovation: While India underperforms on traditional output measures, such as patents and scientific publications, the country's potential lies in fostering so-called frugal innovations—achieving more through process innovation and with fewer resources. Frugal innovation responds to limitations in resources, whether financial, material or institutional, and using a range of methods, turns these constraints into an advantage. Typical fields of frugal innovation reflect the main strength of India's economy; for instance, agricultural innovations, such as fertilisers and high-yielding varieties, as well as service-sector innovations, where India has become a dominant exporter of computer and IT services. Examples of frugal innovation are found throughout the Indian system: from Dr Devi Shetty's pathbreaking model of delivering affordable heart surgery, to efforts to crowdsource drug discovery driven by government labs, to Bharti Airtel's approach to cutting the cost of mobile phone calls, to the Keralan approach to palliative care which is providing access to support at the end of life for thousands in a void of formal healthcare.[6]

While frugal innovation is difficult to measure, the CPI uses, as proxies for such innovations, *agricultural productivity*, the *distance to the technological frontier*—capturing productivity gains unaccounted for by physical inputs—and the degree of *export sophistication*—reflecting the complexity of ICT and business services traded. When excluding these measures, the country is ranked lower (16th), confirming the importance of these Asia-specific measures, in particular for India.

[1] The Economist Intelligence Unit (2014): India Country Commerce, January 2014.
[2] Darji, H. and Dhandeo, K. (2013): "Decreasing land holdings biggest challenge for Indian agriculture: NABARD," 24 August 2013. Available from http://articles.economictimes.indiatimes.com/2013-08-24/news/41444004_1_indian-agriculture-one-crore-farmers-farmers-capacity. [Accessed: 14 August 2014.]
[3] FAO and UNICEF (2013): "Water in India: Situation and prospects, 2013," available from http://coin.fao.org/coin-static/cms/media/15/13607355018130/water_in_india_report.pdf. [Accessed: 14 August 2014.]
[4] World Bank (2012): "India: Issues and priorities for agriculture," available from http://www.worldbank.org/en/news/feature/2012/05/17/india-agriculture-issues-priorities. [Accessed: 14 August 2014.]
[5] Bound, K. and Thornton, I. (2012a): "Our Frugal Future: Lessons from India's Innovation System," NESTA, available from http://www.nesta.org.uk/publications/our-frugal-future-lessons-india%C2%92s-innovation-system. [Accessed: 14 August 2014.]
[6] Ibid.

Indonesia — Rank: 12

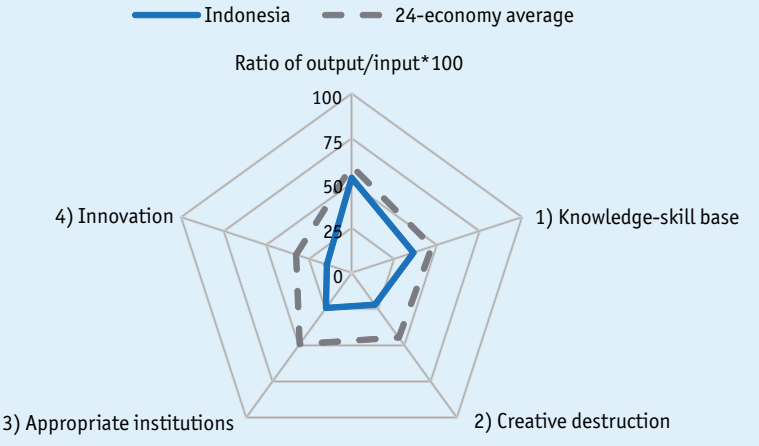
Indonesia is ranked 12th out of 24 overall, with a high level of creative productivity due to its ability to put its relatively scarce inputs to efficient use. In terms of inputs, Indonesia has only a medium-sized knowledge-skill base, and its low degree of *competition*, *firm dynamics* and poor *governance* indicate potential barriers to innovation. Nonetheless, the country is able to generate a comparatively high level of outputs.

As part of the long-term National Development Plan 2005-2025, Indonesia's current plan for 2010-14 focuses on human-resource development and improvements in the field of science and technology, thereby aiming to improve the country's knowledge-skill base. The CPI, however, suggests that the knowledge-skill base may not be the highest-priority area. Compared to the *knowledge-skill base* (ranked 15th), its sub-scores on *creative destruction* (ranked 23rd) and *appropriate institutions* (ranked 19th) hint at even greater challenges.

The country's middling rank for its *knowledge-skill base* is underlined by the poor quality of *infrastructure*. Government spending on infrastructure has fallen to the equivalent of around 2% of GDP, compared with 6% before the 1997-98 Asian financial crisis, despite an acceleration in economic growth. Indonesia's poor transport infrastructure, particularly its inadequate roads, railways and ports, constrains faster economic expansion. In addition, Indonesia suffers from rolling blackouts, as soaring demand, combined with an antiquated generation-and-delivery network, have led to power shortages. Indonesia scores poorly for *creative destruction*. In particular, the country ranks above only Myanmar—a country that has only recently begun to open up to investment—in terms of *competition*. This reflects poor policymaking, state intervention and vested interests in government.

Indeed, setting up new businesses remains a complex and costly process, and persistently high levels of corruption and rigid regulation provide a difficult environment for private business and innovation. In terms of appropriate institutions, access to finance remains a major challenge. In the absence of venture capital, most of the funds are channelled to large incumbent firms, inhibiting the creation of new firms, and, consequently, of competition and creative destruction.[1]

Despite these constraints, Indonesia performs relatively well on the output side. One area in which the country scores relatively well is *cereal yields*. However, other micro measures of innovation see lower scores, such as the *number of patents*, *scientific publications in academic journals*, and *films and books produced per 1,000 people*. More efforts are, therefore, needed to cultivate Indonesia's creative industries. In addition, the low level of *scientific output*, combined with the country's low level of *enrolment of tertiary students in science programmes* and high *Mincerian returns on education*, suggest that productivity in this area can be enhanced by increased investment.



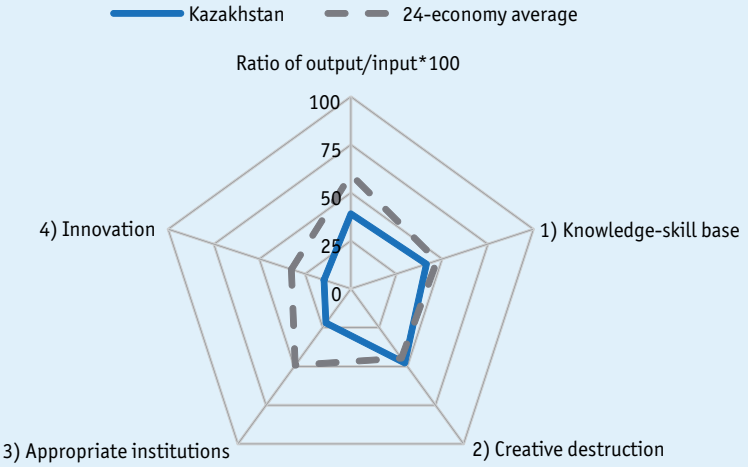
Top quartile	2nd/3rd quartile		Bottom quartile	
	Human capital	39.8	Competition	18.7
	Infrastructure	32.9	Firm dynamics	25.6
	Financial institutions	27.9	Governance	20.8

[1] Mertens, K. (Ed.) (2002): "Innovation in Indonesia: Assessment of the national innovation system and approaches for improvement," Fraunhofer, available from http://www.innovationssysteme.fraunhofer.de/fileadmin/user_upload/InnoSys/Documents/04_Referenzen/PERISKOP_Buch.pdf. [Accessed: 14 August 2014.]

Kazakhstan — Rank: 17

Kazakhstan is ranked 17th out of 24 economies overall, with a medium level of *creative productivity*. In terms of inputs, the country is characterised by high *firm dynamics*, due to a flexible labour market. The firm dynamics of Kazakhstan are ranked fourth of the 24 economies in the index, which balances the country's poor score for *competition* in the overall ranking for creative destruction (it is ranked 24th for *freedom to compete*, for example).

However, despite Kazakhstan's *ease of labour turnover*, the quality of the pool of human capital remains poor, and it continues to be difficult for businesses operating in the country to recruit skilled workers. Kazakhstan scores poorly in the *human capital* dimension, where it is ranked 15th. Within this dimension, Kazakhstan performs particularly badly in *enrolment ratio of tertiary students in science*, finishing 23rd out of 24 economies.



Top quartile		2nd/3rd quartile		Bottom quartile	
Firm dynamics	66.8	Human capital	35.8	Financial institutions	23.2
		Infrastructure	47.0	Governance	20.8
		Competition	28.8		

The country lags behind in appropriate institutions, in particular the poor *enforcement of contracts*, high *corruption* and low levels of *investment openness*. Kazakhstan languishes at 22nd place for *appropriate institutions*. It is relatively difficult to invest in the country; the government is particularly active in securing and increasing its stakes in the natural-resources sector. In particular, this has left foreign investors at the mercy of changes to contract terms in the energy arena. *Corruption* levels also drag down Kazakhstan's overall score, as the country was ranked 133rd out of 176 economies in Transparency International's 2012 Corruption Perceptions Index.

On the output side, the country performs poorly, due to low levels of *scientific output*, as well as *agricultural productivity*. With a rich endowment of natural reserves of oil, gas, minerals and ferrous metals, Kazakhstan's economic growth has been predominantly resource-driven. Concerns about the sustainability of an extractive growth model have led to increasingly innovation-oriented policies that aim to shift away from innovations in the natural-resources sector.

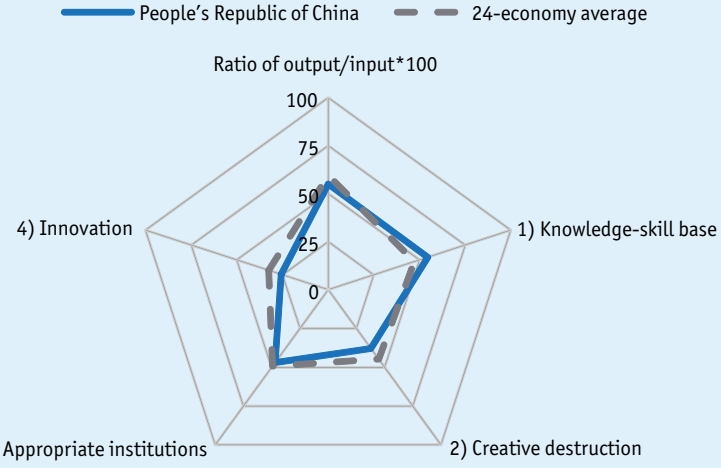
These policies are well reflected in the CPI. Starting with a severe output contraction following the collapse of the former Soviet Union and the associated shortfall in public investment, the current average score for *knowledge-skill base* is a result of steadily rising investments in physical infrastructure and tertiary education. The *gross enrolment rate in tertiary education*, for example, increased by up to 15% between 1999 and 2009. Kazakhstan's efforts in removing administrative barriers and regulatory hurdles for private firms is also well reflected in the dimension of *creative destruction*.

Despite these efforts, however, challenges remain: Kazakhstan is still ranked low down in terms of *public R&D spending*, and the improvements in creative inputs does not appear to translate efficiently into creative outputs, giving the country an overall ranking of only 17th. One reason for this may lie in the lack of complementary institutions that would help channel financial resources for R&D and foster better co-ordination among the public and private sectors, as evidenced in the below-average score on *appropriate institutions*.

People's Republic of China — Rank: 11

The People's Republic of China is ranked 11th out of 24 economies in the overall index. In terms of inputs, the country performs solidly across most sub-dimensions, lagging behind only in *creative destruction*, as reflected in its low scores for *firm dynamics* and *competition*. The People's Republic of China performs well on some measures in the innovation sub-dimension, such as levels of export sophistication, where it finishes eighth.

The country scores relatively well for *infrastructure and financial institutions*. On the former, the People's Republic of China ranks highly for access to electricity, has a high proportion of paved roads, and boasts reasonably good-quality roads, airports and seaports. More affluent parts of the People's Republic of China, namely the south and east, have well-developed infrastructure, with a high density of road and railway networks. Although other regions of the country are comparably underdeveloped, such as the western part of the People's Republic of China, state-led investment has been channelled into constructing better transport networks and ports there.[1] Elsewhere, the People's Republic of China's financial institutions score relatively well for obtaining credit and investment openness.



Top quartile	2nd/3rd quartile		Bottom quartile
	Human capital	52.8	
	Infrastructure	56.4	
	Competition	35.7	
	Firm dynamics	40.1	
	Financial institutions	56.3	
	Governance	37.5	

There is scope for improvement in the People's Republic of China's scores in the innovation sub-dimension. For example, although it ranks relatively well in the index for the *number of patents per head and scientific publications in journals* (at tenth out of 24), its scores remain well behind those of the best performers. In 2013, however, 825,000 invention-patent applications were filed in the People's Republic of China, representing a rise of 26.3% on 2012, according to the country's State Intellectual Property Office.[2] Protection of intellectual-property rights (IPR) remains a concern for many companies seeking to do business in the People's Republic of China. Although there have been recent, welcome developments, the United States Trade Representative noted in December 2013 that "It is clear that there will continue to be a need for sustained efforts from the United States and other WTO members and their industries, along with the devotion of considerable resources and political will to IPR protection and enforcement by the Chinese government, if significant improvements are to be achieved."[3]

In light of the recent slowdown in growth, the shift towards a sustainable, innovation-driven growth model is particularly relevant for the People's Republic of China. While the export-oriented growth model relied heavily on low domestic labour costs and imported technology,[4] labour shortages and rising labour costs pose major challenges to the extensive-growth model. Upgrading the value chain from an extensive, imitation-driven model to an intensive, innovation-driven growth model is key in rebalancing and sustaining growth and economic development.[5]

The *creative productivity* score reflects the People's Republic of China's efforts to provide an environment conducive to creativity and innovation; the People's Republic of China's efforts in expanding the higher-education system and infrastructure is reflected in the above-average performance on the *knowledge-skill base*. Challenges, however, remain in overcoming the legacies of the planned economy, in particular in raising the productivity of state-owned enterprises (SOEs) and allowing for the emergence of a more competitive environment for private firms, as reflected in the below-average score on *creative destruction*.

There is also scope for improving the efficiency with which the given level of inputs are transformed into outputs; if the People's Republic of China had the same level of efficiency as Japan, the highest-ranked country in the sample, its creative outputs, as measured by the CPI, would be doubled.[6] Improving creative efficiency, therefore, has large payoffs.

[1] The Economist Intelligence Unit, People's Republic of China Country Forecast, January 2014.
[2] State Intellectual Property Office (SIPO): "People's Republic of China's invention patent applications up 26.3%," 17 January 2014. http://english.sipo.gov.cn/news/official/201401/t20140117_898836.html. [Accessed 14 August 2014.]
[3] USTR (2013): "2013 report to Congress on People's Republic of China's WTO compliance," p. 118, available from http://www.ustr.gov/sites/default/files/2013-Report-to-Congress-China-WTO-Compliance.pdf. [Accessed: 14 August 2014.]
[4] OECD (2007): "OECD reviews of innovation policy: People's Republic of China—Synthesis report," available from http://www.oecd.org/sti/inno/39177453.pdf. [Accessed: 14 August 2014.]
[5] Das, M. and N'Diaye, P. (2013): "The end of cheap labor," in *Finance & Development*, vol. 50(2), pp. 34-37.
[6] With Japan's output/input ratio of 1.114 and the People's Republic of China's current level of inputs of 0.464, the People's Republic of China's output level would be 0.464 x 1.114 = 0.516, as compared to the actual level of creative outputs, 0.256.



Conclusion

There is ample academic evidence to demonstrate that creativity and innovation are critical factors to enable the transition from middle-income to high-income status. There are many different dimensions of creativity, both in inputs and outputs, and a key challenge for policymakers is to understand for which inputs increasing their levels will lead to higher levels of creativity in the economy, and on how to create an enabling environment for the effective transfer of creative inputs—such as education—into creative outputs—such as new business formation. The contribution of this report is threefold:

- a systematic literature review to establish for which creative inputs there is real evidence to suggest they contribute to creative outputs;
- introduction of the new concept of *creative efficiency*, the efficiency with which creative inputs are transformed into creative outputs; and
- the calculation of an index, the *Creative Productivity Index*, to benchmark economies in Asia on creative efficiency, as well as more traditional measures of inputs and outputs.

Overall results

The CPI's focus is very much on the "efficiency" of economies at turning inputs such as human capital or infrastructure into outputs such as patents or the number of scientific publications. Japan, Finland and the Republic of Korea are the top three countries in the CPI. Due to the focus on efficiency, some economies in the CPI with high scores in the input category, such as Singapore (ranked 1st for input) and Hong Kong, China (ranked 2nd for input), finish lower in overall ranking than their input scores suggest they would.

At the same time, economies that have low input scores, such as the Lao PDR (ranked 23rd for input) and Indonesia (ranked 21st for input), are ranked higher in the overall CPI score. The Lao PDR is ranked 9th overall while Indonesia finishes 12th. Table 8 presents the ranking of each economy according to this efficiency angle.

Table 8: Ranking economies along the Creative Productivity Index, coloured by ranking: Very high, high, medium and low

Very high | High | Medium | Low

Economy	Overall	Input	Output
Japan	1	8	4
Finland	2	6	1
Republic of Korea	3	9	8
United States	4	3	3
Taipei,China	5	7	9
New Zealand	6	5	5
Hong Kong, China	7	2	2
Australia	8	4	7
Lao People's Democratic Republic	9	23	17
Singapore	10	1	6
People's Republic of China	11	11	11
Indonesia	12	21	16
Malaysia	13	10	10
India	14	15	13
Thailand	15	12	12
Viet Nam	16	14	14
Kazakhstan	17	13	15
Philippines	18	17	18
Sri Lanka	19	20	19
Bangladesh	20	22	21
Fiji	21	18	20
Myanmar	22	24	23
Pakistan	23	16	22
Cambodia	24	19	24

Note: Japan and the Republic of Korea are the two leading Asian economies in the Creative Productivity Index (CPI).

In Asia, Japan and the Republic of Korea are the two highest ranked economies in the CPI. Japan finishes eighth overall in the input category and fourth overall in the output category, yet is the most efficient in turning these inputs into outputs. It tops the ranking in the output category in the number of patents filed per capita, and issue the government has prioritised in recent years, as well as in the export sophistication category. In terms of inputs, Japan scores top in access to electricity, resolving insolvency and is second in the CPI for the share of domestic credit provided to the private sector as a percentage of GDP.

The Republic of Korea, which finished third overall in the CPI, has high scores in the input category for the number of Internet users, the penetration rate of fixed broadband services and public spending on R&D. In terms of outputs, it has a high number of patents per capita, finishing second to Japan in that category. Finland is second overall in the CPI. It scores well on inputs such as infrastructure, competition, financial institutions and governance, and outperforms most other economies on outputs, with a particularly strong performance in scientific output.

Singapore and Hong Kong, China finish first and second in the input category yet tenth and seventh overall in the CPI. In terms of inputs, both Singapore and Hong Kong, China perform extremely well in a majority of indicators. However, some areas of relative weakness for Singapore include mean years of schooling (ranked 13th), Mincerian returns to education (ranked 11th) and domestic credit available to the private sector as a share of GDP (ranked 12th). Hong Kong, China finishes 22nd in enrolment

of students in technical and vocational programmes and 12th in public spending on R&D. In terms of outputs, the economy finishes eighth in terms of number of patents per capita.

