INNOVATIVE ASIA: ADVANCING THE KNOWLEDGE-BASED ECONOMY

Country Case Studies for the People's Republic of China, India, Indonesia, and Kazakhstan

ASIAN DEVELOPMENT BANK

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Foreword

Asia has enjoyed such spectacular economic growth over the past 3 decades that we expect most of our developing member countries to have attained middle-income status by 2020. However, this means their development challenges will be more complex. First, they need to avoid becoming stuck in the middle-income trap. Second, they need to engineer a shift from mainly agricultural output and jobs to manufacturing and high-productivity services at a time when resources are becoming strained and skills of the workforce are reaching their limits. Building knowledge-based economies is therefore the most sustainable way of ensuring strong, long-term growth. It is with this thinking in mind that the Asian Development Bank prepared the study *Innovative Asia: Advancing the Knowledge-Based Economy.*

Building such an economy is difficult and multifaceted; it requires quality and accessible higher education, sound information infrastructure, strong research and development, persistent innovation, and the right economic institutions to support it all. Major countries in the Organisation for Economic Co-operation and Development, where more than 50% of gross domestic product is knowledge-based, have these attributes and successfully completed their structural transformations decades ago.

We have good examples in Asia also and lessons can be drawn from the experiences of Japan; the Republic of Korea; Singapore; Hong Kong, China; and Taipei,China, which all rank highly in the Knowledge Economy Index. The Republic of Korea, for one, has shown us that building a labor force capable of supporting sustained growth requires the correct mix of quality skills and knowledge. It has also exhibited the benefits of investing in information and communication technology (ICT) infrastructure. Singapore, similarly successful, has meanwhile shown the value of adopting and absorbing the latest technologies and building a highly efficient public sector that works seamlessly with the private sector to promote knowledge development.

Developing Asia is at a unique moment in history. Technological trends will help developing economies jump traditional development stages, redefining traditional patterns of growth and amplifying the potential that exists within these economies today. Moreover, strengthening information networks, particularly through mobile technologies that have the capacity to reach even the remotest customer in the poorest countries of the region, is a technology option that can serve both economic and social development needs. Rethinking education delivery using ICT platforms and tools to better prepare youth and employees for the changing demands of the workplace is another technology-based solution for growth with equity. There are also significant business opportunities in using innovative products and technologies to serve both price-sensitive customers at the bottom of the pyramid and the large and growing base of middle-class consumers.

True transformation into a knowledge-based economy does not mean merely the production of knowledge-intensive goods and services; rather, knowledge must be internalized and disseminated throughout the economy. Asia is home to some of the world's largest developing economies, but many countries—big and small—fall way below Organisation for Economic Co-operation and Development levels in rankings of knowledge-based economies. We need to close the gap between economic size and knowledge to be able to sustain Asia's growth. To do this, the choice of policy mix is critical.

My hope is that this study triggers a healthy debate on exactly how Asia should move forward as a collection of vibrant knowledge-based economies. We must understand the trade-offs and alternative scenarios at play. We need to identify the disruptive technologies which can change the rules of the game. We should also learn how to spur the entrepreneurial spirit needed for innovative thinking. A large part of that is encouraging critical thinking on how to create world-class tertiary education institutions, promote innovation, and strengthen ICT infrastructure in Asia in order to produce a workforce for the future. Finally, I hope that this study will convince both policy makers and the private sector to invest in research and development to allow Asian countries to leapfrog old technology.

We were fortunate to receive insights and guidance from the High-Level Panel for this study, led by Kishore Mahbubani of the Lee Kuan Yew School of Public Policy of the National University of Singapore and Lawrence Summers of Harvard University, together with eminent experts Dominic Barton, Han Duck-soo, Takatoshi Ito, K. Vaman Kamath, Justin Yifu Lin, Mari Pangestu, and Andrew Sheng.

The study's final report is presented in two volumes:

- Innovative Asia: Advancing the Knowledge-Based Economy – The Next Policy Agenda
- Innovative Asia: Advancing the Knowledge-Based Economy – Country case studies from the People's Republic of China, India, Indonesia, and Kazakhstan

In addition, the Asian Development Bank engaged the Economist Intelligence Unit to construct a new Creative Productivity Index. The report *Analysing Creativity and Innovation in Asia,* prepared by the Economist Intelligence Unit, highlights the importance of productivity and efficiency of various investments that contribute to knowledge-based economic development.

We hope this study will stimulate further discussion in the emerging economies of Asia on strategic choices and pathways to strengthen knowledge-based economic development for everyone.

Bindu N. Lohani
Vice-President, Knowledge Management and Sustainable Development
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Acknowledgments

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The reports *Innovative Asia: Advancing the Knowledge-Based Economy – The Next Policy Agenda*

and *Innovative Asia: Advancing the Knowledge-Based Economy – Country Case Studies for the People's Republic of China, India, Indonesia, and Kazakhstan* were prepared by Shanti Jagannathan, Senior Education Specialist, Regional and Sustainable Development Department, ADB, Team Leader for this project. Members of the ADB team who worked on this study include Donghyun Park (co-Team Leader), Principal Economist, Economics and Research Department, ADB and Seok Yong Yoon, Senior Public Management Specialist, Regional and Sustainable Development Department, ADB. Carmela Fernando Villamar provided coordination and research support throughout the study.

Consultants:

Carl Dahlman, Jae Moon, Ron Perkinson, and Poh Kam Wong participated and contributed to this policy research study as a whole. The experts who contributed to the four country case studies are Yang Yao (People's Republic of China), Arpita Mukherjee (India), Hafid Abbas (Indonesia), and Oraz Jandosov (Kazakhstan). Rudai Yang and Binkai Chen (People's Republic of China), Tanu Goyal (India), Mohamad Fahmi (Indonesia), and Kassymkhan Kapparov (Kazakhstan) also contributed to the respective country reports.

Ross O'Brien provided editorial and infographic support.

Abbreviations

ADB	–	Asian Development Bank
ASEAN	–	Association of Southeast Asian Nations
COE	–	center of excellence
EIR	–	economic incentive and institutional regime
FDI	–	foreign direct investment
GDP	–	gross domestic product
ICT	–	information and communication technology
IFC	–	International Finance Corporation
IPR	–	intellectual property right
ITeS	–	information technology–enabled services
KBE	–	knowledge–based economy
MOOC	–	massive open online courses
MOE	–	Ministry of Education
MOIIT	–	Ministry of Industry and Information Technology
MOST	–	Ministry of Science and Technology
OECD	–	Organisation for Economic Co–operation and Development
PPP	–	purchasing power parity
PRC	–	People's Republic of China
R&D	–	research and development
SEZ	–	special economic zone
SMEs	–	small and medium–sized enterprise
SOE	–	state-owned enterprises
STEM	–	science, technology, engineering and mathematics
TVET	–	technical and vocational education and training

Introduction

Knowledge and innovation are widely acknowledged as key drivers of growth and economic development. The economies of Asia and the Pacific have been steadily growing in prominence in terms of share of global gross domestic product (GDP), which increased from 21% in 1980 to 38% in 2012, but they need to pursue knowledge-based economic development to sustain their high rates of growth. The share of developing Asia in global GDP has also risen sharply from 8% to 26% in the same period, and is expected to reach 30% by 2017 (IMF 2012).[1] The *Asia 2050* report of the Asian Development Bank (ADB) projects that if Asia continues to grow on its recent trajectory, it could account for 52% of global GDP by 2050 in purchasing power parity (PPP) terms (ADB 2011).[2] However, the *Asia 2050* report concludes that an "Asian Century" is by no means preordained: Asia's continued ascent is predicated upon the ability of the region's economies to transform themselves effectively into knowledge-based economies (KBEs). Pursuing a development process driven by effective creation, dissemination, and application of knowledge will be necessary to turn the growth potential into reality.

This report argues that it is absolutely essential for emerging economies in Asia to transition into KBEs to sustain their economic development, while preparing effectively for the future challenges of an increasingly connected global economy. In fact, pursuing KBE development could help emerging economies effectively position themselves better to capitalize on market opportunities by using their unique endowments and strengths. The times are opportune for Asia to accelerate KBE development.

Emerging economies in Asia need to have new models of growth and development to maintain the robust rates of growth experienced in recent times. Structural policy reforms are required to ensure productivity growth. Reforms are also needed for economic upgrading to move the region's economies up the global value chains of more sophisticated products and services. Countries need become competitive in technology-intensive sectors. This report presents the case studies for four countries at the middle-income level—People's Republic of China, India, Indonesia, and Kazakhstan—in their KBE approaches and identifies a range of policies and initiatives they need to consider to make a transition to high-income levels.

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1 IMF. 2012. World Economic Outlook: Coping with High Debt and Sluggish Growth.

2 Asian Development Bank. 2011. Asia 2050: Realizing the Asian Century.

Measuring Knowledge-Based Economies

A knowledge-based economy (abbreviated throughout this report as KBE) describes an economy that uses information resources—technologies, skills, and processes—to achieve and accelerate economic growth potential. This report adopts the following definition which combines World Bank and OECD descriptions:

A knowledge-based economy is one that has an economic and institutional regime that stimulates the acquisition, creation, dissemination, and use of knowledge and information to improve its growth and welfare, as well as effective systems of education and skills, information and communication technology (ICT), research and development (R&D), and innovation.

In order to measure and monitor progress of economies as KBEs, the World Bank developed the Knowledge Economy Index (KEI), using a four-pillar framework (World Bank 2012b):[3]

1. An ***economic incentive and institutional regime*** to provide incentives for the efficient use of new and existing knowledge and the flourishing of entrepreneurship

2. An ***educated and skilled population*** to create, share, and use knowledge well

3. An efficient ***innovation and technological adoption system*** of firms, research centers, universities, consultants, and other organizations to tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology

4. ***Information and communication technology*** to facilitate the effective creation, dissemination, and processing of information

The KEI includes subindices for the four pillars of economic incentive and institutional regime, education and training, innovation and technological adoption, and ICT infrastructure. Table 1 gives details on the composition of the KEI.

[3] World Bank. 2012. Knowledge Economy Index 2012 Rankings.

Table 1: The Knowledge Economy Index Taxonomy

Pillar	Rationale	Indicators
Economic incentive and institutional regime	An economic incentive and institutional regime provides incentives for the efficient use of new and existing knowledge, and the flourishing of entrepreneurship.	• Tariff and nontariff barriers • Regulatory quality • Rule of law
Education and skills of population	An educated and skilled population creates, shares, and uses knowledge well.	• Adult literacy rate • Gross secondary enrollment rate • Gross tertiary enrollment rate
Innovation and technological adoption system	An efficient innovation system of firms, research centers, universities, consultants, and other organizations taps into the growing stock of global knowledge, assimilates and adapts it to local needs, and creates new technology.	• Royalty payments and receipts ($ per person) • Technical journal articles per million people • Patents granted to nationals by the United States Patent and Trademark Office per million people
Information and communication technology infrastructure	Information and communication technology facilitates the effective creation, dissemination, and processing of information.	• Telephones per 1,000 people • Computers per 1,000 people • Internet users per 1,000 people

Note: The World Bank developed the Knowledge Economy Index (KEI), an indicator of the knowledge economy based on these four pillars and uses that index to benchmark economies.
Source: World Bank Knowledge Assessment Methodology and Knowledge Economy Index.