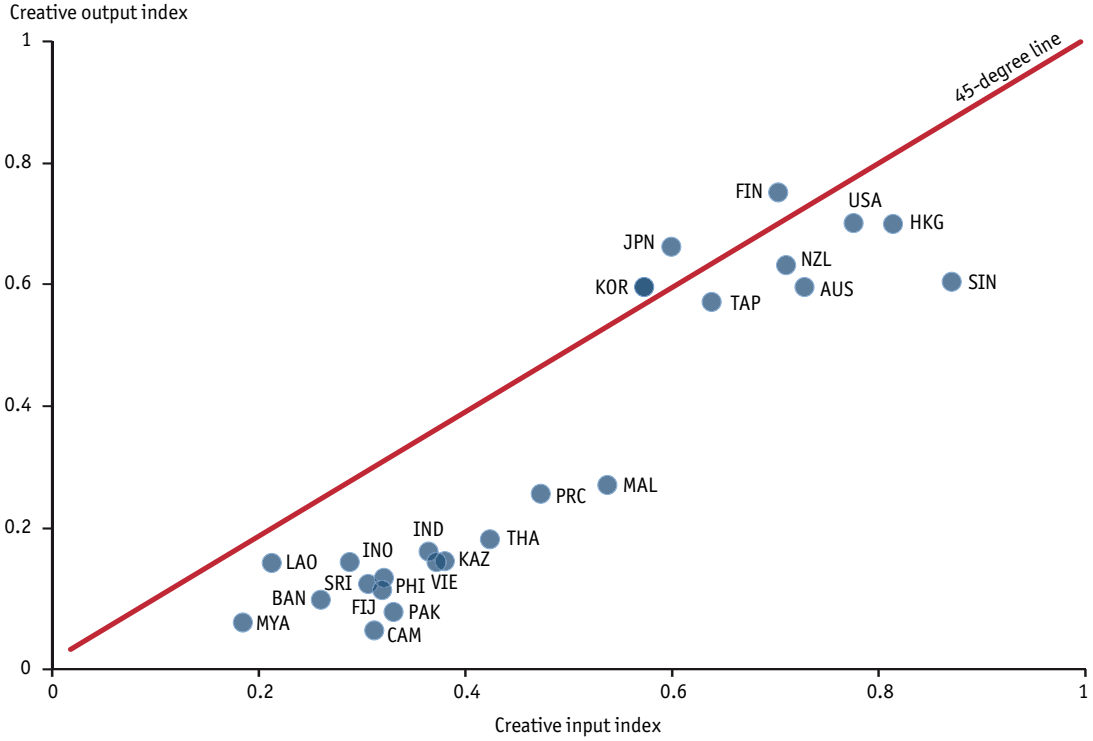
Both the Lao PDR and Indonesia have low input scores yet finished 9th and 12th respectively in the overall rankings. Indonesia and the Lao PDR perform relatively well on Mincerian returns to education, finishing second and ninth in that category. Other areas where Indonesia does relatively well include the enrolment of students in technical and vocational programmes (ranked fifth) and the availability of venture capital (ranked seventh). The Lao PDR does well in export sophistication and share of FDI in total investment.

Potential drawbacks of reading too much into the overall rankings of economies with low overall inputs have been discussed at length (see Box 1). However, these still serve to highlight several interesting policy areas for discussion and further research, especially in light of the efficiency focus.

Who has the most to gain?

Another way in which the final ratio can be interpreted is to plot the absolute levels of output against input, which shows that are more marginal benefits for low- and middle-income economies. The economies in the study are clustered into two groups: those with high creative inputs and those with low creative inputs.

Figure 3: The relationship between creative inputs and outputs



Note: Economies in the CPI are clustered in two groups: those with both high creative outputs and inputs, and those with both low creative outputs and inputs. The position of economies relative to the 45-degree line, indicates how productively economies are employing their inputs to produce output. The steeper the slope of a line from the origin to the dot marking the position of an economy, the higher the CPI score. Economies above the line are performing the best on this metric.

The impact of increasing creative inputs appears to be *larger* in *low- and middle-income economies*, suggesting that policies to increase creative inputs in those economies will yield a larger marginal benefit. Japan, Finland and the Republic of Korea (the top three economies in the overall CPI) are able to produce relatively more with their given level of input, and thus have a CPI score above 1. Of the high-income economies, Singapore and Australia are not as efficient as other economies at turning inputs into outputs. Other economies that are further away from the line, such as Cambodia and Pakistan, are not able to put their inputs to good use.

Many Asian developing economies face a similar challenge in order to avoid being stuck in the middle-income trap. They need to transition from an imitation-driven economy to an innovation-based growth model more commonly found in developed countries. Richer economies are clearly able to invest more in physical infrastructure such as transport networks, communications and power generation, which are key underlying factors in economic creativity and innovation. However, some differences are a result of the enabling environment that facilitates the generation of creative outputs from creative inputs. A poorer country may not be able to muster the same level of creative inputs as a richer country, but can still benefit by using what resources it does have efficiently. While the precise policy recommendations will differ for each economy, the results of this report highlight a number of important policy areas where an increased emphasis would be beneficial for many Asian countries.

The CPI allows policymakers in each economy to understand their position in terms of inputs, outputs and efficiency compared to peers. Furthermore, the literature review demonstrates for which factors there is evidence of a link between inputs and outputs, which can assist to focus resources in areas where they are likely to be more effective.

At the economy level, the CPI indicates for which creative inputs the economy has a relative advantage and disadvantage: this invites further research into the economy-specific dynamics of creativity to enable a prioritisation of policy to increase levels of creative inputs. Where certain creative output levels are low compared to peer countries with similar levels of inputs, further research should be undertaken to determine the specific channels in that economy that are enabling or hindering the efficient transfer of inputs to outputs. In some cases, improving the enabling environment may be a more cost-effective way of increasing creative outputs than increasing inputs.

Appendix

The appendix is divided into three sections. Section A1 (Going beyond the CPI), explores indicators and areas not included in the CPI, and compares the CPI to other indices. Section A2 (Methodology) has the details of the literature review, the rationale behind choosing each indicator, and a section on measurement. Section A3 (Economy summaries) contains the economy summaries and scores for a deeper look into the performance of the economies in the CPI.

Section A1

Going beyond the CPI: New sources of creativity and growth

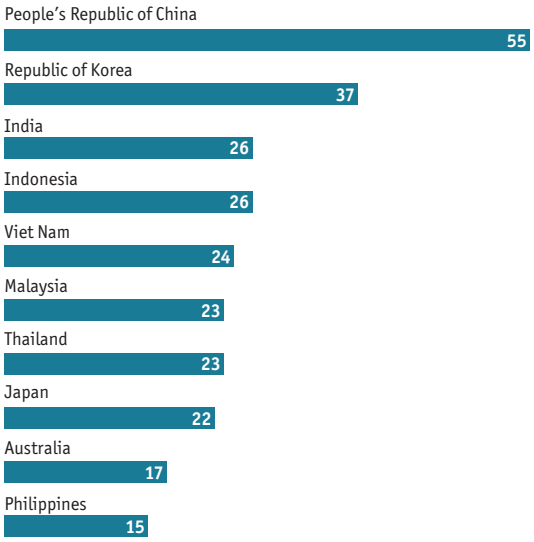
A1.1. M-commerce in Asia: On the rise, but networks feel the crunch

Internet commerce has seen phenomenal growth around the world, with global online revenue surpassing US$1trn in 2012 and expected to rise by 18% in 2013, to US$1.2trn, according to estimates from eMarketer, a market research company. The Asia-Pacific region was also expected to become the most lucrative region for e-commerce in the world in 2013, surpassing North America for the first time, with a market share of 34%, growing to 40% by 2016.

Asian m-commerce: Achieving lift-off

In Asia e-commerce is increasingly taking place via mobile devices (m-commerce), as wireless connectivity and smart phones proliferate (see Figure A1). According to eMarketer, 55% of Internet shoppers in the People's Republic of China used their mobile phone to make a purchase in the last quarter of 2012, the highest percentage in the world. Other Asian countries are not far behind, with the Republic of Korea at 37%, India and Indonesia at 26% and Viet Nam, Malaysia and Thailand at over 20%. These numbers compare with just 19% in the United States.

Figure A1: Internet users who have made a purchase via mobile phone (%), 4th quarter 2012



Source: eMarketer, GlobalWebIndex, Statista

People's Republic of China, the regional powerhouse

In terms of individual countries, the People's Republic of China is the powerhouse in the region. Most analysts expect the Chinese e-commerce market to surpass that of the United States, sometime before 2016. An estimated 271m Internet users in the People's Republic of China made an online purchase in 2013, a number that is expected to rise to 423m by 2016. For the most part, these shoppers are young, mobile urban dwellers. A study by McKinsey, a consultancy, found that average online spending per head in fourth-tier Chinese cities is nearly the same as for residents in the second- and third-tier cities. Remarkably, in fourth-tier cities, the average online shopper spends just over one-quarter of their disposable income online, likely because of a lack of ready access to physical retail outlets.

Future killer apps: Retail, video and e-books

As more Asian consumers adopt smart phones and wireless-broadband networks transition from 2G to faster3G and 4G speeds in the next decade, the potential for online retail is tremendous. Established locally based players such as Alibaba in the People's Republic of China, with US$157bn in revenue in 2012, and the smaller Qoo10 in the Republic of Korea, which sells groceries, gadgets and clothing in Japan, Singapore and elsewhere in the region, are already taking large shares of the market and can be expected to solidify their lead positions with brand recognition and loyalty.

Mobile video is also a future money-spinner, based on the popularity of Internet protocol television (IPTV), which is already the most predictably lucrative broadband service globally. IPTV revenue is widely expected to grow by double-digit percentages annually over the next five years. The number of homes subscribing to IPTV will more than triple, from 51m at the end of 2011 to 165m by 2017, according to Digital TV Research, a market research firm. It expects the People's Republic of China to supply 47% of that total, up from 28% at the end of 2011.

For e-books, developed markets still lead the world in terms of revenue, but the Asian market is growing fast. By 2017, global e-book revenue will be around US$23bn, according to PwC, a consultancy, amounting to 22% of all book revenue. North America will have the highest percentage, at 38%; in Europe, the Middle East and Africa (EMEA) the figure will be 17%; followed by the Asia-Pacific at 15% and 6% in Latin America. In addition, PwC found that three of the top five growing markets in the world for both print and e-books are in Asia: Thailand, with average annual growth of 6% between 2013 and 2017; 5% in India; and 4% in Pakistan. It is expected that, in markets such as India, the popularity of e-books (currently only about 1% of all book sales there) will follow a similar trajectory to that of Western countries, and play a much larger role in the future as devices become more widespread.

Infrastructure: The urgent need

Although m-commerce has a bright future in Asia, demand for services is threatening to outpace the capacity of networks, a mismatch that governments urgently need to address. Here, there is a divide between developed and developing Asian markets. Singapore, the Republic of Korea and Japan have all made huge investments in fixed and wireless connectivity, and will stay ahead of the pack in terms of capacity for years to come. In developing markets, broadband providers are rapidly linking the cities with fibre-optic connections, but smaller cities and rural areas are suffering from a lack of access. Unclear rules and delays to spectrum auctions are also holding back markets. However, in



developing markets, clear leaders and laggards will emerge as more governments adopt digital plans and investment strategies.

Governments have an important role to play. National broadband strategies give direction and certainty to investors. These strategies, for the most part, have been presented as political documents, with high-level commitments to connect a certain number of homes at minimum speeds. In the future, these plans need to be more specific, detailing how funds will be raised, what percentage will be state-funded, pledging public investment where the market has failed to provide connectivity, and addressing the cost of devices, which is still prohibitive for too many potential online consumers in Asia.

A1.2. MOOCs in Asia: Hope or hype?

Massive open online courses (MOOCs) were introduced in the last decade and, like many online phenomena, have exploded in popularity in a short time. The ideal behind the concept was to expand free university education to anyone with an Internet connection, and millions of Asian consumers have benefited from access to free courses run by some of the most influential scholars in their fields. MOOCs are set to become a fixture of education in Asia, but there remain several barriers to wider adoption, and policymakers have important decisions to make about how MOOCs can best be exploited in the future.

Rise of the MOOC

MOOCs are delivered online, primarily through short, live lectures, also posted to the Internet for download. Some MOOCs include automated tests, and even quizzes and games, but a key feature is that students can progress at their own pace. They are, as the name implies, open to anyone, and usually free or available for a relatively small fee.

The delivery eco-system is evolving, but there are already major players. Non-profits include United States-based Khan Academy, and edX, a non-profit start-up created by Harvard University and MIT, which had 370,000 students for its initial courses in 2012. For-profit providers include Udacity and Coursera, backed by Stanford, Princeton, Yale and other leading United States universities, which reached 1.7m students in its first ten months of operation, and is now trying to attract Chinese students with local-language programmes. There are also a number of additional venture-capitalist-backed efforts.

MOOCs in Asia

MOOCs have become prominent in Asia in two ways. The first is through Asia-based students attending the online courses provided primarily by United States-based universities. In 2012, about 5% of Coursera's 1m+ students came from India and 5% came from the People's Republic of China. Udacity also reports high Indian participation. According to *The Financial Times*, visits to major MOOC sites from India doubled between November 2012 and August 2013, and it is the largest market for MOOCs outside the United States.

The second is through MOOC start-ups across the continent, of which there have been several in recent years. India-based Edukart was launched in 2011 in partnership with Indian and international universities. Indonesia saw its first MOOC founded in 2013, Universitas Ciputra Entrepreneurship

Online (Education without boundaries), with 20,000 registered members for courses in Indonesian. Japan, the People's Republic of China and Singapore have all seen launches, and a number of Asia-based universities have introduced programmes on the Coursera platform.

Overcoming barriers to adoption

Although the popularity of MOOCs is on the rise, there are several barriers to further adoption. One of the most widely cited challenges is high drop-out rates. Only around 5% of those who sign up for a Coursera class make it to the end. A study by the University of Pennsylvania in 2013 found that, among 1m MOOC users, only half had ever attended a lecture and only about 4% had finished the course.

A lack of business models also threatens the sustainability of MOOCs. Large universities are currently funding many of the courses, and appear to be using them mainly as marketing tools to attract students from abroad. Other models that have been proposed, but remain unproven, include selling the data that students generate about the courses they are interested in, lectures attended, or drop-out rates; charging businesses a fee to recruit students; and a *free-mium* model, by which students get the course materials for free, but must pay for accreditation at the end.

Policy approaches: Finding the right niche

These and other problems are forcing a rethink about the goals and ambitions of MOOCs. This does not dim the importance of the phenomenon in Asia, but requires nuanced strategies on the part of policymakers. The surge in demand from India, for example, even with a fraction of the broadband penetration found in developed countries, proves there is a need. Governments seeking to expand broadband infrastructure for wider economic purposes should use education as a key public-policy justification for investment in fibre and 4G networks. Digital divides within countries must also be addressed through incentives and universal service contracts, in order to reach potential users in smaller cities and rural areas, where the business case to build networks is not as clear-cut. Governments can also promote more courses in local languages.

Policymakers looking to support MOOCs should study the broad range of needs that free open courses can meet, and choose which they wish to promote. These include: to market the best Asian universities at home and abroad; to provide access to university-quality degree qualifications for those who otherwise could not afford them; to give professionals access to continuing education; and to offer people with secondary education an introduction to college courses, with a view to encouraging full-time attendance in person.

Finally, returning to the original concept behind MOOCs—education for the masses—MOOCs should not be considered in a vacuum, but as part of an overall policy to expand and complement educational opportunities via emerging broadband networks, from childhood right through to early adulthood.

A1.3. Film-making: Playing policy catch-up

Cultural and creative industries have been in the ascendant for some time, but, in Asia, policy is only just beginning to catch up. This reflects the fact that policymakers are beginning to realise the economic significance of the creative industries, rather than simply their cultural impact. In the past few years, many policymakers have begun to formulate policies specific to the creative sector, and to



offer tangible financial incentives, such as subsidies and tax rebates (which are particularly useful in economies with small domestic markets). For example, in December 2013 Taipei,China's Financial Supervisory Commission announced plans to double funding to the creative sector to NT$360bn (US$12.1bn) within three years, while Bollywood received "industry" status in 2000, enabling it to receive financing from commercial banks. Meanwhile, in 2007 Hong Kong, China injected HK$300m (US$40m) into its Film Development Fund to support the territory's film industry. However, the basis for successful domestic film industries and their varying impacts on an economy are manifold.

More Bollywoods

Film clusters represent a crucial way of bringing together technically skilled labour, production resources and distribution capabilities in one place, facilitating knowledge transfer and technical spillovers. Establishing a specialised cluster has been integral to the success of Asia's film-production powerhouse, Bollywood. India's film and TV industry together were worth an estimated US$7.7bn in 2008, with this figure expected to grow to US$13.2bn by 2013. The emergence of the Bollywood cluster in the early 20th century was largely owing to its location, in Mumbai, where producers were able to take advantage of merchant trade and venture capital spilling over from the booming manufacturing sector. Over the following decades, Bollywood has expanded exponentially, helping India's film industry to become the biggest entertainment exporter to the United States.

Other Asian film clusters are emerging in less organic ways. In mid-January 2014 the Singaporean government opened the first development of Mediapolis (a mixed-use digital studio village), as part of its Creative Industries Development Strategy, announced in 2002, to raise the economic contribution of arts, culture, design and media. Mediapolis forms part of one-north, a larger cluster of industries targeted by the government as a means by which to transform Singapore into a "knowledge and innovation-intensive economy." By focusing on upgrading production capabilities—the site is host to Singapore's largest soundstages and incorporates cutting-edge green-screen technology—and positioning Mediapolis at the centre of a collaborative network of clusters, it is hoped that it will attract large foreign production companies, increasing the value-added output of the city-state's creative industries.

The film industry is knowledge-intensive, as is the case for most creative industries. It is, therefore, unsurprising that some of the most successful film-producing economies in Asia have a large pool of skilled labour. Although India's human capital is, on the whole, of a lower quality than the other successful film-producing economies, the Bollywood cluster has both attracted large flows of technically skilled labour and passed on valuable expertise and training to new crops of workers. But the relationship between film industries and domestic human capital is also highly symbiotic. For example, the success of a domestic film industry and its contribution to the overall economy is largely contingent on the purchasing power of its consumer base. Countries like India and the People's Republic of China have seen their film exports grow in value, with large India and Chinese diaspora around the world serving both as a market for films and often being a crucial source of financing. This suggests that the success of a film industry is not just contingent on agglomeration in clusters, but also on broader international networks.

Quantifying the wider economic benefits

In other countries, the impact on the economy of creative industries and films, in particular, has been both tangible and, in other ways, more difficult to measure. In New Zealand, the government has, for some time, recognised the economic importance of supporting its nascent film industry, offering tax rebates and other incentives for foreign production firms to base their movies in the country. In 2011 the film and TV industries together accounted for 1.4% of New Zealand's GDP, contributing total value-added output of NZ$2.8bn (US$2.3bn) and 21,315 full-time jobs. The enormously successful *Lord of the Rings* film franchise has had a substantive impact on New Zealand's tourism industry, with international tourist spending growing by an annual average of 5.7% between March 2001 and March 2004. Indeed, it is this thinking that probably spurred the government to increase the production-cost rebate for firms setting their films in New Zealand from 15% to 20% in December 2013, with an additional 5% rebate if they adhere to conditions such as spending at least NZ$500m (US$400m) in the country.

A1.4. Skill mismatch in Asia: Brake on growth?

The extent to which the demand and supply of skills are successfully matched has important consequences for an economy's rate of growth, labour-market outcomes, productivity and competitiveness. Skills are essentially abilities and attributes seen by employers as necessary for people to operate effectively in the workplace, and can be classified as *academic*, *generic* or *technical*. Academic skills are derived from formal and non-formal education; generic or life skills are transferable across jobs and include behavioural "soft" skills; while technical skills are associated with a particular profession and can be achieved with upper-secondary and tertiary education, as well as work experience.

A skill mismatch is a combination of a surplus and a deficit of skills, and is caused by supply and demand gaps in the labour market. This phenomenon is increasing in many Asian countries. On the demand side, the growth of the services and export-oriented sectors in many Asian countries has resulted in a jump in demand for job-specific skills. For example, in a 2008 survey conducted by The EIU for British Council, 80% of the employers polled found that candidates were lacking in critical behavioural and academic skills, primarily English-language and computer skills, for professional jobs in the services sector. However, owing to the lack of appropriate channels through which to communicate their demand for such skills, employers in some Asian countries are unable to find the right people. This is demonstrated by the time taken to fill professional vacancies in Thailand, Malaysia, the Philippines and Cambodia, at more than four weeks, according to a recent World Bank report.[9] Intensifying global competition and the consequent increase in demand for innovation are also raising demand for the critical skills that are required to adopt new technologies.

Supply-side constraints

One of the primary supply-side constraints is that adequate education and training programmes are lacking, preventing the cultivation of necessary skills. According to a 2011 World Bank study on labour outcomes in East Asia, unemployment was seen to be positively correlated with higher levels of education in Mongolia, Indonesia and the Philippines, clearly indicating the poor quality of higher

[9] World Bank (2012b): "Matching aspirations: Skills for implementing Cambodia's growth strategy."



secondary and tertiary education in those countries. In addition, skills shortages have been caused by the low quality of local training, as cited by around 35% of employers in Indonesia and the Philippines. In the latter, some 25% of employers also complained about the emigration of skilled workers as a factor behind skills shortages.[10] The Philippines is constrained by lower-than-average wages; many skilled professionals are, therefore, lured abroad by higher salaries, as evidenced by the fact that more than 35% of emigrating Filipinos belong to the professional class.[11] In addition to these factors, poverty is also one of the underlying causes of skills shortage, as it results in more young people leaving school early in less-developed Asian countries. According to the Cambodia Socio-Economic Survey 2009 (CSES 2009), around two-thirds of respondents cited poverty-related reasons for dropping out of upper-secondary school in Cambodia.[12]

The initial success of non-formal-education programmes, such as Indonesia's Kursus Para Profesi (KPP, Professional Course) and Education for Youth Employment (EYE) schemes, is evidence of an effective policy instrument to reduce widening skills gaps. The EYE programme, in particular, supplements basic education with life-skills training, improved education management and teacher-training modules, and increases youth employment by networking with business and industry. It was found that nearly 82% of EYE participants were employed within three to four months of finishing training and that worker-retention rates remained above 80% after three years.[13] Moreover, analysis of secondary education in Indonesia revealed that formal SMKs (vocational secondary schools) fill an important gap in the secondary-education market by having job-specific curricula and increasing youth employment.[14] The above trends highlight the need to improve the quality and relevance of higher (formal and non-formal) education and training to meet skills gaps in Asian countries.