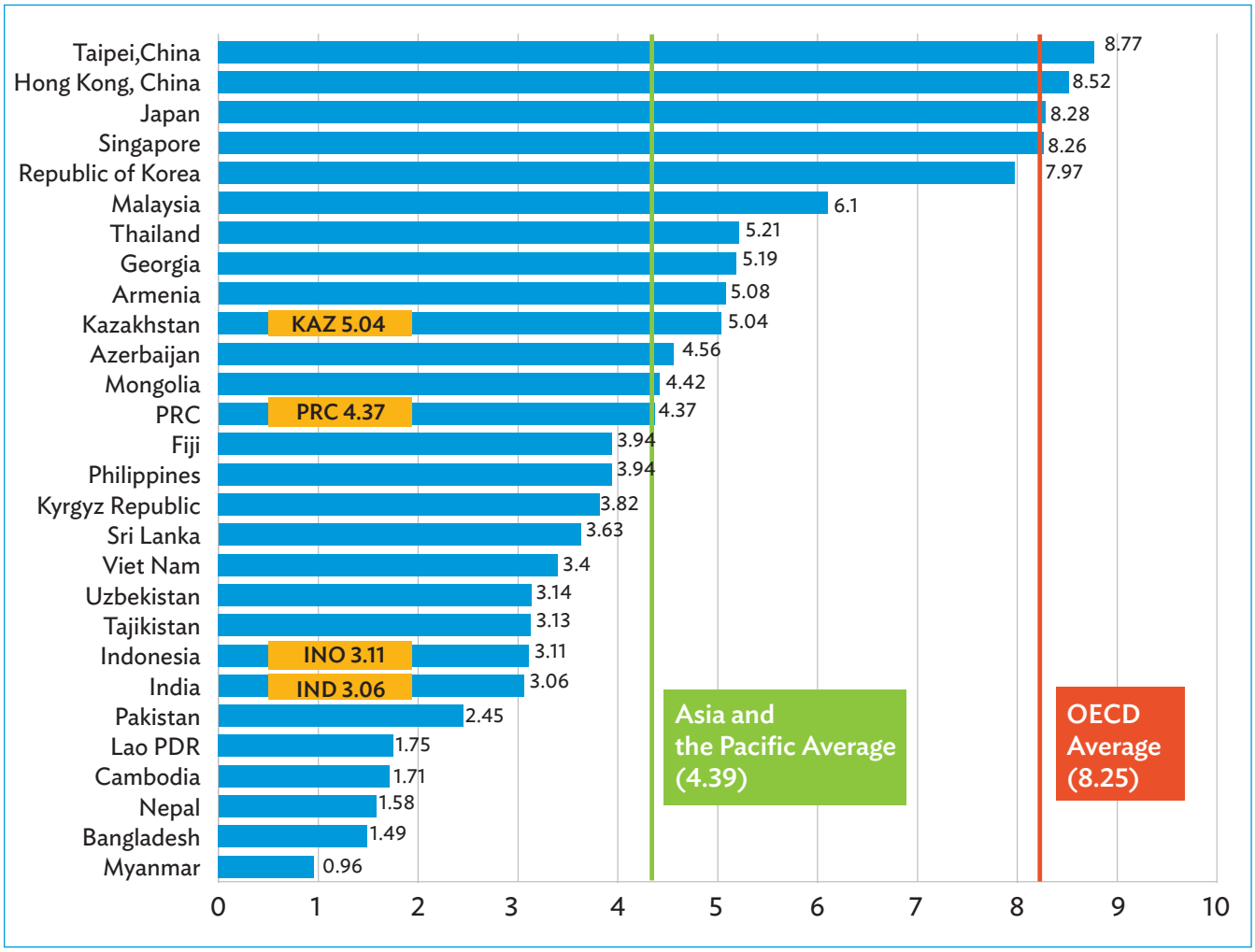
State of Emerging Economies of Asia in the Global Knowledge-Based Economy

In this volume, we review the performance of four economies—the People's Republic of China (PRC), Indonesia, India, and Kazakhstan—in knowledge-based economic growth. Using the framework of the aforementioned Knowledge Economy Index (KEI), we capture the main challenges that these middle income economies face in their future transition to higher levels of development. The report outlines key guidelines these four economies need to consider across the four pillars of the knowledge economy in order to pave the way for them to advance toward high-income economies. The report attempts to capture the substantial progress and foundation these economies have already laid and how that can provide a springboard to further progress.

A companion volume, *Innovative Asia: Advancing the Knowledge-Based Economy – The Next Policy Agenda*, argues that it is absolutely essential for emerging economies in Asia to transition into knowledge-based economies (KBE) to sustain their economic development, while preparing effectively for the future challenges of an increasingly connected global economy. The study has assessed the current state of KBEs in a number of developing Asian economies and has benchmarked them with advanced countries. The KEI levels of a number of Asian economies are compared with seven comparator developed economies: Finland; Hong Kong, China; Japan; the Republic of Korea; Singapore; Taipei,China; and the United States. The report stresses that pursuing KBE development could help emerging economies effectively position themselves better to capitalize on market opportunities by using their unique endowments and strengths and that the times are opportune for Asia to accelerate KBE development.