Getting the message out

In addition, according to a 2011 survey conducted by HRINC, an HR firm in Cambodia, employers in the country attributed skills shortages to poor information and co-ordination in the labour market, such as a lack of adequate information on the availability and quality of vocational-training centres and on the quality of universities. More links between universities and industry were also viewed as a potential solution by many employers.[15] The Government of Cambodia has, therefore, prioritised these issues in order to minimise the skill-shortage problem. The Skill Development Action Plan suggested by the World Bank focuses on enhancing employment counselling and job-search services to improve access to information in the labour-skills market and create career opportunities. Mainstreaming good technical and vocational education and training (TVET) and strengthening the capacity of national training boards to deliver employer-focused reform of education and training are initiatives that can be taken by the government. The Cambodia Socio-Economic Survey, conducted in 2009, revealed that the returns to post-secondary TVET are nearly equal to those to tertiary education and are found to be an effective instrument in bridging skills gaps.[16] The government is also trying to improve a small number of skills providers, including non-formal training centres, in collaboration with local industry, in order to strengthen links with business.

Alternative measures of quality education

Advocates of endogenous growth theory have cited quantitative differences in education, such as

[10] Di Gropello, E., Kruse, A. and Tandon, P. (2011): "Skills for the labor market in Indonesia: Trends in demand, gaps, and supply," World Bank.

[11] World Bank (2010): "Philippines skills report: Skills for the labor market in the Philippines."

[12] World Bank (2012b): "Matching Aspirations: Skills for Implementing Cambodia's Growth Strategy".

[13] Di Gropello, E., Kruse, A. and Tandon, P. (2011): "Skills for the labor market in Indonesia: Trends in demand, gaps, and supply," World Bank.

[14] Ibid.

[15] World Bank (2012b): "Matching Aspirations: Skills for Implementing Cambodia's Growth Strategy".

[18] Ibid.

mean years of schooling or gross enrolment rates in primary and secondary education, as factors in differing growth patterns among countries.[17] However, recent evidence shows that the quality of education enhances productivity and is a more important factor in driving economic expansion.[18]

Two of the best-known frameworks of quality education, presented by UNESCO and the Convention on the Rights of the Child, focus on two essential elements of quality education: cognitive development, and creative and emotional development.[19]

Based on UNESCO's concept of quality education, Scheerens (2011) modelled the input-process-outcome-context framework to define different perspectives on quality education, such as productivity, effectiveness, efficiency, equity and responsiveness. He categorised the variables included in the OECD Education Indicator Project to fit into his model.[20] The *input indicators* comprise a) system and school-level financial and human resources (for example, spending on education as a proportion of GDP, the ratio of education expenditure to students, public and private investment in education and R&D, and school infrastructure and services); and b) student background characteristics (such as socioeconomic status—SES—gender and ethnicity). The learning environment and organisation of schools and systems constitute the process indicators (community involvement, educational leadership and rating of teaching quality). The *outcome* and *impact indicators* mostly relate to the SES of students after educational attainment (including the rates of literacy, graduation, dropping out of school, class repetition, employment and unemployment, and enrolment).[21] Globally, and particularly in Asia, learning outcomes are regarded as the ultimate indicator of quality education. In the absence of learning assessments (at national and international level) that provide appropriate measures of education outcomes, other indicators, such as survival to the last grade of primary school, the pupil-teacher ratio and completion rates, are also used as proxies for measuring the quality of education.

Developing critical thinking

The low- and middle-income economies of Asia are close to achieving the Education for All programme of universal primary education. The net primary- and secondary-school enrolment rates are close to 90% and 70%, respectively, for all Asian economies with available data, with the exception of the Lao PDR (with net enrolment rates of 82% and 36% for primary and secondary school, respectively), according to UNESCO.[22] Although these numbers are impressive, the story is gloomier when the focus is placed on learning that involves improved problem-solving and critical-thinking skills among students. Applying knowledge learnt in school to work and life might be drastically different from simply excelling academically.

The Trends in International Mathematics and Science Study (TIMSS) attempts to measure internationally the cognitive ability and future learning of students in grades 4-8. Cognitive ability—a key measure of the quality of education—is crucial to a person's job opportunities and potential earnings.[23] According to the TIMSS, the gross enrolment ratio, adjusted for the quality of education, increased by 10% in the Philippines between 1999 and 2003. Very small positive changes were seen in the Republic of Korea and Indonesia; small negative changes were registered in Singapore; Hong Kong, China; and Japan; and noticeable declines were posted in Thailand and Malaysia.

[17] Barro, R. (1991): "Economic growth in a cross-section of countries," in *The Quarterly Journal of Economics*, vol. 106(2), pp. 407-443;

Mankiw, N., Romer, D. and Weil, N. (1992): "A contribution to the empirics of economic growth," in *The Quarterly Journal of Economics*, vol. 107(2), pp. 407-437.

[18] Hanushek, E. and Woessmann, L. (2007): "Education quality and economic growth," World Bank.

[19] UNESCO (2004): "Education for all: The quality imperative," EFA global monitoring report 2005.

[20] OECD (1998): "Education at a glance: OECD indicators 1998," OECD Publishing.

[21] Scheerens, J., (2011): "Measuring educational quality by means of indicators," in Scheerens, J., Luyten, H., van Ravens, J. (Eds.) (2011), *Perspectives on educational equality: Illustrative outcomes on primary and secondary schooling in the Netherlands*, Dordrecht: Springer, pp.35-52.

[22] UNESCO Institute of Statistics data is available from http://datatopics.worldbank.org/education/. [Accessed 14 August 2014.]

[23] Glewwe, P. (1996): "The relevance of standard estimates of rates of return to schooling for education policy: A critical assessment," in *Journal of Development Economics*, vol. 51(2), pp. 267-290;

Moll, P. G. (1998): "Primary schooling, cognitive skills and wages in South Africa," in *Economica*, vol. 65(258), pp. 263-284.



Why has quality declined?

Disaggregated information on the reasons behind the decline in the quality of education in these economies is not available. However, there are some commonalities that can be seen in the low-performing countries. Certain student characteristics—such as gender, early childhood care and family background (including ethnicity, language and poverty)—often have a prominent impact on learning outcomes. In some countries, factors such as the caste system, immigrant status and family structure also affect learning. Research by UNESCO shows that where school systems do not reflect linguistic diversity, this can be detrimental for ethnic-minority students, who may struggle to learn and comprehend in languages other than their mother tongue. In Viet Nam, for example, 90% of ethnic Hmong students ranked in the bottom 20% of the national distribution for average years in school.[24]

Socioeconomic characteristics, including poverty, parents' education and home educational resources, also influence learning outcomes and sometimes lead to high absenteeism and drop-out rates. In Pakistan and Indonesia, students from the poorest families were nearly 30% more likely to drop out by grade 9 than students from wealthy backgrounds. In India, students from families in the lowest-income quintile complete an average of five years of schooling, compared with more than 11 years among students from the highest-income quintile. Poor health and malnutrition also have an adverse impact on students' brain development, which is empirically proven to impact school attendance and performance. Access to good-quality schools in rural areas is another factor. For example, in Malaysia, the Philippines and Sri Lanka, 6.5%, 8% and 18.3%, respectively, of primary-school students had to walk over 5 km to reach their schools.

A study by Park (2004) attempts to investigate the factors leading to high achievement among students in Japan and the Republic of Korea in tests such as the TIMSS and the OECD's Programme for International Student Assessment (PISA).[25] It found that the instructional practices of teachers were largely responsible for high student performance. There was found to be an underlying Confucian culture that binds these teachers in a social contract of imparting good-quality education to their students. Moreover, teachers in the Republic of Korea also need to pass a very demanding national examination (the Teachers Employment Test), thereby contributing to the high quality of teaching.

Focus on teachers

Research suggests that the quality of teaching is the main school-based predictor of student achievement.[26] The Systems Approach for Better Education Results (SABER), a World Bank initiative, collects and analyses country-level data in eight key teacher-policy areas, such as requirements to enter and remain in teaching; compensation; retirement rules; teacher representation; and school leadership. The study finds that most of the policy goals, including preparing teachers with the right skills for the classroom, matching teacher skills with students' needs, and strong and effective leadership goals, are still in the emerging or latent stage in Asian countries. However, Cambodia, Malaysia, the Philippines, Singapore and Thailand have set up mechanisms to provide autonomy to the top management of schools in terms of making decisions related to instruction and personnel, which is found to be a crucial factor in enhancing school-learning outcomes in high-performing economies.

School-based management (SBM) is a form of decentralisation under which school personnel are allowed independence in making most managerial decisions, usually in partnership with other key

[24] UNESCO (2010): "Reaching the marginalized," EFA global monitoring report 2010.

[25] Park, K. (2004): "Factors contributing to East Asian students' high achievement: Focusing on East Asian teachers and their teaching," paper presented at the APEC Educational Reform Summit, January 2004.

[26] Hanushek, E. and Rivkin, S. (2006): "School quality and the black-white achievement gap," NBER Working Paper No. 12651;

Nye, B., Konstantopoulos, S. and Hedges, L. (2004): "How large are teacher effects?" in *Educational Evaluation and Policy Analysis*, vol. 26(3), pp. 237-257.

stakeholders, such as parents and the community. This approach creates the proper conditions for improving student performances.[27] The PISA, which covers and tests 15-year-old students globally on mathematics, science and reading, provides the most recent evidence on the effectiveness of SBM. The top-ranking economies included many in Asia, such as the Republic of Korea; Hong Kong, China; Singapore; Japan; Thailand; and Indonesia. Specifically, the study emphasises that economies with schools that have higher levels of autonomy and better teaching content, resource allocation and their own student assessment, obtained higher PISA rankings.

A1.5. Rural to urban: The digital divide

ICT tools, such as telephones, mobile phones and the Internet, are shown to promote national integration by enabling greater access to healthcare and education services, as well as creating economic opportunities for deprived sections of society.[28] Studies have also indicated a strong association between ICT adoption and economic growth among developed countries, albeit a weak correlation among developing economies. The latter relationship has been attributed to the absence of a critical mass in ICT adoption in developing economies, thereby suggesting the need for a minimum threshold of ICT penetration and usage to ensure its effectiveness in promoting economic growth.

Lack of data

The underwhelming availability of data in Asia makes it difficult to measure the extent of the urban-rural digital divide. However, a few economy-specific studies have attempted to cover this gap. A recent study in the People's Republic of China revealed that teledensity in rural areas was three times lower than in urban areas.[29] Computer ownership was also 23 times lower in rural areas. Meanwhile, 21.6% of those in urban areas had access to the Internet, compared with 5.1% in rural areas. Although the People's Republic of China is a prime example of the mobile revolution, the ratio of urban to rural mobile-phone penetration is 7:1, signalling the confinement of the e-commerce industry to urban areas. The study concluded that there was a strong correlation between the rising income gap and the difference in ICT adoption between urban and rural areas.

Studies in South Asia, particularly in India and Nepal, were conducted in 2000 to analyse the difference in the information needs and access to ICT between poor urban and rural households.[30] Radio was found to be the most popular ICT instrument among rural households (with ownership rates of 80% in India and 90% in Nepal). Only 9% of the rural households surveyed owned TVs, compared with 43% among their urban counterparts. The study also revealed that rural households relied more on in-person social networks, including friends, family and local leaders, rather than formal channels of communication for their information needs. Radio and TV were primarily used for entertainment purposes and occasionally for getting information on family welfare, women's development and politics. This indicates the need to tap into the potential of ICT in spreading awareness among the rural poor about various developmental programmes among the rural poor.

The widening income gap between urban and rural areas is one of the primary demand-side constraints to the rural adoption of ICT. The lack of adequate skills (such as poor ICT literacy) in rural areas is another important factor. For example, Internet usage requires language skills, predominantly in English, as well as technical and computer literacy.

[27] Barrera-Osorio, F., Fasih, T., Patrinos, H. and Santibáñez, L. (2009): "Decentralized decision-making in schools: The theory and evidence on school-based management," World Bank.

[28] Mercer, K. (2001): "Examining the impact of health information networks on health system integration in Canada," in Leadership in Health Services, vol. 14(3), pp. 1-30;

Reisman, S., Roger, G. and Edge, D. (2001): "Evolution of web-based distance learning strategies," in *International Journal of Educational Management*, vol. 15(5), pp. 245-251.

[29] Fong, M. (2009): "Digital divide between urban and rural regions in People's Republic of China," in *The Electronic Journal of Information Systems in Developing Countries*, vol. 36(6), pp.1-12.

[30] Marwah, R. (2000): "Impact of information technology on the poor in Nepal," and "The impact of information technology on the poor in India," World Bank.



Although investment in ICT should not necessarily be prioritised over improvements in traditionally more important sectors—such as healthcare, education, water and sanitation—in developing countries, the digital divide, if not controlled, could further exacerbate economic inequalities. Limited access to ICT could lead to a lack of socioeconomic opportunities, such as *social mobility* (the upward movement in status of individuals enabled by education, job training or better access to healthcare); *economic equality* (ICT adoption can increase the education and earning potential of users); *social equality* (for example, ICT use can improve gender equality by allowing girls constrained by cultural barriers to be educated at home); *e-democracy* (ICT leads to the democratisation of citizens by allowing them to participate in the decision-making process of policymakers through electronic channels); and, finally, *economic growth and innovation* (ICT adoption is crucial for productivity improvements and poverty reduction). However, there is a dearth of empirical research in Asia, with the exception of the aforementioned People's Republic of China study.

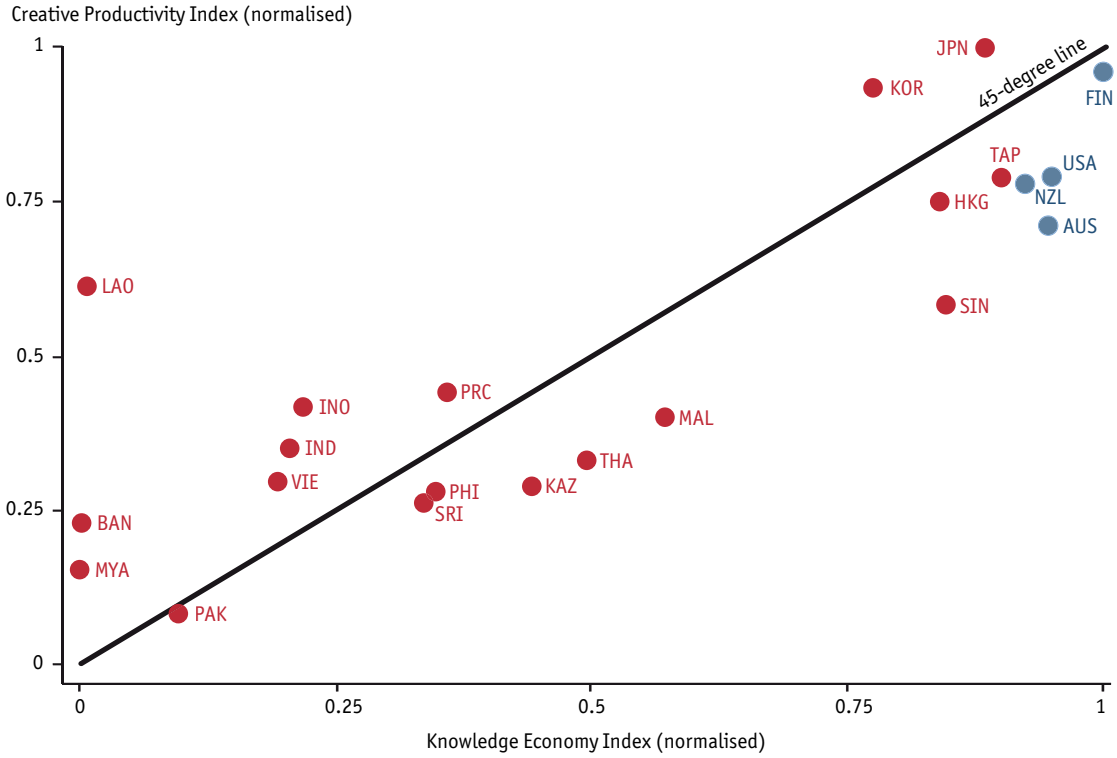
Having realised the potential of ICT, however, governments in Asia are investing in strengthening ICT penetration rates in rural areas. India, for example, which has one of the most dynamic ICT sectors in the world, has initiated government-led programmes for the use of ICT in the administration of rural-development schemes. In one such case, the Indian Space Research Organisation (ISRO) has been utilising satellite communication to provide functional education in rural areas through community TV. Another project established a state-of-the-art computer-communication network in co-operative areas, which was found to be successful in providing agricultural, medical and educational information to rural enterprises. India has also encouraged public-private partnerships (PPPs) in the use and application of ICT, as shown in the case of milk-collection co-operatives, which employ machines developed by the state-owned R&D electronics laboratories to test the fat content of milk. Non-governmental organisations (NGOs) and other donor agencies were also found to be effective in promoting the use of ICT in rural areas through the setting-up of *information shops* to enable rural families to access ICT. Another exemplary story in South Asia is that of Bangladesh's Grameen Village Pay Phone, a Grameen Bank and Grameen Telecom initiative that facilitated the establishment of pay phones in rural areas. These phones link to micro-credit organisations, allowing villagers to start profitable businesses by making the best use of telecoms facilities.

A1.6 The Creative Productivity Index in comparison

How does the CPI compare to other indices? The most closely related index is perhaps the Knowledge Economy Index (KEI) created by the World Bank Institute. While similar in its aim of measuring the role of knowledge creation for economic development, the CPI is different in several ways: for one, in contrast to the "four-pillars" framework of the KEI, the selection of the dimensions for the CPI is based on endogenous growth theory (EGT). For another, the CPI explicitly accounts for the efficiency dimension by examining the ratio of output to input.

Figure A2 plots the normalised KEI against the normalised CPI. The more similar the indices are, the more concentrated are the observations around the 45-degree line. There is a statistically significant correlation between the indices: the correlation coefficient is 0.8 and confirms that both indices are measuring similar dimensions.

Figure A2: Comparing the Creative Productivity Index to the Knowledge Economy Index



But, even though there is a strong correlation between the indices, Figure A2 suggests that there are differences. In particular, a number of economies with low GDP per capita score more highly in the CPI than in the KEI. This is likely driven by the structure of the CPI in considering efficiency as well as absolute levels of creative activity, as well as the inclusion of a broader range of indicators.

A1.7 Robustness checks: Assigning weights

A major concern regarding composite indices is a potential lack of robustness to changes in the weighting schemes used. While the equal-weighting scheme for the CPI is chosen for the purpose of transparency, there is no a priori reason why all sub-dimensions should enter uniformly.

This section investigates the robustness of the CPI by using alternative weighting schemes. In particular, we use a statistical approach—the principal component analysis (PCA)—to determine the weights. Intuitively, the PCA aggregates the three sub-indices into a single dimension while minimising the information lost.[31]

Table A1 (Panel A) presents the results of the PCA. Given the correlation between the sub-dimensions, the results suggest that the three sub-dimensions can indeed be aggregated into a single input dimension. The first component is able to explain about 88% of the total variance, and, given this high explanatory power, the first component can be used as an aggregate measure of the input dimensions.[32]

[31] For a technical discussion, see Johnson, R. and Wichern, D. (2007): Applied multivariate statistical analysis, Upper Saddle River, NJ: Pearson.