A review of the four countries on the KEI reveals that they perform far lower on the overall KEI than the Organisation for Economic Co-operation and Development (OECD) average, and in many instances below the Asia and Pacific average as well (see Figure 1). Economies of Asia and Pacific in general and the four countries in particular have a big gap with the OECD average in terms of their KEI scores. In terms of the Global Competitiveness Index, on the other hand, the gap between the average of OECD countries and the average of economies in Asia and the Pacific is not very wide. The excellent economic performance of these economies has put them closer to the OECD average (Figure 2). In terms of gross domestic product (GDP) using purchasing power parity (PPP), these economies perform very well. The PRC, India, and Indonesia have shown remarkable growth in GDP and have moved to dominant positions in the world economy. While the PRC is ranked 2nd in the world in terms of GDP using PPP, it is ranked 84th in per capita income. India is the 10th largest economy, yet its per capita income rank is 148th. Indonesia is the 16th largest economy and its per capita income rank is 119th. Unless the gap between these ranks is closed, advancing just GDP growth alone will bring a host of additional challenges. Therefore, the choice of appropriate policy mix for KBE development is critical.

Figure 1: Knowledge Economy Index Scores - Selected Economies of Asia and the Pacific

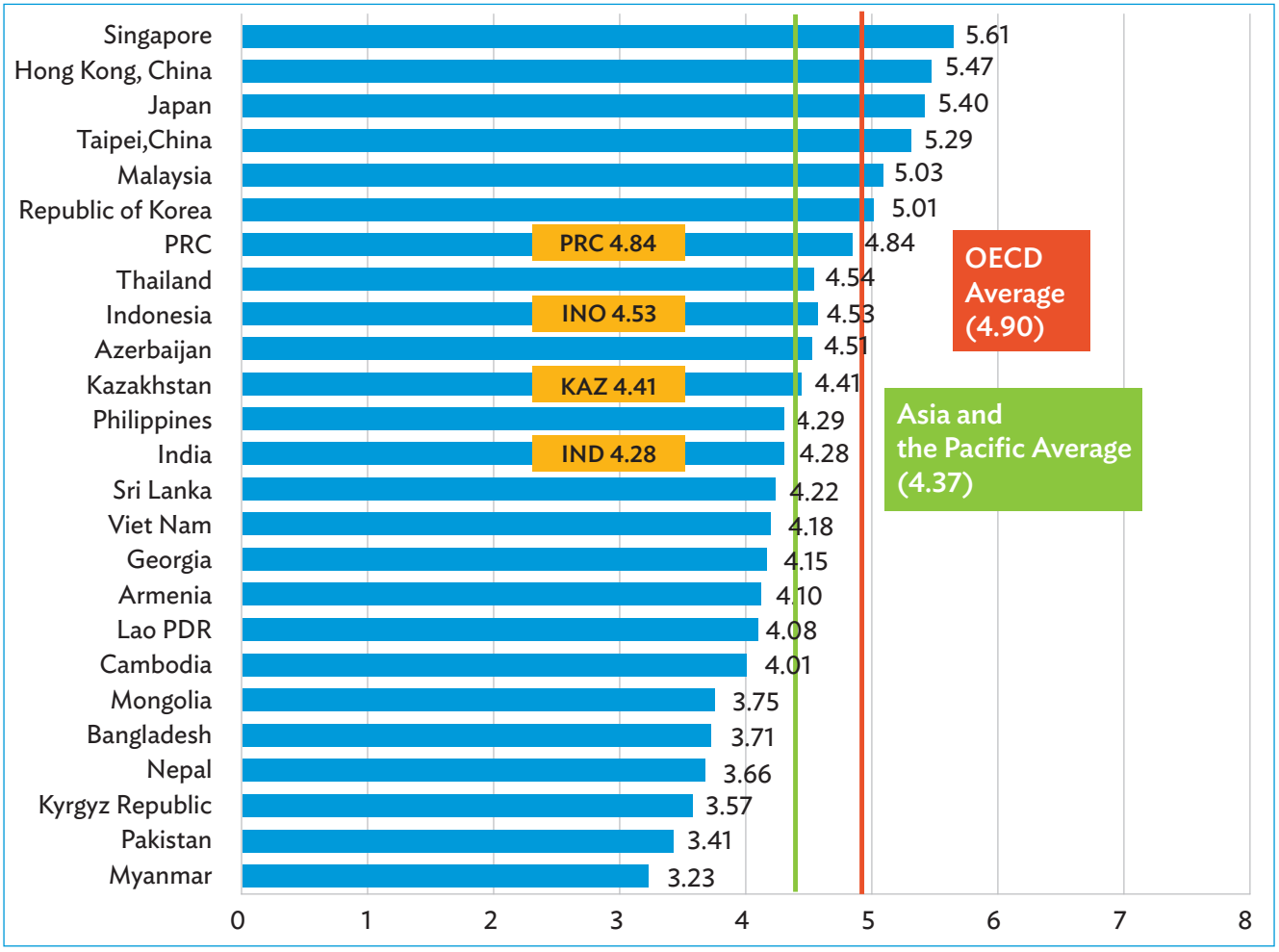


Lao PDR = Lao People's Democratic Republic, OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China.
Source: World Bank Knowledge Assessment Methodology and Knowledge Economy Indexes, with data generation and analysis from ADB. http://info.worldbank.org/etools/kam2/KAM_page5.asp

Developing Asia ranks lower than average on the various economic, social, and infrastructure indicators of the World Bank's KEI. The Asia and the Pacific average KEI score is almost half the OECD average KEI score (Figure 1). A comparison of Asia and the Pacific and OECD in the Global Competitiveness Index shows that Asian economies are closer to the OECD average (Figure 2). Indeed, the PRC, India, and Indonesia have enjoyed some of the highest growth rates in the region. The PRC has advanced to become the second largest economy in the world, after the United States, in nominal GDP terms. However, these growth rates and economic competitiveness can be sustained into the future only by embracing a more innovation-oriented growth. An examination of the economic incentive and institutional regime, education and training, innovation, and information and communication technology (ICT) subindices of the KEI reveals that the average scores for Asian and Pacific economies are far lower than OECD averages. Specific attention to the PRC, India, Indonesia, and Kazakhstan reveals that with the exception of the PRC for innovation and Kazakhstan for ICT, these four countries score even lower than the Asia and the Pacific average

(Figures 3–6). If these middle-income economies aim to move toward high-income levels, it is crucial they close the gap with OECD averages. It is imperative that Asia's emerging economies do more to better their chances, particularly by deepening their ICT infrastructure and increasing their investment in education.

Figure 2: Global Competitiveness Index Scores, Selected Economies of Asia and the Pacific



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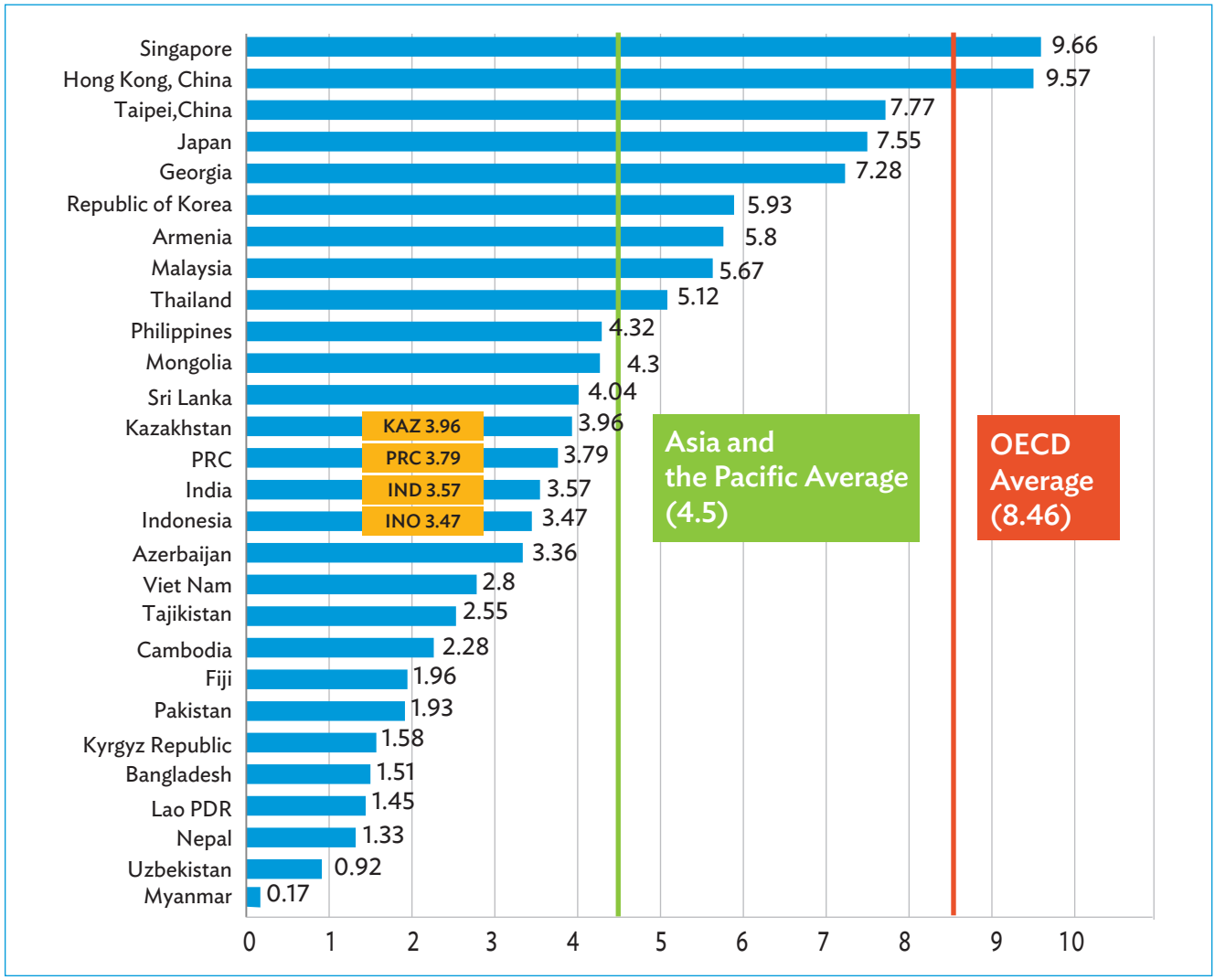
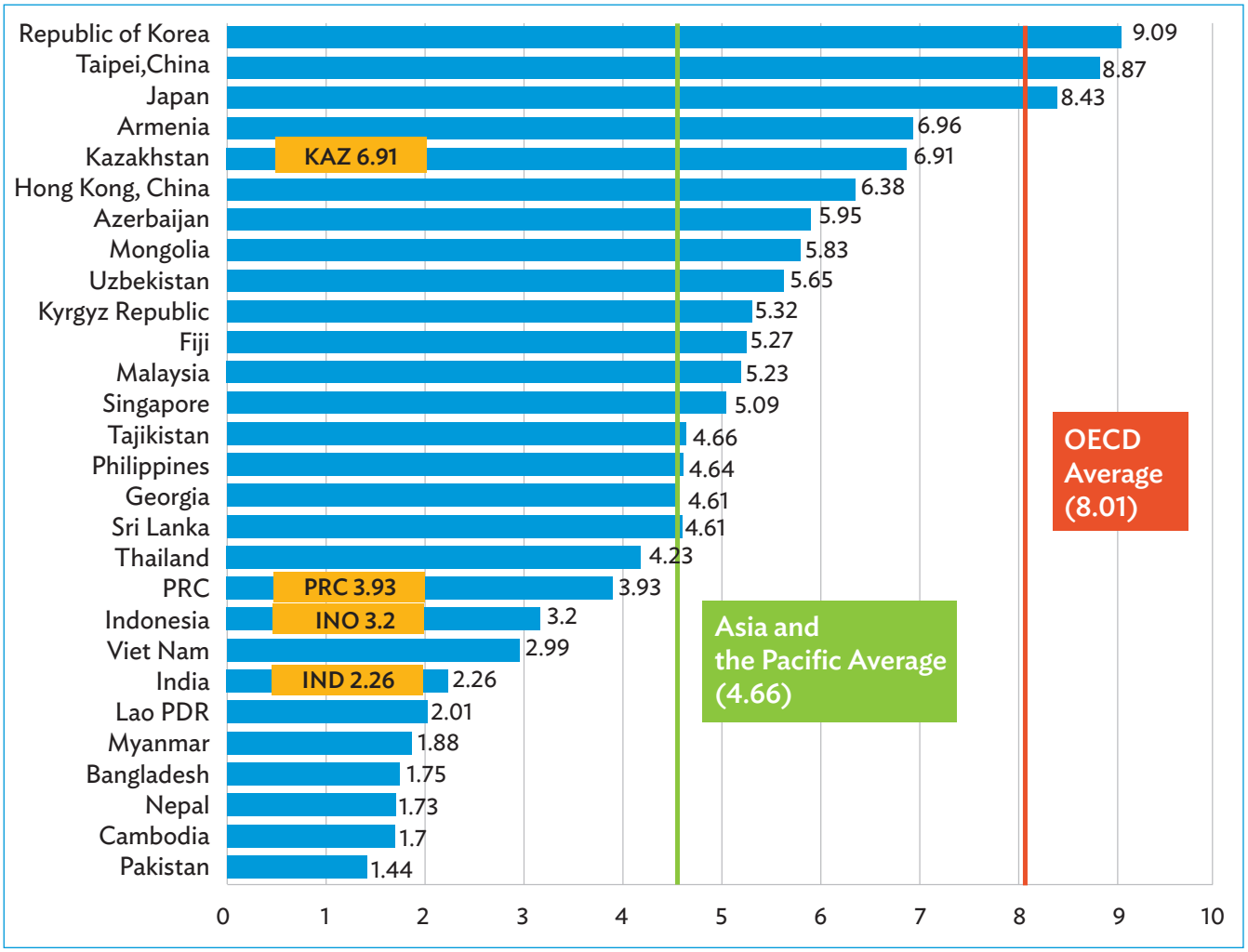
Source: World Bank Knowledge Assessment Methodology and Knowledge Economy Index with data generation and analysis from ADB. http://info.worldbank.org/etools/kam2/KAM_page5.asp