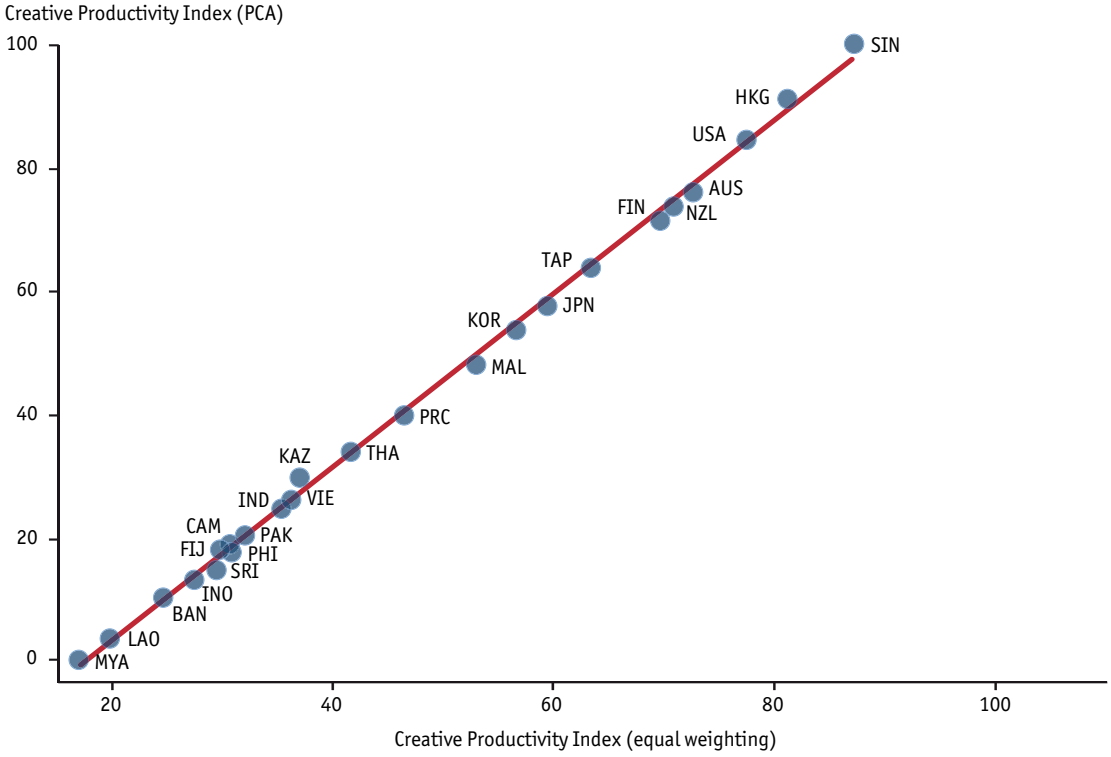
[32] The selection can also be justified along the Kaiser Criterion, as only the first component's Eigenvalue exceeds unity (see Johnson and Wichern, 2007).

Table A1: Principal component analysis—extracted components

Panel A: Principal components			Obs.	24
Rotation: (unrotated = principal)			Components	3
			Trace	3
			Rho	1
Component	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
Comp 1	2.66078	2.38858	0.8869	0.8869
Comp 2	0.272205	0.205192	0.0907	0.9777
Comp 3	0.0670126		0.0223	1.0000
Panel B: Variable	**Comp 1**	**Comp 2**	**Comp 3**	**Unexplained**
Knowledge-skill base	0.5752	-0.6033	0.5524	0
Creative destruction	0.5578	0.7832	0.2745	0
Appropriate institutions	0.5983	-0.1502	-0.7871	0

The PCA weights are strikingly similar to the equal-weighting scheme (Panel B): For the first component, the PCA results suggest that all components enter with roughly the same weight: *Knowledge-skill base* with 0.57, *creative destruction* with 0.55 and *appropriate institutions* with 0.59. Figure A3 compares the input index calculated using the preferred equal-weighting scheme to the index recalculated using the weights obtained from the PCA. Both input indices are nearly identical,

Figure A3: Comparing the input index using equal weighting to the PCA weighting scheme



with an R^2 of 0.99, confirming the robustness of the CPI with respect to alternative weighting schemes.

A1.8. Robustness checks: Relating inputs to outputs using regression

This section conducts an additional robustness check by using a regression-based approach to aggregate the output and input dimensions into the creative-productivity score. The preferred approach has been to relate outputs to inputs directly by examining the ratio of outputs to inputs.

An alternative way to aggregate the CPI is to regress the output index on the input index, and, use the resulting residuals as a measure for creative productivity. The intuition is best illustrated in Figure A4, below, which shows the estimated average relationship between inputs and outputs. Economies that lie above the line (with positive residuals) generate an above-average level of outputs with the given level of inputs (for example, the Lao PDR). Similarly, economies below the line (with negative residuals) generate a below-average level of outputs with their given inputs (for example, Singapore).

Table A2 compares the preferred ranking of the CPI with the ranking calculated using the regression-based aggregation method. Under the ranking, the three top economies are ranked in the exact same order, but there exist some discrepancies for the lower ranks. Overall, the rank correlation coefficient between both rankings is 0.55.

Figure A4: Illustrating the regression-based approach—Singapore performs below average, while the Lao PDR performs above average

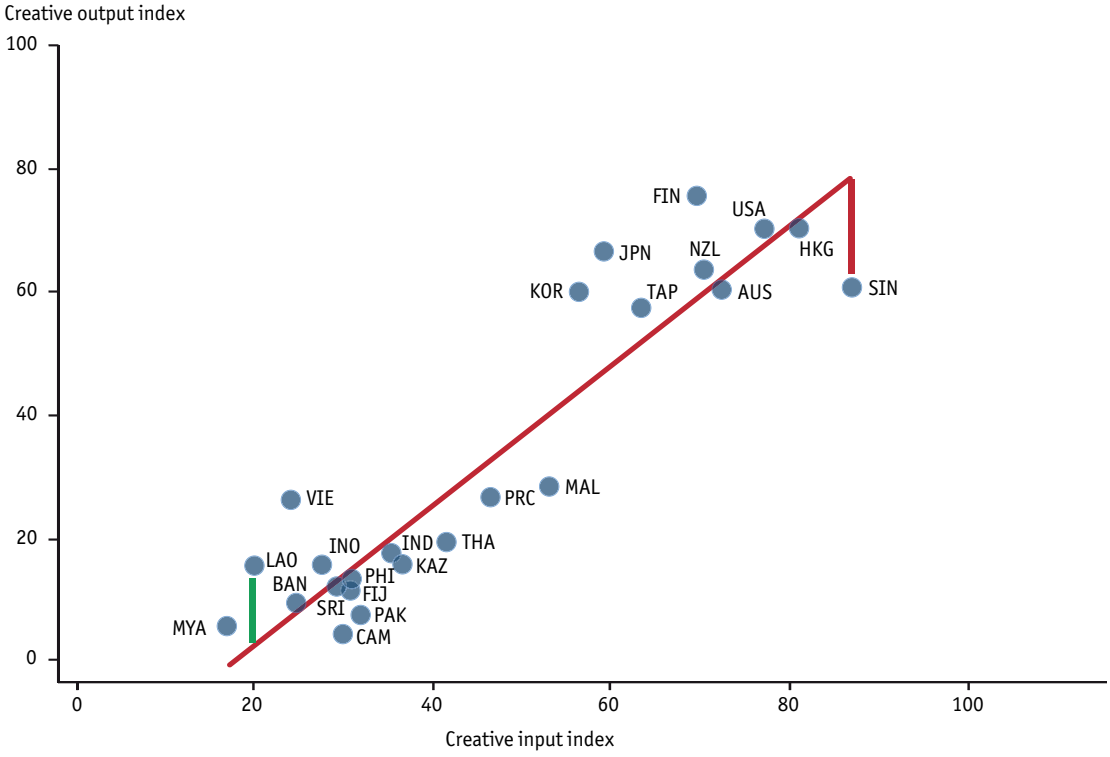




Table A2: Comparing preferred ranking with ranking derived from alternative weighting scheme

Economy	Code	Regression-based ranking	Output/Input (CPI) ranking
Japan	JPN	1	1
Finland	FIN	2	2
Republic of Korea	KOR	3	3
United States	USA	9	4
Taipei,China	TAP	6	5
New Zealand	NZL	8	6
Hong Kong, China	HKG	12	7
Australia	AUS	14	8
Lao People's Democratic Republic	LAO	4	9
Singapore	SIN	24	10
People's Republic of China	PRC	18	11
Indonesia	INO	7	12
Malaysia	MAL	23	13
India	IND	15	14
Thailand	THA	20	15
Viet Nam	VIE	17	16
Kazakhstan	KAZ	19	17
Philippines	PHI	13	18
Sri Lanka	SRI	11	19
Bangladesh	BAN	10	20
Fiji	FIJ	16	21
Myanmar	MYA	5	22
Pakistan	PAK	21	23
Cambodia	CAM	22	24

A2. Methodology

A2.1 Theoretical foundation of the CPI

Although the recent slowdown in growth experienced in many developing countries has raised renewed concerns about a middle-income trap, the slowdown in economic growth per se is a standard predictor of neoclassical conditional convergence: poorer countries experience higher growth rates as their marginal product of capital is higher.[33] This capital-accumulation-driven convergence growth has often been used to characterise and explain the East Asian growth miracle.[34]

In the absence of productivity growth, however, neoclassical capital accumulation exhibits diminishing returns and growth will eventually come to a halt. While the adoption of existing knowledge enables emerging economies to grow quickly, the potential of generating growth solely through imitation and the adoption of existing technologies declines with proximity to the world technology frontier. To sustain growth in the long run, it is therefore necessary to overcome

[33] Felipe, J. (2012): "Tracking the middle-income trap: What is it, who is in it, and why? (Part I)," Asian Development Bank;

Eichengreen, B., Park, D. and Shin, K. (2013): "Growth slowdowns redux: New evidence on the middle-income trap," NBER Working Paper No. 18673;

Aiyar, S., Duval, R., Puy, D., Wu, Y. and Zhang, L. (2013): "Growth Slowdowns and the Middle-Income Trap," IMF Working Paper, WP/13/71;

Solow, R. (1956). "A contribution to the theory of economic growth," in *Quarterly Journal of Economics*, 70(1), pp. 65–94;

Mankiw, N., Romer, D. and Weil, N. (1992): "A contribution to the empirics of economic growth," in *The Quarterly Journal of Economics*, vol. 107(2), pp. 407-437.

[34] Tsao, Y. (1985): "Growth without productivity: Singapore manufacturing in the 1970s," in *Journal of Development Economics*, vol. 19(1-2), pp. 25-38;

Kim, J. and Lau, L. (1994): "The sources of economic growth of the East Asian newly industrialized countries," in *Journal of the Japanese and International Economies*, vol. 8(3), pp. 235-271;

Lau, L. and Park, J. (2003): "The sources of East Asian economic growth revisited," paper presented at the Conference on International and Development Economics in Honor of Henry Y. Wan, Jr., Cornell University, Ithaca, September 6-7, 2003.

diminishing returns to capital accumulation through productivity growth.[35] This, indeed, is the basic premise of endogenous growth (or new growth theory, NGT): that long-run economic growth is perpetuated by innovations that increase productivity by either:

1) increasing the productivity of inputs;[36]
2) expanding the variety of goods;[37] or
3) organisational innovations.

Key to learning about productivity growth is understanding innovation as the result of directed technical change.[38] Within the large body of endogenous-growth literature, two main strands and mechanisms of endogenous growth are identified:[39]

Firstly, the early generation of *AK-type* endogenous growth models, where technological progress is simply just another form of capital accumulation. Similar to *physical-capital accumulation*, this accumulation occurs through investment decisions. In Romer (1990a), for example, technology is embodied by physical capital, which, in turn, drives growth through positive externalities—in this case, higher savings and investments not only have an immediate impact, but also boost long-run growth. In other cases, technology is treated as a part of human capital, and knowledge spill-overs in the accumulation of human capital help overcome diminishing returns.[40] Finally, some models interpret technological progress as the result of innovation, in which case the stock of innovations increases through deliberate investments in R&D.[41]

In the first generation of endogenous-growth models, however, innovation and technological progress are seen as a uniformly beneficial process.[42] As such, it is at odds with the actual experience of technological change. With the advent of new technology, old technology is rendered obsolete. Seen this way, technological change brings winners and losers, and innovation becomes a zero-sum game. In this type of model, the motivation to invest in R&D and new blueprints lies in reaping potential monopoly rents. In the spirit of the work by Joseph Schumpeter, the perpetual competition for innovation and monopoly rents, and creating new blueprints while destroying old blueprints is often called *creative destruction*.

Box A1 discusses the importance of a strong theoretical foundation in choosing indicators of creative productivity. When conceptualising an index on this topic, it is useful to focus on NGT or models of creative destruction, for several reasons. The main reason lies in the immediate policy relevance of this particular class of model. Models of creative destruction focus on industrial organisation and the incentives for firms and entrepreneurs to innovate; these models, for example, strongly favour patent laws and intellectual-property rights (IPR), to ensure that investors in risky R&D activities enjoy the benefits of successful inventions. These models, however, have implications not only for patent policy, but also for competition policy, education policy, trade policy and taxation, which have been empirically investigated using both cross-country and micro-level data.[43] Perhaps more importantly, this class of model remains close to the research frontier;[44] basing an indicator on these theoretical foundations ensures that the indicator itself reflects the cutting-edge.

[36] Romer, P. (1986): "Increasing returns and long-run growth," in *Journal of Political Economy*, vol. 94(5), pp. 1002-1037;

Lucas, R. (1988): "On the mechanics of economic development," in *Journal of Monetary Economics*, vol. 22(1), pp. 3-42.

[36] Lucas, R. (1988): "On the mechanics of economic development," in *Journal of Monetary Economics*, vol. 22(1), pp. 3-42.

[37] Romer, P. (1990a): "Endogenous technological change," in *Journal of Political Economy*, vol. 98(5), pp. 71-102.

[38] Acemoglu, D., Akcigit, U., Bloom, N. and Kerr, W. (2013): "Innovation, Reallocation and Growth," LSE Centre for Economic Performance Discussion Papers, no. CEPDP1216.

[39] Aghion, P. and Howitt, P. (1998): *Endogenous Growth Theory*, Cambridge, MA: MIT Press.

[40] Krusell, P. (2007): "Real macroeconomic theory," available from http://hassler-j.iies.su.se/courses/MacroII/Notes/book.pdf. [Accessed: 14 August 2014.]

[41] Lucas, R. (1988): "On the mechanics of economic development," in *Journal of Monetary Economics*, vol. 22(1), pp. 3-42.

[42] Howitt, P. (2007): "Innovation, competition and growth: A Schumpeterian perspective on Canada's economy," C.D. *Howe Institute Commentary*, issue 246, February.

[43] Aghion, P., Akcigit, U. and Howitt, P. (2013): "What do we learn from Schumpeterian Growth Theory?" available from http://scholar.harvard.edu/files/aghion/files/what_do_we_learn_0.pdf. [Accessed: 14 August 2014.]



Box A1: Moving beyond *mashup* indicators: The importance of theory-based indicators

The growing availability of cross-country-comparison datasets has sparked the use of a wide range of indicators. Today, there exist indicators that range from measuring human development (the Human Development Index, HDI)[1] to governance (the World Governance Index, WGI)[2] and gender inequality (the Gender Inequality Index, GII).[3]

While the strength of such indices lies in reducing complex information into a single, commensurable performance score—thereby allowing ranking comparisons between countries—there is growing concern that these measures are simply mashup indicators of development, with little theoretical underpinnings and even less relevance for policy.[4]

The calculation of a composite index, it is argued, has too many degrees of freedom (for example, the selection of underlying variables and the weighting scheme), which the producer is essentially free to set arbitrarily. Given the growing awareness of such methodological concerns, it is critical to ensure that any novel indicator is based on a solid conceptual foundation.

[1] See http://hdr.undp.org/en/statistics/hdi. [Accessed 17 August 2014.]
[2] See http://info.worldbank.org/governance/wgi/index.aspx#home. [Accessed 17 August 2014.]
[3] See http://hdr.undp.org/en/statistics/gii. [Accessed 17 August 2014.]
[4] Ravallion, M. (2010): "Mashup indices of development," Policy Research Working Paper 5432, World Bank; Fitoussi, J-P., Stiglitz, J. and Sen, A. (2009): "The measurement of economic performance and social progress revisited," Documents de Travail de l'OFCE 2009-33.

A2.2. Creative inputs

Capacity to innovate: The knowledge-skill base measures the capacity of an economy to innovate. The main prediction of early endogenous growth theory (EGT) is that human capital can help overcome the diminishing returns in the accumulation of physical capital. Indeed, the link between human capital and economic growth has been extensively documented at cross-country-comparison,[45] domestic[46] and individual level.[47] Conceptually, it is also helpful to distinguish between improvements in human capital in the extensive and intensive margins. Augmenting human capital in the extensive margin by widening access to basic education (for example, secondary schooling) or extending the years of schooling is conducive to the diffusion of existing knowledge and incremental technological progress. In order to foster innovation, however, improvements in the intensive margin, for example by improving the quality of tertiary education, are required.[48] Finally, the specific type of human capital also matters;[49] evidence from cross-country regressions, for example, suggests that countries with a large share of students graduating in engineering grow faster than countries with a large share students graduating in law.[50]

In addition to human capital, endogenous-growth models often emphasise the role of *size* and *scale effects*. If innovation is interpreted as a random process, having a large population per se will improve the odds of successfully innovating.[51] The underlying assumption here, however, is that productivity growth is proportional to the size of the labour force engaged in R&D, a prediction that is at odds with the empirical evidence.[52] Size, however, could also matter in terms of demand channel. As successful innovations often involve large and risky fixed costs (in terms of R&D), a larger market will—*ceteris paribus*—facilitate risk-sharing, financing and profitability of breaking the fixed costs.[53] Finally, infrastructure can help reduce transaction costs, increase effective market size and help disseminate information more rapidly.[54] In the case of knowledge and innovation, information and communications technology (ICT) is especially relevant; again, both the extensive and intensive margins matter. For the extensive margin, there is substantial evidence of a positive relationship between access to the Internet (for example, as measured by Internet penetration rate) and service-sector growth.[55] For

[44] Acemoglu, D. (2008): *Introduction to Modern Economic Growth*, Princeton: Princeton University Press.

[45] Mankiw, N., Romer, D. and Weil, N. (1992): "A contribution to the empirics of economic growth," in *The Quarterly Journal of Economics*, vol. 107(2), pp. 407-437.

[46] Gennaioli, N., La Porta, R., Lopez-de-Silanes, F. and Shleifer, A. (2013): "Human capital and regional development," in *The Quarterly Journal of Economics*, vol. 128(1), pp. 105-164.

[47] Heckman, J., Lochner, L., and Todd, P. (2003): "Fifty years of Mincer earnings regressions," IZA Discussion Papers 775, Institute for the Study of Labor (IZA).

[48] Hanushek, E. and Woessmann, L. (2012): "Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation," in *Journal of Economic Growth*, vol. 17(4), pp. 267-321.

[49] Florida, R. (2002): "The economic geography of talent," in *Annals of the Association of American Geographers*, vol. 92(4), pp. 743-755;

Marrocu, E. and Paci, R. (2012): "Education or creativity: What matters most for economic performance?" in *Economic Geography*, vol. 88(4), pp. 369-401.

[50] Murphy, K., Shleifer, A. and Vishny, R. (1991): "The allocation of talent: Implications for growth," in *Quarterly Journal of Economics*, vol. 106(2), pp. 503-530.

[51] Grossman, G. and Helpman, E. (1991a): "Quality ladders and product cycles," in *Quarterly Journal of Economics*, vol. 106(2), pp. 557-586.

the intensive margin, there is case-study and cross-country-comparison evidence showing that faster Internet connections (for example via broadband) are positively correlated with economic growth, but reliable (causal) quantitative evidence is sparse, due to *endogenous programme placement*: that is, broadband installed in areas *because* of high growth potential. The quantitative evidence available, however, again suggests that benefits are mostly concentrated in the service sector.[56]

Data sources: The report distinguishes between two broad dimensions determining the knowledge-skill base:

1) Human capital
2) Infrastructure

Human capital is an essential prerequisite of innovation, and we measure the supply side using the urbanisation rate—which may also reflect *agglomeration* effects—and the working-age population (those aged between 15 and 64). In terms of quality, we measure human capital both in its intensive and extensive margins.

For the intensive margin, as a proxy for quality we use the Mincerian return on an additional year of education, which—together with a rating for the strength of the university-industry collaboration—also reflects the potential of the labour market to absorb an educated workforce. This quality measure is complemented by the number of top-500 universities located in the economy of interest, with the underlying assumption that the number of top universities reflects the capacity of an economy both to generate and disseminate new ideas. In terms of the extensive margin, we use standard measures of the mean years of schooling, the gross enrolment ratio in secondary school and the enrolment ratio of students in technical and vocational programmes and the sciences. While the mean years of schooling is a proxy for the average length and level of training in the population, the enrolment ratio in the sciences reflects the empirical results that suggest that, in addition to quantity and quality, the type of human capital accumulated also matters.