Figure 3: Economic Incentive and Institutional Regime Subindex Scores



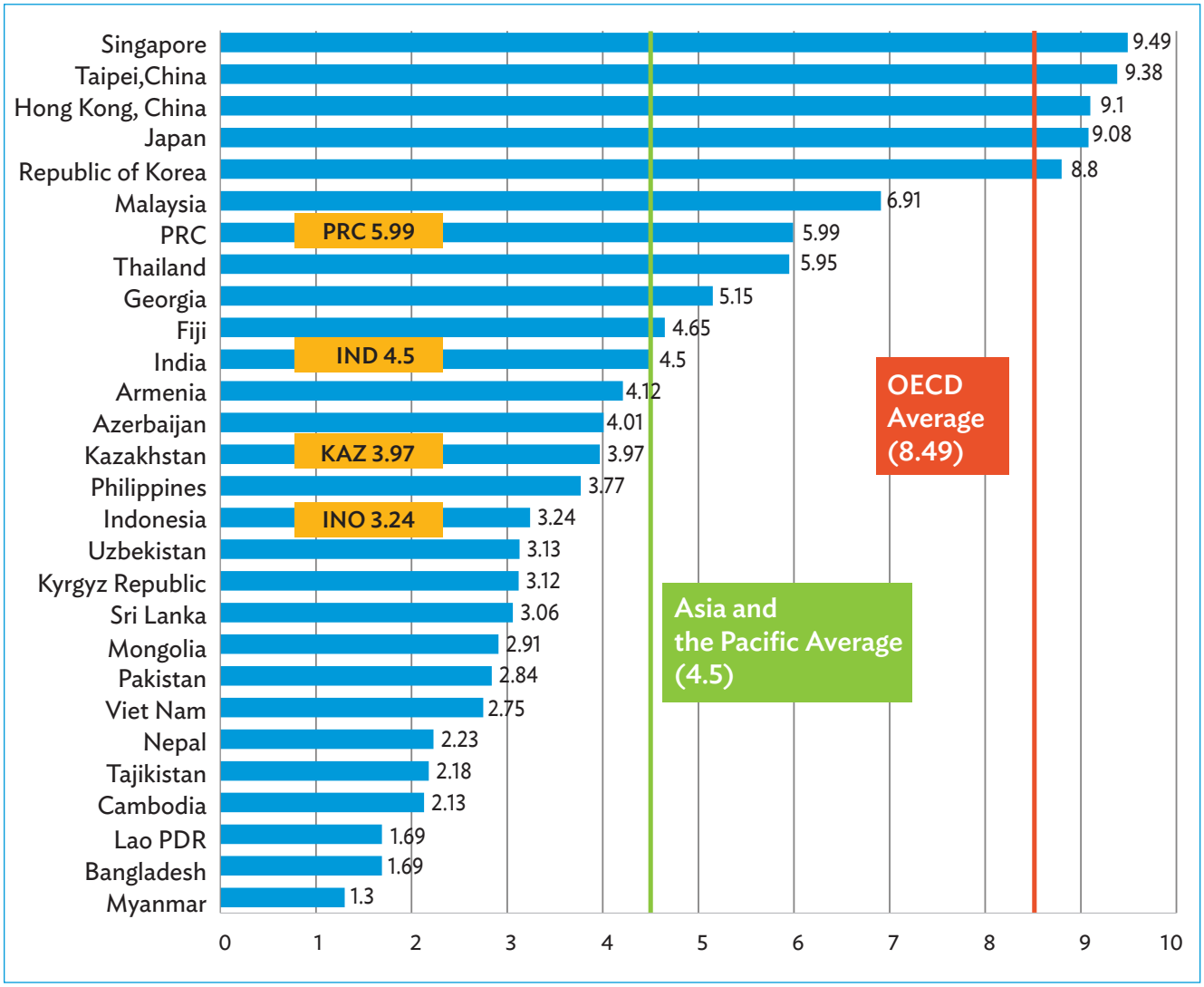
Lao PDR = Lao People's Democratic Republic, OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China.
Source: World Bank Knowledge Assessment Methodology and Knowledge Economy Indexes, with data generation and analysis from ADB. http://info.worldbank.org/etools/kam2/KAM_page5.asp