Infrastructure determines the extent and speed to which existing knowledge can be disseminated. In line with previous intuition, infrastructure is measured both on the intensive and extensive margins. The penetration rates of roads and the Internet, for example, give an indication of how widely infrastructure is spread across the economy, while measures of quality—quality of roads, airports and seaports, as well as broadband availability—may act as a proxy for infrastructure in the intensive margin. Access to electricity is essential in employing mechanised and digital devices in production processes; mobile-phone subscriptions help disseminate information, facilitating the integration of markets.[59] Finally, to capture the potential to generate new ideas, we include the App Gap Index, produced by The EIU in 2013, which measures capacity to change the delivery mode of basic services to mobile, as well as public spending on R&D.

Incentives to innovate: Closely following Schumpeterian Growth Theory (SGT), the role of creative destruction in fostering innovations and technological progress has been well documented. A review of the literature offers three main predictions for the relationships between:

1) Growth and industrial organisation
2) Growth and firm dynamics
3) Growth and appropriate institutions[59]

[52] Jones, C. (1995): "R&D-based models of economic growth," in *Journal of Political Economy*, vol. 103, pp. 759-784.

[53] Murphy, K., Shleifer, A. and Vishny, R. (1989): "Income distribution, market size, and industrialization," in *Quarterly Journal of Economics*, vol. 104(3), pp. 537-564.

[54] Roller, L. and Waverman, L., (2001): "Telecommunications infrastructure and economic development: A simultaneous approach," in *American Economic Review*, vol. 91(4), pp. 909-923;

Qiang, C. (2009): "Broadband infrastructure in stimulus packages: Relevance for developing countries," World Bank;

Donaldson, D. (2010): "Railroads of the Raj: Estimating the impact of transportation infrastructure," NBER Working Paper no. 16487, available from http://www.nber.org/papers/w16487.pdf. [Accessed: 14 August 2014.];

Banerjee, A., Duflo, E. and Qian, N. (2012): "On the road: Access to transportation infrastructure and economic growth in People's Republic of China," National Bureau of Economic Research (NBER) Working Paper No. 17897.

[55] Freund, C. and Weinhold, D. (2004): "The effect of the Internet on international trade," in *Journal of International Economics*, vol. 62(1), pp. 171-189.

[56] Gentzoglanis, A. (2007): "International competitiveness in the telecommunications and ICT sectors: A cross-country comparison," CIRST Note de Recherche 2007-02;

Koutroumpis, P. (2009): "The economic impact of broadband on growth: A simultaneous approach," in *Telecommunications Policy*, vol. 33(9), pp. 471-485.



Firstly, the main channel focuses on competition between innovators and the incentives for firms to invest in R&D. The industrial structure matters for the innovative capacity of a country. The degree of domestic-market competition, as well as international competition (through openness and trade), for example, are strongly associated with productivity growth.[60] The underlying economic rationale is that increased competition, and the risk of seeing their rents destroyed by new innovations forces firms to continue to develop new blueprints and technologies in order to survive.[62] Industries with higher barriers to entry, therefore, will be less inclined to innovate.

Data sources: We use the ease of entry (starting a business) and exiting (resolving insolvency) as a proxy for competition: If barriers to entry and exit are high, incumbents are less likely to fear potential entrants and hence have less incentive to innovate.[61]

Related to that are frictions in labour and output markets: the extent to which hiring and firing is subject to frictions due to tight employment regulations inevitably determines the incentives of the firm and, in particular, flexibility to adjust to new innovations and market environments. Similarly, a high degree of price controls will distort the incentives and production decisions of companies.

To capture the approximate degree of competition that domestic firms are facing from abroad, measures of trade openness are used. The assumption here is that domestic firms in countries with more open economies face a higher level of competition, as their markets are not protected by tariffs or other non-tariff trade barriers. Finally, openness may also determine the knowledge-skill base to the extent that the flow of ideas follows the flow of traded goods.

Secondly, firm dynamics reflect the speed of creative destruction. Faster innovation-led growth is generally associated with higher turnover rates of firms and jobs. The mechanisms linking high turnover rates to speed of innovation are creative destruction and competition. A high rate of firm entry induces a constant arrival of new business ideas and start-ups, while a high rate of firm exit indicates the destructive component, namely, old firms rendered obsolete or poorly productive firms going out of business. Similarly, flexible labour regulation allows companies to adjust the size of their workforce. Indeed, the empirical literature points to creative destruction as a mechanism for "weeding out" the unproductive firms. While small firms, for example, exit more frequently than large firms, they are—conditional on survival—growing more rapidly than large firms.[62]

Data sources: Related to competition, firm dynamics capture the vitality of an economy, both from a domestic and an international perspective. Related to the predictions of NGT models, the labour-turnover rate is used to measure the extent of creative destruction; as old workers retire and new workers are hired, obsolete ideas are disposed of, while fresh workers bring new skills and ideas. As small firms tend to be more productive than large firms, but also exit more often, a measure of firm size and market concentration is included to capture firm dynamics. Finally, to reflect external competition in the labour market, the index measures the net migrant inflow and outflow. As before, a high turnover rate reflects the vitality of the labour market.

Environment conducive to innovation: Finally, countries require the appropriate institutions for creating an environment conducive to innovation. The literature generally focuses on two types of institutions: financial institutions and governance. Access to credit markets, for example, is crucial

[57] Jensen, R. (2010): "Information, efficiency and welfare in agricultural markets," in *Agricultural Economics*, vol. 41(S1), pp. 203-216.

[58] Aghion, P., Akcigit, U. and Howitt, P. (2013): "What do we learn from Schumpeterian Growth Theory?" available from http://scholar.harvard.edu/files/aghion/files/what_do_we_learn_0.pdf. [Accessed: 14 August 2014.]

[59] Nickell, S. (1996): "Competition and corporate performance," in *Journal of Political Economy*, vol. 104(4), pp. 724-746;

Blundell, R., Griffith, R. and Van Reenen, J. (1995): "Dynamic count data models of technological innovation," in *Economic Journal*, vol. 105(429), pp. 333-334.

[60] Porter, M. E. (1990): *The competitive advantage of nations*, New York: Free Press.

[61] Acemoglu, D. (2008): *Introduction to Modern Economic Growth*, Princeton: Princeton University Press.

[62] Aghion, P., Akcigit, U. and Howitt, P. (2013): "What do we learn from Schumpeterian Growth Theory?" available from http://scholar.harvard.edu/files/aghion/files/what_do_we_learn_0.pdf. [Accessed: 14 August 2014.]

to lowering entry barriers for firms. Similarly, the availability of venture capital and business *angels* (defined as "benevolent independent investors") are essential to encouraging high-risk-high-return innovation and start-ups. Empirical research suggests a robust and positive causal relationship between access to finance and economic growth at cross-country-comparison,[63] industry,[64] and individual level.[65]

Data sources: Financial institutions facilitate access to capital and hence enable market entry and the set-up of high-risk-high-return firms. The availability of venture capital indicates the extent to which risky (but potentially highly profitable) investments can be made, and investment openness captures the ability of domestic firms to raise capital abroad, for example through FDI. While the *ease of getting credit* measure indicates the overall ability of firms and enterprises to obtain credit, the index also explicitly measures the ease with which small-scale entrepreneurs and firms may access credit markets by measuring the microfinance penetration rate.

In terms of governance, there is a consensus that the rule of law and the low risk of expropriation reduce the scope for expropriating successful innovations. In addition, good governance reins in corruption and the possibility for incumbent firms (for example, state-owned enterprises) to prevent new entry (and hence innovation) through bribes and political connections. While a lot of political-economy literature focuses on the link between democracy and economic growth, the links through which electoral competition impacts growth are empirically unclear. The early literature focused on the negative impact of redistribution on economic growth induced by the median voter. For the CPI, however, this dimension is of minor importance.

Data sources: Since the literature on the role of governance remains inconclusive, the CPI includes only the most robust dimensions that have proven to be conducive to innovation and growth. Measures such as the ability to enforce contracts, and the protection of IP rights and investors serve as a proxy for the degree to which innovators are able to reap the benefits of their R&D. In the absence of IPR protection, new ideas and blueprints remain non-excludable and may be appropriated by competing firms, hence diminishing any private incentive to invest in R&D. The channel through which corruption and bureaucracy affects innovation is the *protection of incumbents* (for example, state-owned firms) enabled by bribes and other informal measures (for example, favourable access to credit). As the protection of incumbents raises the barriers of entry, incumbents will have less incentive to invest in R&D and to innovate.

[63] Barro, R., Mankiw, N. and Sala-i-Martin, X. (1995): "Capital mobility in neoclassical models of growth" in *American Economic Review*, vol. 85(1), pp. 103-115.

[64] Rajan, R. and Zingales, L. (1998): "Financial dependence and growth," in *American Economic Review*, vol. 88(3), pp. 559-586.

[65] De Mel, S., McKenzie, D. and Woodruff, C. (2008): "Returns to capital in microenterprises: Evidence from a field experiment," in *Quarterly Journal of Economics*, vol. 123(4), pp. 1329-1372.



A2.3. Creative outputs

The CPI measures creative outputs more broadly, moving beyond the number of registered patents as the sole proxy for innovation. The measures of creative output can be broadly divided into general measures of innovation and measures that are particularly relevant to Asia.

Data sources: In terms of general measures, scientific innovations are captured using the number of patents per capita and the numbers of scientific publications in academic journals per capita. Although these are crude proxies of creative outputs, which emphasise quantity over quality, both proxies remain the most widely used measures (see Box A2: Challenges in measuring innovation—the case of patents). These micro-level measures are complemented by two macro-level measures: the degree of export sophistication[66] and the distance to the world technology frontier, as approximated using the standard total factor productivity (TFP) decomposition.[67]

In terms of Asia-specific measures, the index captures innovations in the agricultural sector and entertainment sector. Both these areas remain large across developing Asia and the inclusion of such measures ensures that the outputs are adequately captured. For the agricultural sector, agricultural productivity is measured using the cereal yield per hectare and the agricultural value added per worker, two widely used measures of productivity.[68] For the entertainment sector, we measure the production of intangible outputs using films and books published per capita, recognised by UNESCO as two standardised measures of cultural output.

[66] Hausmann, R., Hwang, J. and Rodrik., D. (2005): "What You Export Matters," in *Journal of Economic Growth*, vol. 12(1), pp. 1-25.

[67] Durlauf, S., Johnson, P. and Temple, J. (2005): "Growth econometrics" in Aghion, P. and Durlauf, S. (Eds.), *Handbook of economic growth volume 1A*, North-Holland: Amsterdam, pp. 555-677.

[68] Zepeda, L. (Ed.) (2001): *Agricultural investment and productivity in developing countries*, FAO Economic and Social Development Paper No. 148.

Box A2: Challenges in measuring innovation—the case of patents

Although there is an abundance of input-based indicators of innovation and creative productivity, such as R&D expenditure, R&D stock or the number of researchers,[1] there exist almost no reliable output measures for innovation: in contrast to tangible inputs, innovation has been hard to measure.

Among the few outcome measures, the number of patents is arguably the most frequently used indicator. Virtually all composite indices of innovation, including the Technology Achievement Index (TAI), the Global Competitiveness Index (GCI) and the Global Creativity Index (GCRI), attempt to approximate the stock of knowledge using the simple count of patents from a given country.

The main problem of using the count of patents, however, lies in measurement errors: the simple count may be misleading, as patents are highly heterogeneous, and knowledge is often sector-specific and difficult to standardise. Giving a total of patents, therefore, is very misleading, as the measure emphasises quantity over quality.

Attempts to capture the heterogeneity of patents either draw upon additional information on the citation links or try to estimate the value of a patent.[2] Citation-based approaches can either estimate the quality of a patent by measuring the number of subsequent patents that build upon its findings (*forward linkages*) or by examining the pool of patents it draws upon (*backward linkages*). This fine-grained information allows the calculation of indices of dispersion (that is, drawing upon patents from different fields), which may reflect the degree of originality of a given patent.[3] Value-based measures, in turn, are derived based on the assumption that the current value of a patent should reflect discounted future cash flow. A related measure that combines both concepts is the receipt of loyalty and licence fees from abroad, capturing both the quality and market value of a given invention.[4]

While micro-level data allow the use of a wide range of measures to reflect the complexity of innovation, the obvious disadvantage is the high demand for data; in developing countries, in particular, these data requirements often cannot be met. What is worse, there is also evidence suggesting that crude summation, while conceptually problematic, may, in practice, be a reasonable proxy: Park and Park (2005), for example, calculate two quality measures for patents based on citation counts and the valuation approach, but find that the resulting measures are highly correlated with the standard count and input measures of innovation.[5] These two factors—high data demand with only a modest improvement in accuracy—may also explain why a simple count of patents remains a widely prevalent measure of innovation.

[1] OECD (2002), "Special issue on new science and technology indicators," STI Review No. 27, available from http://www.oecd.org/sti/37124998.pdf. [Accessed 17 August 2014.]
[2] Squicciarini, M., Dernis, H. and Criscuolo, C. (2013): "Measuring patent quality: Indicators of technological and economic value," OECD Science, Technology and Industry Working Papers 2013/3, OECD Publishing.
[3] Trajtenberg, M., Henderson, R. and Jaffe, A. (1997): "University versus corporate patents: A window on the basicness of invention," in *Economics of Innovation and New Technology*, 5(1), pp. 19-50.
[4] This is done both in the Technological Achievement Index and NESTA's UK Innovation Index.
[5] Park, Y., and Park, G., (2004): "A new method for technology valuation in monetary value: procedure and application," in *Technovation* vol. 24, pp. 387-394.

Box A3: Agricultural productivity

Agricultural productivity is an important output measure of productivity in emerging countries where the primary sector remains large. Rising agricultural productivity, perhaps best exemplified in the Indian productivity surge during the *green revolution*, from the 1940s to the 1960s, due to the introduction of high-yield varieties (HYV) and fertilisers,[1] is often considered a necessary condition for poverty reduction and the successful transition to a manufacturing and service-sector-led economy.[2]

Improvements in agricultural productivity, however, are not only key in unleashing structural change, but also critical for meeting growing food demand, partly driven by economic development. According to the *OECD-FAO Agricultural Outlook 2012-2021*,[32] global agricultural production will need to increase by 60% over the next 40 years to meet the rising food demand induced by population growth and the growing shift towards resource-intensive foods. With limited scope for expanding agricultural land, these increases in production must be met by increases in productivity.

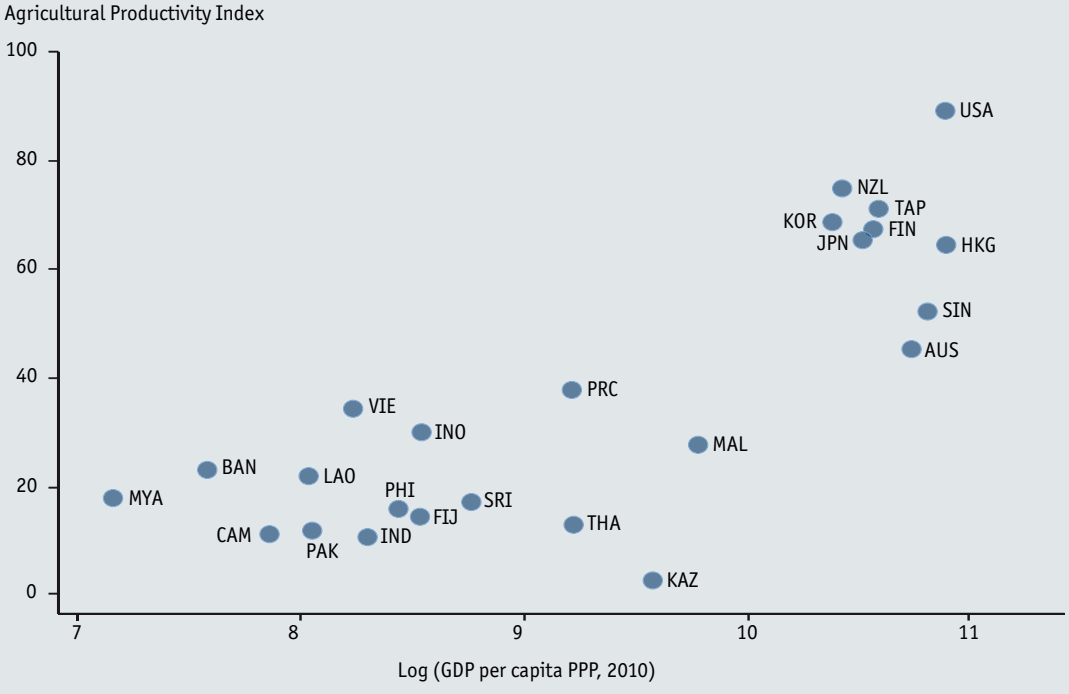
The CPI captures agricultural productivity using two proxies:

- Cereal yield per hectare (World Bank)
- Agricultural value added per worker (FAO)

The final Index for Agricultural Productivity is a simple average of these two normalised proxies, ranging between 0 (lowest) and 1 (highest).

The inclusion of measures of agricultural productivity also aims to capture *invisible innovations* that go beyond increased agricultural inputs. Such invisible innovations, often associated with *frugal innovations* (see economy summary: India), encompass organisational and process innovation, for example improved access to agricultural credit due to innovative lending schemes or mobile banking.[3] Whereas conventional measures of innovation and productivity tend to focus on creative outputs commonly associated with developed countries (for example, patent registrations), the inclusion of agricultural productivity is intended to provide a more balanced measure of output, which also accounts for improvements in the rural sector.

The figure below plots the Agricultural Productivity Index (API) as a function of GDP per capita. Despite recent increases in agricultural productivity, large cross-economy-comparison productivity differences persist: India, despite having experienced large productivity gains in the 1980s,[4] is still ranked poorly on the API among the sample of 24 economies. These differences are positively related to GDP per capita, with countries such as the United States leading in terms of agricultural productivity (68,182 hg/ha annual cereal yield and agricultural value added of US$49,817 per worker), and Kazakhstan lagging behind (16,877 hg/ha cereal yield and US$4,223 per worker).



[1] Singh, N. and Kohli, D. (2005): "The Green Revolution in Punjab, India: The economics of technological change," in *Journal of Punjab Studies*, vol. 12(2), pp. 285-306.

[2] World Bank (2008): "World development report 2008: Agriculture for development."

[3] *OECD-FAO Agricultural Outlook 2012-2021*.

[4] Kumar, P. and Mittal, S. (2006): "Agricultural productivity trends in India: Sustainability issues," in *Agricultural Economics Research Review*, vol. 19, pp. 71-88.



Box A4: Distance to the technological frontier

The distance to the technological frontier, an outcome of creative production in the CPI, tracks the relative distance in productivity of a given country to the technologically leading country, conventionally equated to the United States.[1]

Since productivity itself is difficult to measure, the conventional approach is to retrieve it as a "residual," the so-called *total factor productivity* (TFP). Assuming that GDP can be decomposed into its main inputs—physical capital, labour and productivity—it is possible to "back out" productivity using aggregate statistics by subtracting from the overall GDP the contribution made by physical capital and labour. The remaining part of the GDP that cannot be explained by tangible factors of production, then, is the TFP:

Productivity (TFP) = Output (GDP) – Capital stock (K) - Labour input (L)

To obtain the final measure, the estimated productivity (TFP) is divided by the productivity level of the United States—the technological frontier—so that the resulting "distance to the *technological frontier*" expresses a given economy's distance relative to the United States, that is the ratio to the observed maximum.