Figure 4: Education and Skill Subindex Scores



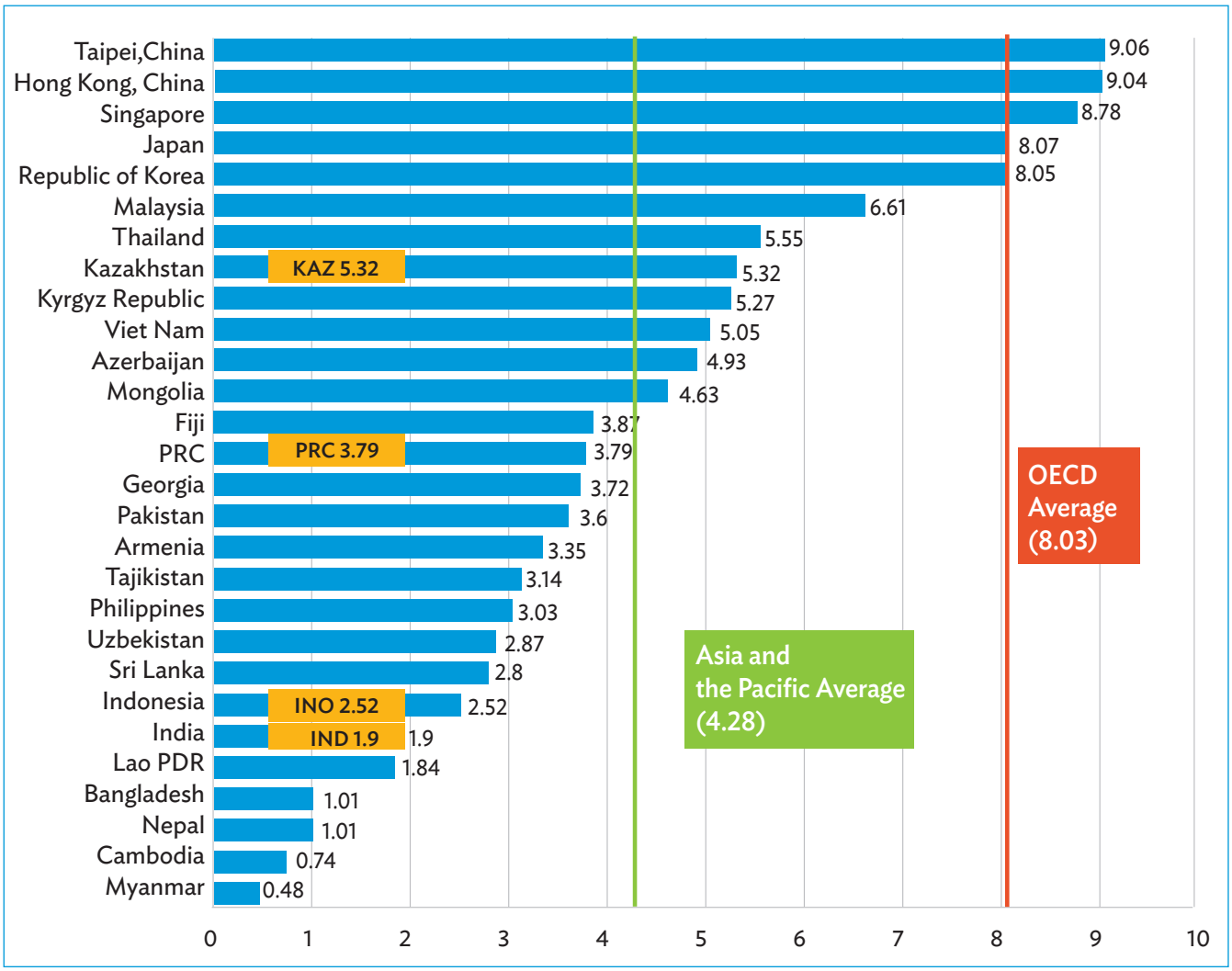
Lao PDR = Lao People's Democratic Republic, OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China.
Source: World Bank Knowledge Assessment Methodology and Knowledge Economy Indexes, with data generation and analysis from ADB. http://info.worldbank.org/etools/kam2/KAM_page5.asp

Figure 5: Innovation Subindex Scores



Lao PDR = Lao People's Democratic Republic, OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China.
Source: World Bank Knowledge Assessment Methodology and Knowledge Economy Index (http://info.worldbank.org/etools/kam2/KAM_page5.asp), with data generation and analysis from ADB.