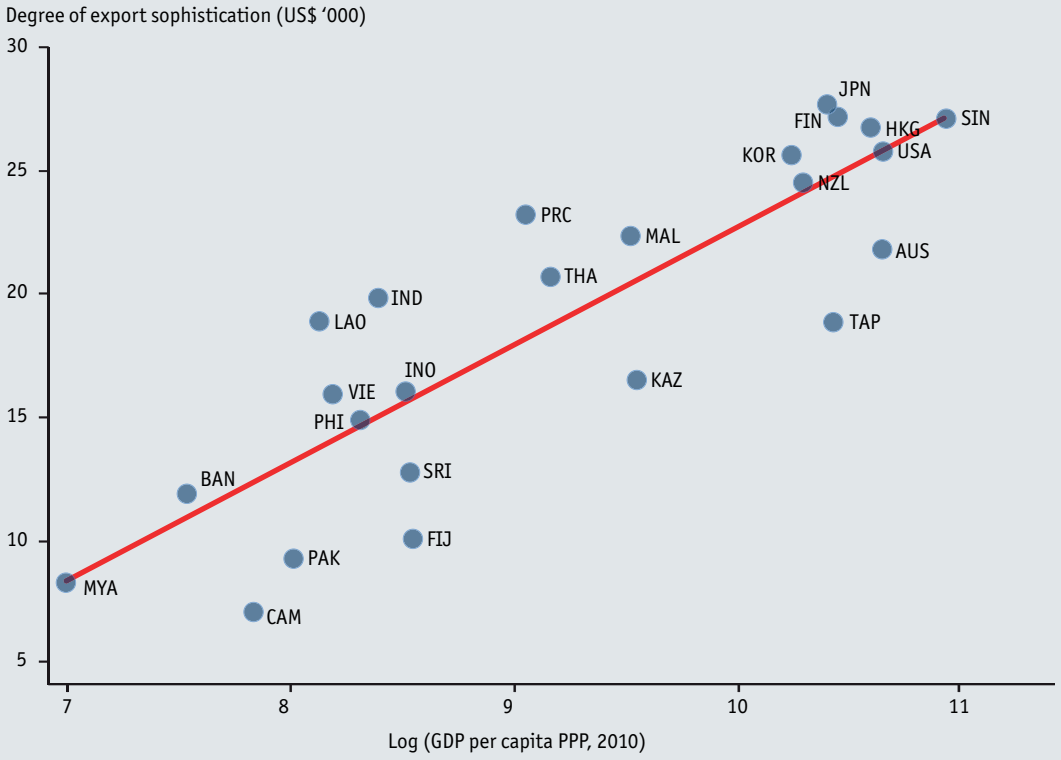
In contrast to measuring narrow indicators of creative production, such as patents filed or the number of scientific publications, the advantage of such a measure of innovation is the ability to capture creative production and the resulting productivity growth in a broader way. As a residual-based approach, however, a drawback is the inability to disentangle measurement error from actual TFP. To the extent that the assumed decomposition of the GDP is misspecified, the resulting TFP estimate may capture other unobserved factors (for example, differential quality of capital or labour), and not actual TFP. Despite these concerns, the *decomposition technique* used is the conventional approach.

[1] Durlauf, S., Johnson, P. and Temple, J. (2005): "Growth econometrics" in Aghion, P. and Durlauf, S. (Eds.), *Handbook of economic growth volume 1A*, North-Holland: Amsterdam, pp. 555-677.

Box A5: Export sophistication

Export sophistication measures the quality and composition of exported goods. Intuitively, the degree of export sophistication is determined by the average level of economic development associated with the production of a given exported good: If an exported good, for example, is only produced by another economy with a per-capita income level of US$5,000, then the level of sophistication of the good is, correspondingly, US$5,000. If several economies produce the same good, the level of sophistication is a weighted average of the per-capita income level of all economies producing the good. The overall degree of export sophistication then is a weighted sum of the level of sophistication for each good exported.[1]

The degree of export sophistication is an important measure of the ability of an economy to sustain its growth: Rodrik (2006), for example, shows that the degree of export sophistication is robustly associated with a country's subsequent growth rate:[2] the People's Republic of China, in particular, stands out in the relationship (see figure below), with a basket that is significantly more sophisticated than predicted by the average relationship. The Chinese case illustrates that the extensive margin—that is, the volume exported—may not be the critical indicator for the ability to sustain growth. Instead, what matters is the *intensive* margin; that is, whether an economy is able to climb the value chain, for example through targeted and innovation-led upgrading of domestic production capabilities.



[1] Hausmann, R., Hwang, J. and Rodrik., D. (2005): "What you export matters," in *Journal of Economic Growth*, vol. 12(1), pp. 1-25.

[2] Rodrik, D. (2006): "What's so special about the People's Republic of China's exports?" *China & World Economy*, Institute of World Economics and Politics, Chinese Academy of Social Sciences 14(5), pp. 1-19.

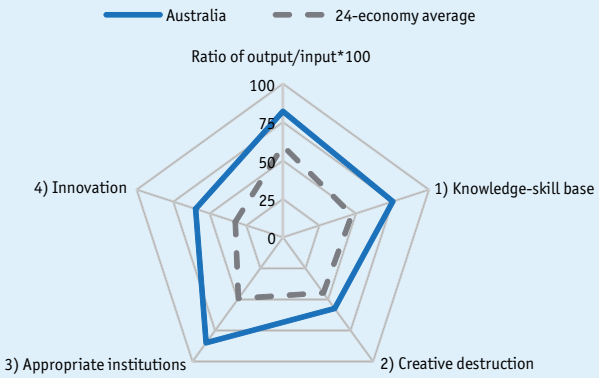
A3. Economy summaries

Australia — Rank: 8

Australia is ranked eighth out of 24 economies in the overall index. It is among the best-performing economies in terms of inputs, outperforming in the provision of a strong *knowledge-skill base* and appropriate institutions. However, the country lags behind in *firm dynamics*, which may slow down labour-market adjustments. In terms of outputs, Australia ranks seventh, outperforming in the creative industries.

The country's knowledge-skill base is second only to Singapore in the CPI. It scores particularly well in the *provision of top-rated educational institutions*—sharing the top ranking with Japan, the People's Republic of China and the United States—with 19 of its universities among the top-500 institutions globally.[1] In terms of infrastructure, Australia ranks first for access to electricity. Although it fares relatively well in the CPI for *Internet penetration*, the country lags behind its OECD peers for *broadband access and speed*; the government intends to address this shortcoming with the eventual roll-out of a National Broadband Network. The country also boasts a high score for *appropriate institutions*, with good *governance* (Australia was ranked seventh out of 176 economies in Transparency International's 2012 Corruption Perceptions Index), *easy access to credit* and *wide availability of microfinance*.

Australia does not fare as well in other areas. In particular, it ranks poorly for *ease of labour turnover*. A new national workplace-relations system came into effect from January 1st 2010, standardising labour-relations regulations in the private sector under the Fair Work Act 2009. Concerns about job security during the 2008-09 global financial crisis led to a rise in membership of unions, which has put pressure on the government to restrict businesses' ability to bring skilled workers to Australia on a temporary basis.[2] These factors mean that Australian firms may not be as flexible when adjusting to new market conditions or innovations. Elsewhere, the country's score for *agricultural value added per worker* is high, but it ranks only above Kazakhstan for *cereal yield*, indicating that more investment is needed in technological innovation to improve productivity. In addition, despite being ranked below only Finland in the index for the *number of scientific publications* in journals, it languishes at 17th for the *ratio of tertiary students enrolled in science*.



Top quartile		2nd/3rd quartile		Bottom quartile
Human capital	70.7	Firm dynamics	54.0	
Infrastructure	79.9			
Competition	60.6			
Financial institutions	76.2			
Governance	93.8			

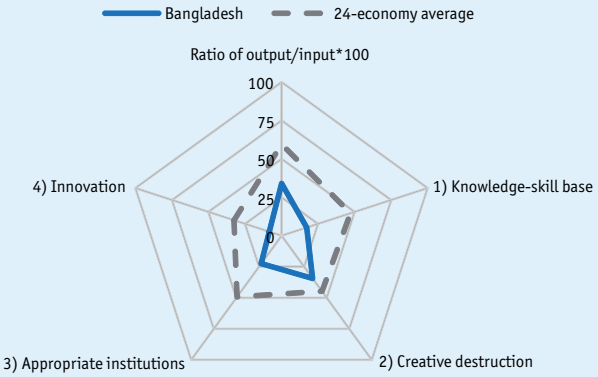
[1] Shanghai Jiao Tong University, Academic Ranking of World Universities 2012; *Times Higher Education*, World University Rankings 2012.

[2] The Economist Intelligence Unit, Australia Country Commerce and Australia Country Forecast, January 2014.

Bangladesh — Rank: 20

Bangladesh is ranked 20th out of 24 economies and has a low level of creative productivity, owing to poor-quality human capital, inadequate infrastructure and a lack of formal financial institutions. Its relative strengths lie in sound levels of competitiveness and firm dynamics. For outputs, Bangladesh is ranked 21st, owing in particular to a low performance on *macro outputs* (including *distance from the TFP frontier* and *export sophistication*).

Although Bangladesh is close to the back of the pack in terms of firm dynamics, this is still the country's highest-scoring macro indicator. It has a negative ratio for net migrant inflow/outflow, showing that more people are leaving the country than are moving there. However, labour turnover is relatively fluid in Bangladesh, characterised by relatively lax regulation and the absence of large trade unions. In the area of competition, the freedom to compete in Bangladesh is on a par with that of Japan and Taipei,China. Nevertheless, the government does not have a competition policy and tends to favour local interests over foreign ones, with only a narrow elite benefiting from the administration's system of patronage. This represents a barrier for new entrants to the market and inhibits innovation in the economy.



Top quartile	2nd/3rd quartile		Bottom quartile	
	Competition	29.2	Human capital	22.5
	Firm dynamics	39.7	Infrastructure	11.9
	Governance	27.1	Financial institutions	17.9

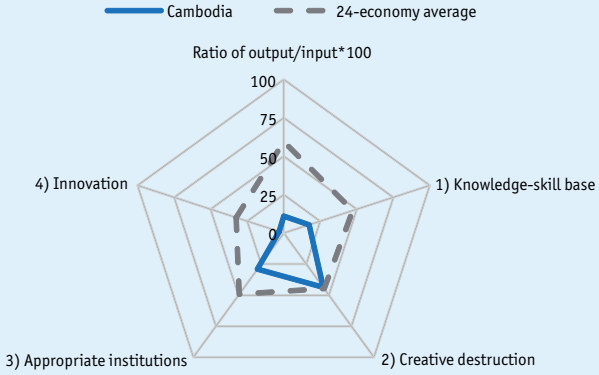
Bangladesh has a small pool of skilled labour, being ranked 20th out of 24 economies for *human capital*, with highly skilled Bangladeshis often leaving to take up work overseas. This is also partly the result of the low-quality education provided by the country's state-run schools. Several companies in Bangladesh complain about the lack of skilled technical and professional personnel in the local workforce, and many tend to look elsewhere to recruit high-quality employees.[1] The country also suffers from inadequate infrastructure, in particular a lack of energy supplies and a poor road network (it ranks second to last in the index for both indicators). Under its long-term Digital Bangladesh initiative, the government aims to boost growth in information and communications technology (ICT) services and improve Internet connectivity, but more needs to be done to increase the pool of skilled technical labour if this outcome is to be achieved. Finally, Bangladesh is in need of better financial institutions, at a ranking of 22nd out of 24 economies, to improve its productivity. The banking sector remains opaque and is characterised by poor asset quality.

[1] The Economist Intelligence Unit, Bangladesh Country Forecast, January 2014.

Cambodia — Rank:24

Cambodia is ranked last among the 24 economies overall, owing to its inability to use its existing inputs efficiently. In terms of inputs, the country performs well on *firm dynamics* conducive to creative destruction, but lags behind substantially in *human capital*, *infrastructure*, *competition* and *governance*. For outputs, it ranks lowest, owing to poor scores on *conventional micro* and *macro measures of innovation*.

The country shares the top ranking for *ease of labour turnover* with Hong Kong, China; Kazakhstan; Singapore; and the United States, indicating flexible labour laws and the low cost of making workers redundant. But garment-worker strikes have become more common in the past year in the face of poor working conditions. If implemented, a threat from the EU to withdraw preferential tax treatment for Cambodia's garment exports, following the government's violent suppression of worker unrest, could topple a pillar of the local economy.[1] In addition, the country's poor *human capital* score (it is ranked near the bottom for almost all education indicators in the index) underlines the fact that innovation remains a problem, as shown in its lowest-placed ranking in terms of output. In particular, Cambodia fares poorly for *mean years of schooling*, its *rate of urbanisation* and the *secondary-school enrolment ratio*. Nevertheless, the country is ranked seventh out of 24 for the *Mincerian return on education*, suggesting that the government should do more to invest in education and encourage additional years of schooling.



Top quartile		2nd/3rd quartile		Bottom quartile	
Firm dynamics	65.1	Financial institutions	37.3	Human capital	18.1
				Infrastructure	16.7
				Competition	22.2
				Governance	20.8

Poor governance remains a problem, with instability a feature of the political scene following the disputed election that took place in July 2013. The business environment is characterised by endemic corruption and poor rule of law, and often only well-connected Cambodians have the means to invest in the country. Poor regulation of the telecommunications sector has also meant that Internet connectivity has remained low. Yet, there is much scope for improvement in Cambodia's ranking for *agricultural productivity* (currently 22nd out of 24), as the government aims to boost the country's rice production, so as to bring its performance in line with that of Thailand or Viet Nam.[2] However, Cambodia's poor irrigation and transport infrastructure will need to be upgraded if this aim is to be achieved.

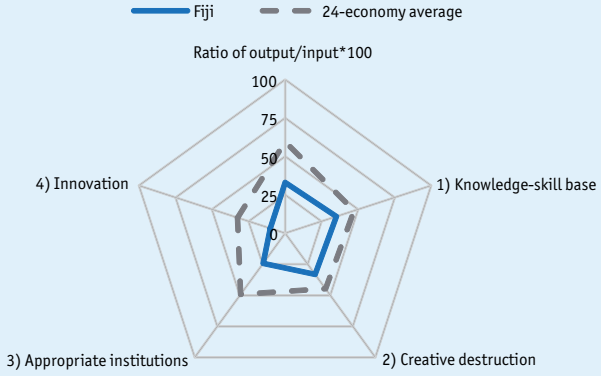
[1] The Economist Intelligence Unit (2014c): "Garment industry at risk," 24 January 2014. Available from: http://country.eiu.com/article.aspx?articleid=461466430&Country=Cambodia&topic=Economy. [Accessed: 17 August 2014.]

[2] The Economist Intelligence Unit (2014b): "Cambodia economy: Missed opportunity?" 22 March 2014.

Fiji — Rank: 21

Fiji is ranked 21st out of 24 economies for *creative productivity*. On the provision of creative inputs, the country lags behind in *infrastructure*, *firm dynamics* and *governance*. On the output side, it languishes in terms of *conventional measures of innovation*, such as *scientific output*, *distance from the TFP frontier* and *export sophistication*.

This Pacific-island country is ranked highly for *ease of labour turnover*, at sixth place, although this partly reflects a lack of power on the part of trade unions. In October 2013 the Committee on Freedom of Association, a governing body of the International Labour Organization (ILO), noted allegations of clandestine government decrees restricting trade unions' rights and intimidation or harassment of union members, among other claims.[1] Proper assessment of working conditions has been hampered by the fact that ILO delegations have not been invited to the country since late 2012. In addition, Fiji is ranked last in the index for *net migrant flows*, with more people leaving the country than entering it. On the infrastructure side, Fiji scores particularly poorly for *access to electricity*, but fares better in terms of *Internet connectivity* and *telecoms penetration*. The economy ranks 22nd in terms of *governance*, being ranked above only the Lao PDR and Myanmar. However, the current government, which came to power through a coup in 2006, has promised to hold democratic elections in September 2014; there is, therefore, a possibility that governance will improve in the near future.



Top quartile	2nd/3rd quartile		Bottom quartile	
	Human capital	39.5	Infrastructure	30.7
	Competition	28.8	Firm dynamics	37.5
	Financial institutions	34.0	Governance	14.6

Fiji scores poorly for *export sophistication* and *scientific output*. It is also ranked only 19th out of 24 economies in terms of *agricultural productivity*. Investment in mills for sugar, Fiji's principal export, has led to improved efficiency in output, and, in addition to better cane quality, this has resulted in higher yields. However, a failure to modernise means that production costs remain high, suggesting that there is scope for improvement in this area.[2]

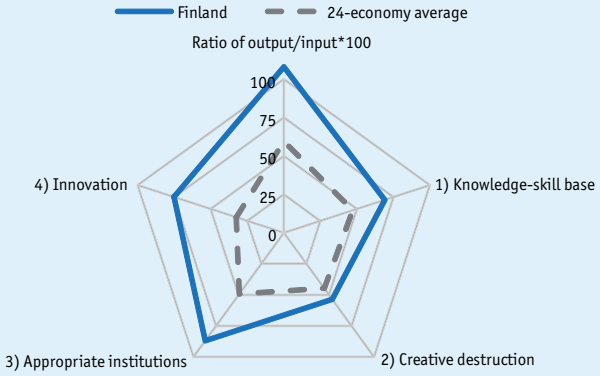
[1] ILO (2013): "ILO Governing Body adopts report of the Committee on Freedom of Association," 31 October 2013, available from http://www.ilo.org/global/about-the-ilo/activities/WCMS_228426/lang--en/index.htm. [Accessed 17 August 2014.]

[2] The Economist Intelligence Unit (2013b): "Quality of sugar production rises, but output falls again," 7 June 2013, available from http://country.eiu.com/article.aspx?articleid=1810586365&Country=Fiji&topic=Economy&subtopic=Forecast&subsubtopic=Economic+growth&u=1&pid=251084409&oid=251084409&uid=1. [Accessed: 17 August 2014.]

Finland — Rank: 2

Finland is in second place in the CPI and is the highest-ranked non-Asian economy. In terms of inputs, it outperforms, with strong *infrastructure*, *competition*, *financial institutions* and *governance*. The relative weaknesses lie in *firm dynamics*, owing to the country's low immigration flows. In terms of output, Finland outperforms on all dimensions, with particularly high levels of *scientific output*.

The country scores highly for *governance*, with its record of effective policymaking, a fair and transparent legal system, and lack of corruption (Finland was ranked joint first out of 176 countries in Transparency International's 2012 Corruption Perceptions Index). The Finnish economy is largely open to competition and the government takes action to curb unfair business practices.[1] The banking sector remains the major source of funding, and local lenders are well capitalised and structurally sound, as reflected in Finland's high score for *financial institutions*. Finland's infrastructure is ranked fourth in the world, according to The EIU's Business Environment Rankings. In particular, the transport, telecoms and technology systems are highly developed, and the country boasts high broadband and mobile-phone penetration rates.



Top quartile		2nd/3rdquartile		Bottom quartile
Infrastructure	89.6	Human capital	48.6	
Competition	65.1	Firm dynamics	42.2	
Financial institutions	77.9			
Governance	95.8			

Finland ranks at the top of the index for *innovation*. The country's strong reputation for innovation is largely the result of government efforts to focus on education, science and technology, and the authorities allocate funding fairly across the private and public sectors.[2] The prime minister heads the Research and Development Council, which steers Finnish innovation. The government remains proactive in encouraging innovation through cross-disciplinary co-operation, as reflected in its national innovation strategy.[3]

[1] The Economist Intelligence Unit, Finland Country Forecast, December 2013.

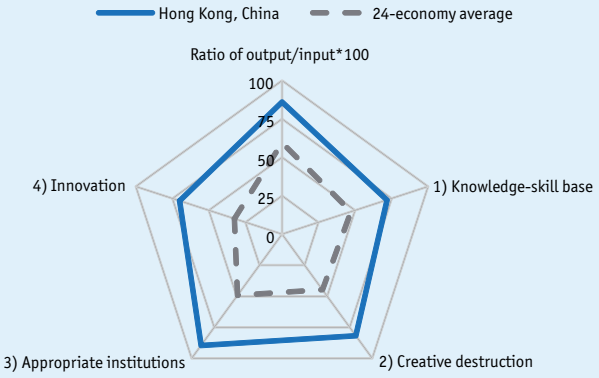
[2] Kao, J. (2009): "Tapping the world's innovation hotspots," in *Harvard Business Review*, March 2009, pp. 109-114.

[3] Ministry of Employment and the Economy (2009): "Government's communication on Finland's national innovation strategy to the parliament," available from https://www.tem.fi/files/21010/National_Innovation_Strategy_March_2009.pdf. [Accessed: 17 August 2014.]

Hong Kong, China — Rank:7

Hong Kong, China is ranked seventh overall, indicating a high level of creative productivity. In terms of creative inputs, the economy performs exceptionally well on all dimensions. Nevertheless, a comparison with the top-ranked economies, such as Japan and Finland—which produce more outputs with lower scores on inputs—reveals the potential benefits of putting the high level of inputs to even better use.

The territory ranks behind only Singapore both for *creative destruction* and appropriate institutions. Hong Kong, China is ranked first in the index for *starting a business*, with investors drawn in by the simplicity of procedures for investing, expanding and establishing a local company in the territory. For example, the incorporation of a business may be completed electronically within one hour, under a one-stop service launched in March 2011. According to the World Bank's *Doing Business 2013* report,[1] the territory is ranked second out of 185 economies in terms of *ease of doing business*. In addition, despite public concern over close relations between officials and businesspeople, Hong Kong, China's judicial and regulatory systems are relatively effective and impartial.[2]



Top quartile		2nd/3rd quartile		Bottom quartile
Infrastructure	88.0	Human capital	55.8	
Competition	89.2			
Firm dynamics	74.3			
Financial institutions	97.9			
Governance	81.3			

Hong Kong, China is the top-ranked Asian economy in terms of *innovation*. It scores particularly well for *distance from the TFP frontier*, *films* and *books per 1,000 population*, and *export sophistication*. On the export side, Hong Kong, China has taken advantage of its proximity to the People's Republic of China, using competitive manufacturing bases there to become the world's leading re-exporter of garments and imitation jewellery, among other goods. However, the territory is ranked below Japan and Finland in terms of the *number of patents per head* and *agricultural productivity*. There is scope for improvement in Hong Kong, China's creative outputs under the government's Innovation and Technology Commission and CreateHK, the latter of which was set up in 2009 to spearhead the development of creative industries in the territory.

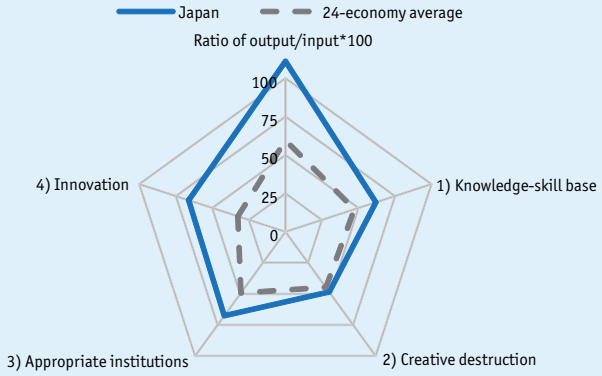
[1] World Bank and International Finance Corporation (2012): "Doing Business 2013: Smarter regulations for small and medium-size enterprises."

[2] The Economist Intelligence Unit, Hong Kong, China Country Forecast, December 2013.

Japan — Rank: 1

Japan leads the CPI ranking of the 24 economies in the sample. Although the country does not top the list in terms of creative inputs (six countries are ranked higher), Japan is able to employ its existing resources successfully to produce high levels of creative outputs. Despite its high ranking, challenges remain and the relatively low score on *creative-industry outputs* highlights the scope for further improvements.

Japan's highest scores are achieved in *infrastructure* and *financial institutions*. The quality of transport infrastructure is high—and is likely to increase, as the government intends to expand transport networks further through the construction of new motorways and high-speed railways—and the country has one of the most sophisticated telecoms networks in the world. In addition, public expenditure on R&D is high, and the government encourages foreign companies to site their R&D operations in the country through tax and other incentives.[1] It is relatively easy to obtain financing in Japan (the country shares the top ranking for *access to credit*), and there are around 200 private-sector financial institutions at present. The country is ranked tenth for *human capital*, but there is significant scope for improvement. For example, Japan is ranked last in the index for the *enrolment of tertiary students in science programmes*, and close to the bottom for *Mincerian returns on education*.



Top quartile	2nd/3rd quartile		Bottom quartile
	Human capital	46.6	
	Infrastructure	77.4	
	Competition	56.0	
	Firm dynamics	40.8	
	Financial institutions	72.7	
	Governance	62.5	

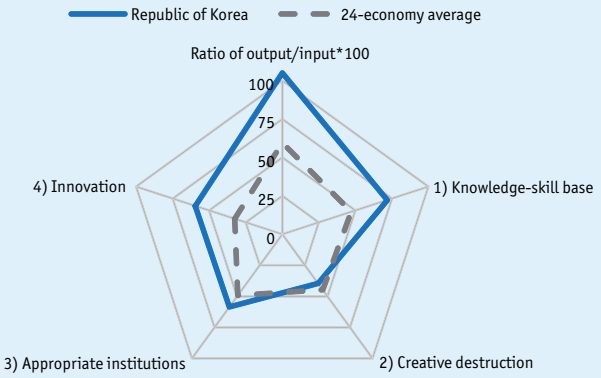
On the output side, the country tops the ranking for the number of patents filed per capita. This may partly reflect government efforts to encourage global firms to locate their R&D facilities in Japan, as, under the Act for Promotion of Japan as an Asian Business Centre, enacted in 2012, small- and medium-sized enterprises' (SMEs) R&D businesses may qualify for a reduction in their patent fees.[2] According to the World Intellectual Property Organization, in 2012 Japan was ranked second in the world for the number of patent applications and first for the number of patent grants, with the electrical machinery, apparatus and energy-technology field seeing the highest number of patent applications.[3] However, Japan is still ranked only eighth for the *number of scientific publications*—below Taipei,China; Singapore; and Hong Kong, China—suggesting that there is room for improvement on this measure of innovation.

[1] The Economist Intelligence Unit, Japan Country Forecast, December 2013.
[2] The Economist Intelligence Unit, Japan Country Commerce, December 2013.
[3] World Intellectual Property Organization, "Statistical country profiles: Japan," available from http://www.wipo.int/ipstats/en/statistics/country_profile/countries/jp.html. [Accessed: 2 February 2014.]

Republic of Korea — Rank: 3

The Republic of Korea is ranked second in Asia in the CPI. Its performance is driven by its ability to generate a high level of creative outputs, despite relatively low scores on the dimensions of *creative destruction* and *appropriate institutions*.

In terms of creative inputs, the Republic of Korea is characterised by an exceptionally high quality of infrastructure, with top scores on *access to electricity*, *public spending on R&D* and *broadband-Internet penetration*. The high broadband-penetration rate is partly owing to the fact that around 80% of the population lives in urban areas, which simplifies broadband access and installation, and will be boosted by the government's provision of extensive IT facilities in schools, which has helped to make the Republic of Korea's population highly computer-literate.[1] The weaknesses lie in its rigid labour market as a result of the historically state-driven development process. In contrast to other indicators, the Republic of Korea scores relatively poorly on *firm dynamics*, with little labour turnover and international competition for the domestic labour market. The lack of firm dynamics may prevent firms from flexibly adjusting their pool of workers in the short term.



Top quartile		2nd/3rd quartile		Bottom quartile	
Human capital	57.8	Competition	51.0	Firm dynamics	28.3
Infrastructure	85.8	Financial institutions	58.7		
		Governance	58.3		

The Republic of Korea's success in generating creative outputs is mainly driven by a high number of *patents per capita* and high *agricultural productivity* (with good *cereal yields*, in particular). But the country's very low ranking for the *number of scientific publications per capita*, at 23rd (above only Myanmar), also point to scope for future improvements. The current government is aiming to develop the country's creative industries, as well as restructure the large public sector, under its three-year economic innovation policy. As part of its efforts to shift the domestic economy away from export-led expansion, the government is seeking new sources of growth around leading-edge technologies,[2] which should boost the Republic of Korea's innovative output in the medium term.

[1] The Economist Intelligence Unit, Republic of Korea Telecommunications Industry report, October 2013.

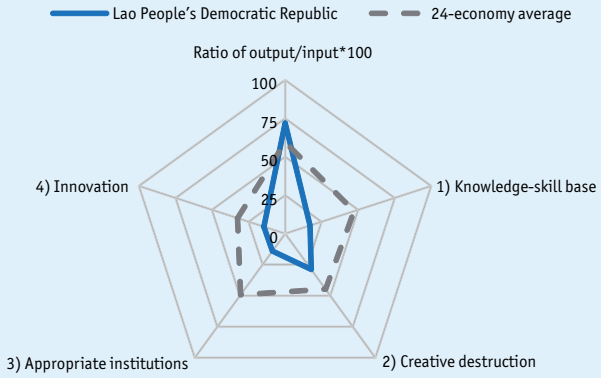
[2] The Economist Intelligence Unit (2014d): "Government emphasises role of private sector in GDP growth," 14 January 2014.

Lao People's Democratic Republic — Rank: 9

Despite its relatively poor performance on the creative-input side, the Lao People's Democratic Republic's *creative productivity* is ranked highly, owing to its ability to transform the given inputs into a relatively high level of creative outputs. As a result, it ranks ninth out of 24 economies in the overall index.

On the input side, the major weaknesses lie in poor infrastructure and a lack of appropriate institutions. In terms of infrastructure, the Lao People's Democratic Republic is characterised by low levels of R&D spending and low Internet- and broadband-penetration rates. On this front, however, some improvement can be expected in the medium term, following recent moves to improve physical infrastructure in order to boost cross-border trade in the Greater Mekong Subregion.[1]

The low score on *appropriate institutions* is driven by both lagging financial institutions and governance. The lack of financial institutions that provide micro-loans or raise venture capital limits the scope for entrepreneurial activities. Similarly, poor protection of IP and investors, combined with relatively high levels of red tape and corruption, further limit incentive to innovate. (The Lao People's Democratic Republic is ranked 160th out of 176 economies in Transparency International's 2012 Corruption Perceptions Index, compared with 88th place for neighbouring Thailand, but roughly on the same level as Cambodia and Myanmar at 157th and 172nd, respectively.)



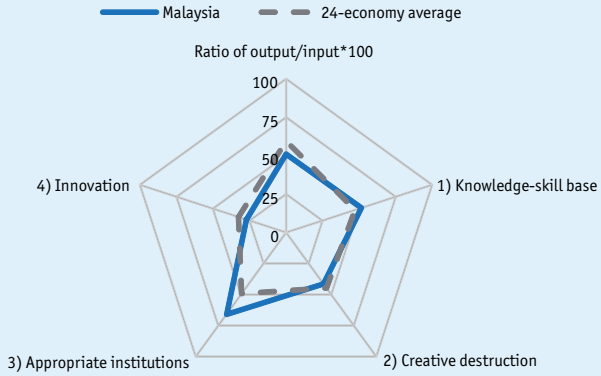
Top quartile	2nd/3rd quartile		Bottom quartile	
	Competition	32.0	Human capital	15.6
			Infrastructure	18.3
			Firm dynamics	25.8
			Financial institutions	19.6
			Governance	8.3

The Lao People's Democratic Republic's relatively high creative output is driven by its *export sophistication*, which is a proxy for the quality and composition of exported goods (see Box A5: Export sophistication), and *cereal yield*, a measure of agricultural productivity and innovation. The weaknesses in creative outputs lie in the performance on conventional measures of innovation, such as the *number of patents* and *scientific publications per head*, as well as the *number of films* and *books produced per 1,000 people*. Given the Lao People's Democratic Republic's poor scores across the micro measures of human capital, this suggests that greater public investment in education, and in science programmes in particular, would help to boost the country's creative output.

[1] The Economist Intelligence Unit (2013a): "Mekong countries vow to enhance trade and transport," 26 November 2013, available from http://country.eiu.com/article.aspx?articleid=1081271892&Country=Laos&topic=Economy&subtopic=Forecast&subsubtopic=External+sector&u=1&pid=1101266894&oid=1101266894&uid=1. [Accessed: 17 August 2014.]

Malaysia — Rank: 13

Malaysia is ranked 13th out of 24 economies and has a medium level of *creative productivity*. In terms of inputs and based on the sample of economies studied, Malaysia's performance is roughly average, with slightly above-average scores on *financial institutions* and *governance*. In terms of creative outputs, the country performs relatively well on macro measures of creative output, with a high level of *export sophistication*, but lags behind in *scientific output* and *agricultural productivity*.



Top quartile	2nd/3rd quartile		Bottom quartile
	Human capital	44.3	
	Infrastructure	58.7	
	Competition	43.0	
	Firm dynamics	40.0	
	Financial institutions	65.0	
	Governance	66.7	

On the input side, Malaysia's strongest area is its *appropriate institutions*, with a ranking of eighth for this indicator. In particular, the country shares the top rank for *protection of investors* with Singapore, the United States and Finland. In respect of its *financial institutions*, Malaysia ranks highly for the *availability of venture capital* and *access to credit*. However, the country scores poorly for *investment openness*, although this is likely to improve over the next decade. Under the Economic Transformation Programme, launched in 2010, FDI is deemed essential to helping the government to achieve its goal of transforming Malaysia into a high-income nation by 2020. In addition, the government will be keen to attract more FDI in an effort to position the country as a base for high-technology manufacturing and high-value-added services.[1]

On the creative-output side, there is room for improvement in Malaysia's scores for the *number of patents*, *scientific publications* and *books*. This may partly reflect the country's low ranking for *public spending on R&D* (at 21st out of 24 economies).[2] However, in recent years, the authorities have made good progress in improving IPR legislation, which may boost the number of patent applications. In addition, an acceleration in economic activity may see both measures increase in the coming years.

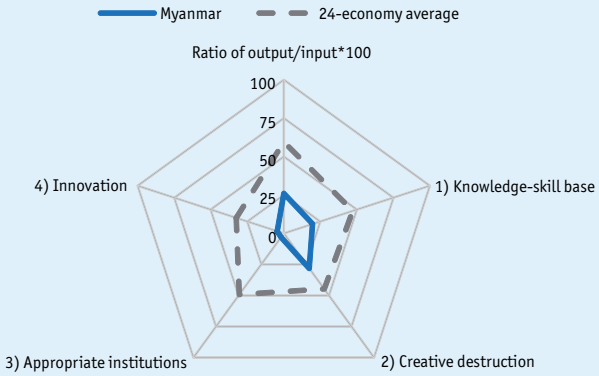
[1] The Economist Intelligence Unit, Malaysia Country Forecast, December 2013.

[2] World Intellectual Property Organization, "Statistical country profiles: Malaysia," available from http://www.wipo.int/ipstats/en/statistics/country_profile/countries/my.html. [Accessed: 2 February 2014.]

Myanmar — Rank: 22

Myanmar, with a CPI score of 0.26, is near the bottom of the rankings. The country lags behind across all three dimensions of creative inputs and has not been able to utilise its existing inputs effectively for the generation of creative outputs.

In terms of creative inputs, the low score is attributed to the low level of infrastructure and the lack of appropriate institutions. The country lags behind substantially in the *adoption of technologies conducive to the generation and dissemination of knowledge*, with a low score on *R&D spending*, as well as a last-place ranking for both *mobile-phone-* and *Internet-penetration rates*. The absence of functioning financial institutions is a major barrier for entrepreneurial activities. Myanmar ranks lowest on all indicators of *financial institutions*, and nearly all indicators of *governance*. The abysmally low levels of protection of IP and investors, coupled with high levels of corruption and bureaucracy, provide few incentives for entrepreneurs to create new firms and undertake investments in innovation. These issues were flagged in the World Bank's *Doing Business 2013* report, in which Myanmar was ranked a dismal 182nd out of 189 economies.



Top quartile	2nd/3rd quartile		Bottom quartile	
	Human capital	31.6	Infrastructure	7.9
	Firm dynamics	40.2	Competition	16.3
			Financial institutions	0.0
			Governance	6.3

However, there is scope for improvement on a number of these fronts. In late January 2014, for example, the World Bank approved a development programme for Myanmar that will entail around US$1bn of spending on expanding the country's electricity-generation, transmission and distribution networks.[1] In addition, the government is working with the World Bank and the IMF to develop a reform programme for Myanmar's banking sector that will also allow foreign lenders to operate limited services in the country.[2] In the long term, this should improve access to credit, thereby engendering more entrepreneurialism and boosting innovation.

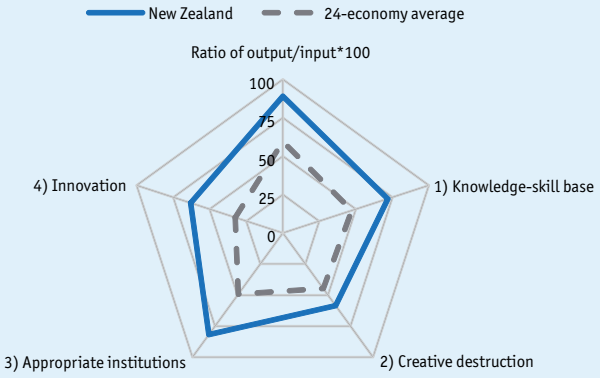
[1] World Bank (2014): "Power to people: World Bank Group to invest US$2 billion in Myanmar to support reforms, reduce poverty, increase energy and health access," press release of 26 January 2014.

[2] The Economist Intelligence Unit (2014a), "Banking reforms take shape," 29 January 2014.

New Zealand — Rank: 6

New Zealand is ranked sixth out of 24 economies and has a high level of *creative productivity*. It outperforms on most dimensions of creative inputs, but performs averagely on *infrastructure*, owing to relatively low scores on *public spending on R&D* and the *proportion of paved roads*. In terms of output, the country performs exceptionally well on *creative industry* and *agricultural outputs*. Scope for improvement remains in *scientific outputs*.

The country ranks in third place for its *human capital*, with high scores for *mean years of schooling* and the *gross enrolment ratio in secondary school*, as well as a relatively urbanised population. New Zealand's relative strengths lie in its good governance and sound financial institutions. The country has a stable democratic framework of government and an efficient, corruption-free public service and judiciary (New Zealand was ranked joint first out of 176 economies in Transparency International's 2012 Corruption Perceptions Index). The financial sector is fairly open and financial regulation is of a high standard. New Zealand's highest scores in this area are for *access to credit* and *availability of microfinance*.



Top quartile		2nd/3rd quartile		Bottom quartile
Human capital	64.2	Infrastructure	79.4	
Competition	58.6			
Firm dynamics	58.4			
Financial institutions	80.4			
Governance	83.3			

New Zealand's score for *infrastructure* should improve in the coming years. Work is under way on the government's NZ$6.5bn (US$4.7bn) Roads of National Significance programme. According to the New Zealand Transport Agency, 92% of freight (by weight) within the country is transported by road, and "With less time and money spent transporting goods, more investment can be made in productive assets and increasing wages, which continues to fuel economic expansion."[1] On the output side, more investment is needed to boost the *number of patents per capita* (the *number of IP filings* declined from 3,061 in 2011 to 2,856 in 2012)[2] and to increase innovation in the agricultural sector; although New Zealand's *cereal yield* is high, ranked behind only that of the Republic of Korea in the index, it has a score of only 51 for *agricultural value added per worker*.

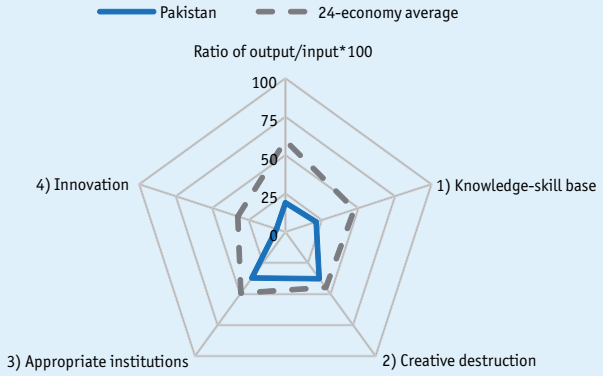
[1] NZ Transport Agency (2013), "Roads of national significance," updated 10 September 2013, available at http://www.nzta.govt.nz/network/rons/. [Accessed 3 February 2014].

[2] World Intellectual Property Organization, "Statistical country profiles: New Zealand," available from http://www.wipo.int/ipstats/en/statistics/country_profile/countries/nz.html. [Accessed: 3 February 2014.]

Pakistan — Rank: 23

Pakistan ranks 23rd out of 24 economies, with a low level of *creative productivity*. In terms of inputs, the country lags behind in the *knowledge-skill base*, with low levels of *human capital* and *physical infrastructure*. In addition, a lack of competition—particularly from abroad—provides little incentive for domestic firms to innovate. The low scores on outputs, particularly with respect to *scientific outputs* and *creative-industry goods*, are accordingly low.

Pakistan's *knowledge-skill base* is ranked 20th out of 24, above only Myanmar, Cambodia, Bangladesh and the Lao PDR. Although the country scores better for the strength of *university-industry collaboration* and the *enrolment ratio of tertiary students in science*, it has no universities in the world's top 500 and ranks poorly for the *average years of education*, as well as on indicators of secondary schooling. The country is characterised by a pool of poorly educated workers and a small well-educated elite, as the government has prioritised tertiary education at the expense of primary and secondary schooling, owing both to capacity constraints and because investment in tertiary education is more popular among Pakistan's urban elites.[1] In addition, infrastructure remains poor after decades of underinvestment. Pakistan's severely inadequate electricity supplies are of particular concern and pose a large threat to businesses and, more generally, productivity.



Top quartile	2nd/3rd quartile		Bottom quartile	
	Firm dynamics	49.2	Human capital	14.7
	Financial institutions	45.2	Infrastructure	27.5
	Governance	29.2	Competition	26.1

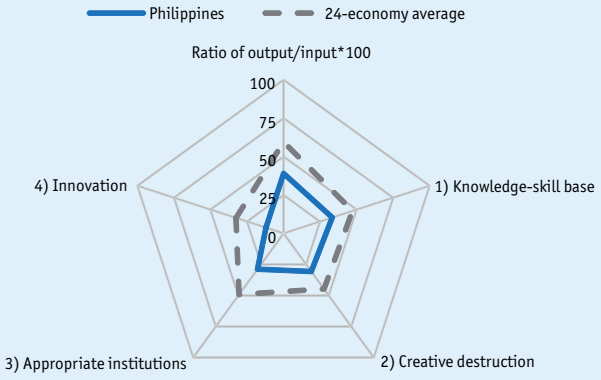
In terms of overall output, the economy ranks near the bottom of the index, at 22nd. As with several other economies, it lags behind in terms of the *number of scientific publications* and *patents*. Although it outperforms economies with higher levels of inputs, such as the Republic of Korea, in the area of scientific publications, there is scope for improvement given the country's relatively high enrolment ratio of tertiary students in science. Just 112 patent applications were filed by residents and Pakistanis abroad in 2012, down from 139 in 2011, while only 26 patents were granted in 2012. Elsewhere, the country is ranked above only Sri Lanka for the *number of films* and *books published*, indicating that more investment is needed to foster Pakistan's creative industries.

[1] The Economist Intelligence Unit, Pakistan Country Forecast, December 2013.

Philippines — Rank: 18

The Philippines is ranked 18th out of 24 economies and has a medium level of *creative productivity*. On the input side, the country's performance is average on most dimensions, but is behind on *firm dynamics*, owing to rigid labour markets and *financial institutions*, which prevent firms from accessing credit. The low-medium output score is driven by the low levels of scientific output and creative-sector goods (books and films).

The country's best scores are for *competition* and *human capital*, for which it is ranked 12th and 16th, respectively. Despite the fact that policymakers are broadly in favour of private enterprise and competition, concerns linger over the sanctity of contracts and the influence of the country's family-owned conglomerates. On the labour side, the Philippines scores relatively well for the *enrolment ratio of students in technical* and *vocational programmes*, and of *tertiary students in science*. However, this masks the fact that the country suffers from *brain drain*, with many technically skilled Filipinos emigrating to work in countries where wages are higher. According to official figures, around two-thirds of the 1.5m people who depart the Philippines each year are skilled or semi-skilled workers.[1] The country's input scores are dragged down by its inadequate financial institutions (ranked in joint last place for *access to credit*) and inflexible labour market, although the World Bank notes that the cost of firing workers is lower than in Indonesia, Thailand and Viet Nam.



Top quartile	2nd/3rd quartile		Bottom quartile	
	Human capital	34.3	Firm dynamics	25.5
	Infrastructure	32.4	Financial institutions	26.4
	Competition	35.8		
	Governance	31.3		

The Philippines' main priority output areas include the typical scientific measures of innovation, the *number of patents and scientific publications in academic journals*, and *agricultural value added per worker*. Despite the country's relatively good scores for the *enrolment ratios of students in technical and vocational programmes* and in *science at tertiary level*, it has a relatively low level of *patents* and *scientific publications*, with scores of just 0.1 and 0.3, respectively. This, combined with the large numbers of technically skilled Filipinos who take up employment abroad, including medical professionals, suggests that more investment is needed domestically to retain these workers, so that the benefits are felt at home.

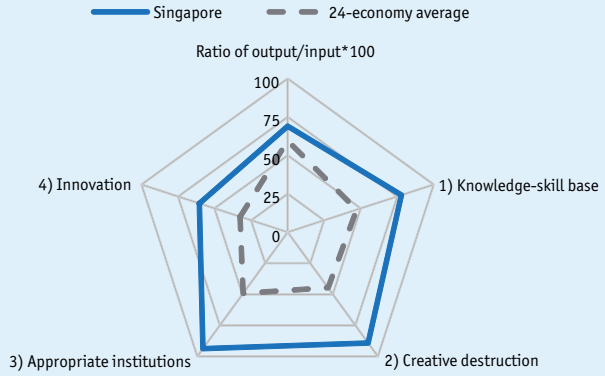
[60] The Economist Intelligence Unit, Philippines Country Forecast, December 2013.

Singapore — Rank: 10

Singapore is ranked tenth out of 24, one position ahead of the People's Republic of China and three spots behind Hong Kong, China. In terms of inputs, Singapore is at or near the top of the list on all dimensions. Nevertheless, the city-state is ranked only sixth in terms of output, highlighting the need to focus on putting existing inputs to their most effective use. On the output side, Singapore ranks near the top of the index across all macro measures of innovation, but can still improve its production of creative outputs.

In terms of macro measures of inputs, Singapore scores highest for the *appropriateness of its institutions*. The country is top-ranked for *enforcing contracts*, *IP protection* (which includes a combination of comprehensive laws, strict enforcement and stiff penalties)[1] and *investment-protection schemes*. In addition, Singapore has a strong reputation for political and institutional effectiveness, and corruption is very rare (it was ranked fifth out of 176 economies in Transparency International's 2012 Corruption Perceptions Index). The city-state also leads the rankings on both measures of *firm dynamics*, indicating a very flexible labour market. Although the government has increased the levy on local companies employing foreign workers, following public resistance to rapid immigration in recent years, it will continue to try to attract skilled workers in order to offset the shrinking of the working-age population.

Although Singapore scores well on most measures of innovation, particularly *scientific publications in academic journals* and the *sophistication of its exports*, some of its output scores remain below potential. Despite the fact that the number of *IP filings per capita* is relatively high, at 4,826 in 2012,[2] patent applications remain below those in Japan, the Republic of Korea and Taipei,China, all of which are ranked below Singapore on all macro measures of inputs. In Asia, Singapore also ranks below Hong Kong, China and Australia for the *number of books and films produced per 1,000 people*. However, in 2002 the Singaporean government announced its Creative Industries Development Strategy, with the aim of raising the economic contribution of arts and culture, design and media.[3] The first development of Mediapolis, an ambitious studio village promoted by the government and intended to attract film and other media corporations, opened in mid-January 2014, and will host, among others, The Walt Disney Company.[4]



Top quartile		2nd/3rd quartile	Bottom quartile
Human capital	63.1		
Infrastructure	92.8		
Competition	78.5		
Firm dynamics	100.0		
Financial institutions	89.8		
Governance	97.9		

[1] The Economist Intelligence Unit, Singapore Country Commerce, June 2013.

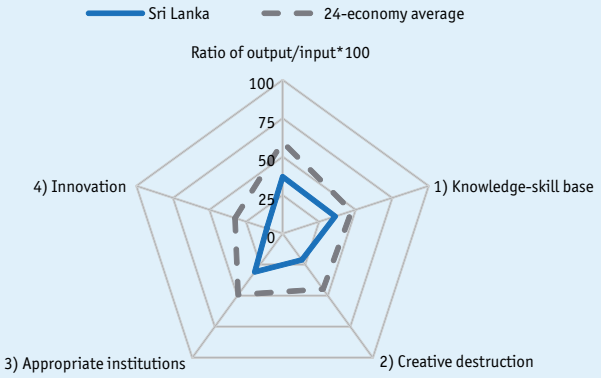
[2] World Intellectual Property Organization, "Statistical country profiles: Singapore," available from http://www.wipo.int/ipstats/en/statistics/country_profile/countries/sg.html. [Accessed: 4 February 2014.]

[3] Ministry of Communications and Information (2002): "Creative Industries Development Strategy", September 2002, available from http://www.mci.gov.sg/content/dam/mica_corp/Publications/MasterPlan/Download/Download1/ERCSubCommitteeon%20CreativeIndustriesDevelopment%20Strategy.pdf. [Accessed: 17 August 2014.]

[4] Channel NewsAsia (2014): "S'pore equipped to take on large-scale film and TV productions," 15 January 2014, available from http://www.channelnewsasia.com/news/singapore/s-pore-equipped-to-take/955124.html. [Accessed: 17 August 2014.]

Sri Lanka — Rank: 19

Sri Lanka is ranked 19th out of 24 economies in terms of its *creative productivity*, between the Philippines and Bangladesh. The country performs averagely in the provision of the *knowledge-skill base* and *appropriate institutions*, but challenges remain in its sluggish *creative destruction*, driven by the rigid labour market and the poor quality of its financial institutions. On the output side, Sri Lanka's pressing areas are scientific output and creative-industry goods.



Top quartile	2nd/3rd quartile		Bottom quartile	
	Human capital	40.2	Firm dynamics	11.9
	Infrastructure	31.7	Financial institutions	16.1
	Competition	30.7		
	Governance	45.8		

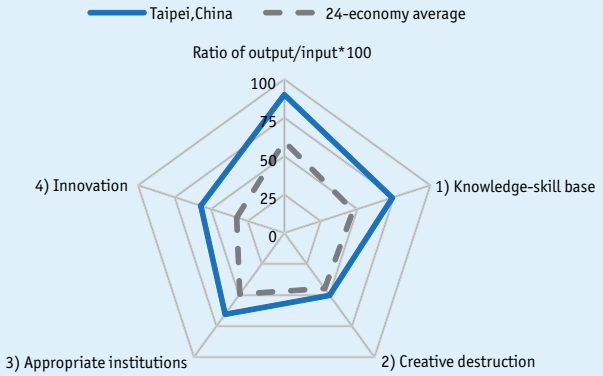
Although Sri Lanka has fairly well-developed competition laws, enforcement is lax, as reflected in the country's middling score for competition in the CPI. Its *human capital* score is average, with a ranking of 12th out of 24. But the problem of labour shortages in a number of sectors that require specific skills, typically IT and English-language skills, which is exacerbated by outward migration, is highlighted by the country's low score for *technical and vocational enrolment in secondary school*. There is scope for improvement in tertiary education, however, as the government is moving to open the sector to private foreign investment.[1]

Sri Lanka's low overall ranking is also characterised by its poor *firm dynamics*, which means that innovation is not encouraged. On the labour side, productivity is hampered by the country's large number of holidays and generous leave entitlements. Productivity remains relatively low in areas such as *agriculture*; the country has an average score for overall *agricultural productivity*, but *agricultural value added per worker* is still poor. Sri Lanka's low rankings for both measures of *scientific output* show that more investment is needed to encourage scientific innovation (the country's score for *public spending on R&D* is only 7.6). It is also ranked at the bottom of the index for *films produced per 1,000 population*, which shows that Sri Lanka's creative industry remains nascent.

[1] The Economist Intelligence Unit, Sri Lanka Country Forecast, November 2013.

Taipei,China — Rank: 5

Taipei,China is ranked fourth out of 24 and third among the Asian economies for *creative productivity*. The economy is characterised by an outstanding level of *human capital*, as well as high scores on the remaining input dimensions. In terms of output, Taipei,China performs exceptionally on *scientific output* and *agricultural productivity*, but can still improve its creative-industry performance.



Top quartile		2nd/3rd quartile		Bottom quartile
Human capital	70.9	Infrastructure	77.1	
		Competition	57.7	
		Firm dynamics	42.9	
		Financial institutions	66.5	
		Governance	64.6	

The workforce of Taipei,China is well educated and very urbanised, while the high score for *Mincerian returns on education* (behind only Sri Lanka and Indonesia) shows that further study is highly valued by local employers. Taipei,China also tops the ranking for *enrolment of students in technical and vocational programmes*. This is likely partly to reflect the fact that some of its sectors, notably manufacturing, compete with other low-cost locations in Asia (particularly the People's Republic of China and the Republic of Korea) and technological innovation is, therefore, needed to ensure its attractiveness to firms. The island's already good-quality infrastructure is likely to improve further with planned expansions to some of its busiest harbours and airports. However, despite Taipei,China's seventh-place ranking in terms of *competition*, the share of *FDI in total investment* remains very low, with a score of only 1.4.

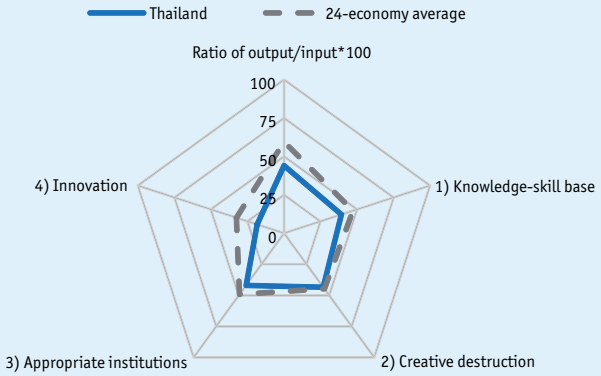
The island lags behind one of its main competitors, the Republic of Korea, for *innovation*. Although it outperforms that country on measures such as *agricultural productivity and distance from the TFP frontier*, its output of traditional creative-industry products is low. In particular, at 20th place Taipei,China's level of *film production* remains poor. The nascent film industry lacks adequate investment and appropriate policies to support its expansion. To this end, in December 2013 the island's Financial Supervisory Commission announced plans to double funding for the creative sector (including films, television, and cultural and creative goods) to NT$360bn (US$12.1bn) within three years, by encouraging support from domestic banks.[1]

[1] Commercial Times, 6 December 2013.

Thailand — Rank: 15

Thailand is ranked 15th out of 24 economies and has a medium level of *creative productivity*. On the input side, Thailand performs averagely, but is not able to generate the corresponding level of creative outputs. On the output side, major challenges lie in its low *agricultural productivity* (particularly the low *value added per worker*), although Thailand performs relatively well in terms of macro measures of innovation.

The country is ranked relatively highly in terms of competition, at tenth (with a score of 46.3). This reflects the government's efforts to attract higher levels of value-added investment and to reduce tariffs, in line with its obligations as a member of the Association of Southeast Asian Nations (ASEAN).[1] A number of industries have been liberalised and several state monopolies have been dismantled over the past two decades, but barriers remain in the form of political and public resistance. In addition, Thailand's labour market is relatively flexible, and its infrastructure is of average quality compared with the other economies in the index, with further improvements in transport networks and Internet infrastructure expected over the medium term.



Top quartile	2nd/3rd quartile	Bottom quartile
	Human capital	32.7
	Infrastructure	45.9
	Competition	46.3
	Firm dynamics	40.8
	Financial institutions	42.3
	Governance	41.7

Efforts are needed to increase innovation in the agricultural sector. Thailand is ranked 20th for agricultural productivity, and has a low score for *value added per worker*, of just 1.6. This largely reflects the deep pool of agricultural workers, the seasonality of agricultural production and the nature of the crops Thai farmers choose to produce.[2] Crops such as rice, maize and sugarcane are not difficult to process, and, once they become tradeable commodities, "Any additional comparative advantage for Thailand is limited to market access or transportation."[3]

[1] The Economist Intelligence Unit, Thailand Country Commerce, December 2013.

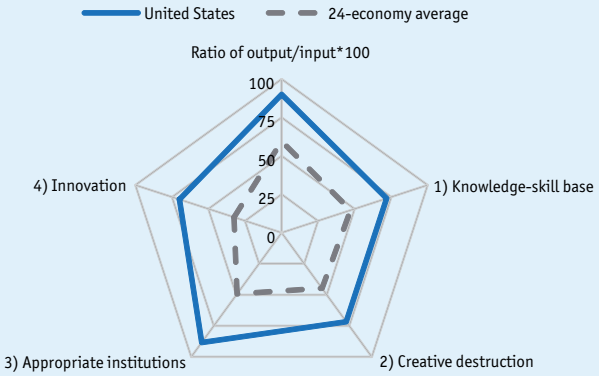
[2] Siamwalla, A. (1991): "Land-abundant agricultural growth and some of its consequences: The case of Thailand," paper presented at IFPRI conference on "Agriculture on the road to industrialization," held in Taipei,China 4-7 September 1990, available from http://econ.tu.ac.th/archan/rangsun/ec%20460/EC%20460%20Readings/Thai%20Economy/Agriculture/Agricultural%20Growth/Land-Abundant%20Agr%20Growth%20and%20Consequences.pdf. [Accessed: 17 August 2014.]

[3] Falvey, L. (2000): "Thai agriculture: Golden cradle of millennia," Bangkok: Kasetsart University Press.

United States

Rank: 4

The United States is ranked fourth among the 24 economies featured in the CPI. Although the United States is ranked higher in the provision of inputs than Finland, it is less able to employ these high levels of input efficiently to generate comparable per-capita levels of creative outputs. The United States performs exceptionally well on *agricultural productivity* and *macro measures of innovation*, but the relatively low score on *creative-industry outputs* may indicate further scope for improvement.



Top quartile		2nd/3rd quartile	Bottom quartile
Human capital	60.8		
Infrastructure	83.2		
Competition	69.3		
Firm dynamics	74.1		
Financial institutions	85.1		
Governance	91.7		

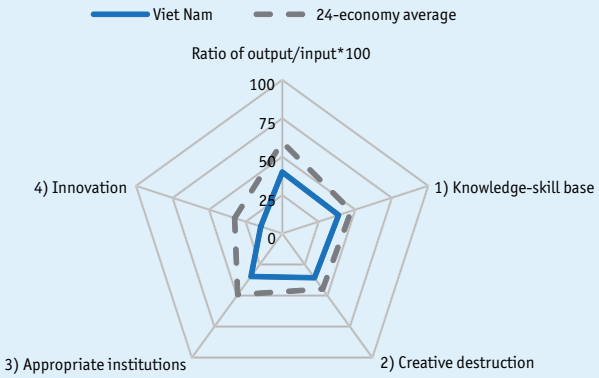
The country scores highly for *human capital*, topping the ranking for the *number of top-500 universities*, *mean years of schooling* and scoring only below Finland for the *strength of university-industry collaboration*. However, it lags behind a number of other countries in terms of the *number of students enrolled in technical and vocational programmes* and in *science courses at tertiary level*. With its effective policymaking, transparent legal system, high degree of investment openness and low levels of corruption (it was ranked 19th out of 176 economies in Transparency International's 2012 Corruption Perceptions Index), the United States scores near the top of the list for its sound institutions. The country is especially notable for its high level of *competition*, ranking in third place for this indicator, with the government participating only as regulator.[1] However, there is scope for improvement in other micro measures of input, including broadband-Internet penetration, mobile-phone subscriptions and trade intensity—the United States ranks last for the last of these indicators.

The United States ranks third out of 24 for *innovation*, behind Finland and Hong Kong, China. Firms are encouraged to invest and innovate by the relaxed regulatory environment. In addition, the flexible labour market (owing to light labour regulation) engenders easy staff turnover, creating an environment that is conducive to innovation. Through its development of its ICT sector into a global leader, the United States has been able to reap large efficiency gains through the adoption of ICT in other sectors. Although the number of working-age Americans as a proportion of the total population is declining, with a score of 33.2 for this micro measure, innovation and increases in labour productivity are offsetting this trend.

[1] The Economist Intelligence Unit, United States Country Commerce, May 2013.

Viet Nam — Rank: 16

Viet Nam is ranked 16th out of 24 economies, meaning that it has a medium level of *creative productivity*. Although the country is average in terms of overall inputs, challenges remain in the provision of *human capital*, owing to relatively low scores on the *quality* and *extent of tertiary education*. Correspondingly, Viet Nam's main weakness on the output side is the low level of *scientific outputs*.



Top quartile	2nd/3rd quartile		Bottom quartile	
	Infrastructure	50.1	Human capital	27.2
	Competition	31.4		
	Firm dynamics	40.1		
	Financial institutions	31.6		
	Governance	37.5		

Viet Nam's *human capital* is poor, with a score of 27.2 out of 100. The country performs unimpressively across most micro measures of human capital, with the exception of the *size of its working-age population as a proportion of the total*. Although more than 90% of the population is literate, Viet Nam's school system and curricula are outdated.[1] There is a general lack of skills in services, IT and banking and finance, as reflected in the country's low score for *enrolment in technical and vocational programmes*. In addition, despite Viet Nam's average score for *firm dynamics*, the risk of worker unrest is rising and is a source of growing concern for firms.

On the output side, Viet Nam's low ranking for innovation is driven by poor scientific output, including *patents and scientific publications in academic journals*. The number of IP filings has fluctuated in the past decade (declining sharply in 2006), although it rose from 322 in 2011 to 424 in 2012.[2] Nevertheless, this pales in comparison with the number of patent applications for the top two countries for this indicator, Japan and the Republic of Korea, with 486,070 and 203,410 in 2012, respectively. In order to boost scientific output, and given Viet Nam's low scores for the quality of its tertiary education, more investment at higher-education level is required to facilitate greater enrolment of students in science-oriented programmes.

[1] The Economist Intelligence Unit, Vietnam Country Forecast, September 2013.

[2] World Intellectual Property Organization, "Statistical country profiles: Viet Nam," available from http://www.wipo.int/wipolex/en/profile.jsp?code=VN. [Accessed: 6 February 2014.]

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