Figure 6: Information and Communication Technology Subindex Scores



Lao PDR = Lao People's Democratic Republic, OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China.
Source: World Bank Knowledge Assessment Methodology and Knowledge Economy Indexes, with data generation and analysis from ADB. http://info.worldbank.org/etools/kam2/KAM_page5.asp

The following chapters provide case studies of four countries in the state of play of KBE development. In these four middle income countries, an assessment of the four pillars of the knowledge economy index is provided compared to advanced countries as well as key guidelines for each of the pillars. The country chapters also present promising trends related to knowledge-based economic development in the respective countries that can be amplified for the benefit of their economies.

State of the People's Republic of China's Knowledge-Based Economy

Introduction

The initiation of market reforms in the late 1970s steered the transformation of the economy of the People's Republic of China (PRC) from a centrally planned one to a market-based economy. Today the PRC stands out for its exemplary track record of growth and development in the past 3 decades. The economy has experienced a stupendous pace of economic and social development. Gross domestic product (GDP) growth in the PRC averaging about 10% a year in recent years has propelled the economy forward in many dimensions. The PRC is the world's largest manufacturing economy and the world's largest exporter, and has often been referred to as the "factory of the world." In addition, its high-technology exports as a percentage of manufactured exports increased from 10% in 1980 to 26% in 2005.[4] It overtook Japan as the world's second largest economy in 2011, and it is projected to overtake the United States (US) as the world's largest economy in the near future. Structural transformation has been rapid and the share of manufacturing and services in GDP has been steadily rising. The PRC is ranked second in the world in the 2014 Foreign Direct Investment Confidence Index by AT Kearney.

The PRC has not only distinguished itself with high rates of economic growth for the longest time of any country in the world (an average of almost 10% since 1980) but has also achieved one of the highest rates of savings and investment. As a result of its high growth rates, the PRC has increased its share of global GDP in purchasing power parity (PPP) terms from 2.2% in 1980 to 15.5% in 2013.[5] Along with economic growth, much progress was also made in poverty reduction as the PRC's poverty rate fell from 84% in 1981 to 13% in 2008. The country reduced the number of people living below $1.25 PPP per day from 835 million in 1981 to 118 million in 2009; and of those living below $2.00 PPP per day from 972 million to 272 million over the same period.[6] It also increased life expectancy from 67 years in 1980 to 75 in 2011.[7] Official aid expenditures on grants and loans are estimated to be $6 billion in 2011, with the PRC emerging as an important donor in its own right. The country has carved for itself an ever-increasing position of influence in the world economy.

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4 World Bank World Development Indicators (WDI) database.

5 International Monetary Fund Datamapper based on World Economic Outlook October 2012. http://www.imf.org/external/datamapper/index.php (accessed 11 April 2013).

6 WDI 2012, p. 72.

7 World Bank Health, Nutrition and Population Statistics Databank. http://databank.worldbank.org/data (accessed 30 October 2013)

Over the last 15 years, manufacturing has accounted for one-third of the overall economy and the share of medium- and high-tech activities in total manufacturing has remained above 40%. During this period, the PRC also transformed its export basket, which previously was dominated by labor-intensive and low-tech products (such as food and textiles), toward more medium- and high-tech products (including metal products, machinery, and electrical equipment), which have come to account for more than half of total manufactured exports. While initially the massive expansion of the manufacturing base was mainly absorbed and stimulated by external demand, since the 2008 financial crisis, domestic consumption, investments, and productivity growth have gained in importance. The PRC established itself as a manufacturing powerhouse by gaining 10% of world manufacturing value-added share and 11% of world manufacturing trade within the last 15 years (UNIDO 2013).

The PRC has also made impressive achievements in the knowledge area. It increased the average years of total education for the population over 15 years of age from 4.0 years in 1980 to 8.2 years in 2010.[8] It increased the total number of students in tertiary education from 1.0 million in 1980 to 31.0 million in 2010 (50% more than the US, which is the next highest in the world with 19 million) and increased its gross tertiary enrollment rate from 1.2% to 26.0% in the same period.[9]

There has been a dramatic increase in research and development (R&D) inputs as well as knowledge outputs such as scientific and technical journal articles, and patent and trademark applications by PRC residents. The share of GDP spent on R&D increased from 0.5% in 1990 to 1.8% in 2010. In 2012, the PRC was the second largest spender in R&D in the world in PPP terms. The PRC's share of the world's total R&D expenditure grew to 13.7% in 2012 and was second only to that of the US, whose share was 29% in 2012.

The PRC is a good example of a very poor economy that has become a global competitive power through what could be considered a very effective knowledge-based economy (KBE) strategy, although that has only been formally articulated in the last decade (Dahlman and Aubert 2001). A key element throughout this whole period consisted of gradually engaging more with the global trading system. This started by opening up four export processing zones in 1980 across Taipei,China and Hong Kong, China, and relying on foreign direct investment (FDI) to produce labor-intensive manufactured goods initially for the export market. These were expanded to 14 zones, then to more, and eventually the PRC joined the World Trade Organization in 2001. The PRC has benefited enormously from joining the global trading system. In 1980, its merchandise exports were less than 1% of global merchandise exports. In 2010, the PRC became the largest merchandise exporter in the world. And by 2012, the PRC's global export share was 12%. Moreover, manufactured exports accounted for 94% of its merchandise exports in 2012.[10]

Although the PRC's exports started as labor-intensive manufactured products, they rapidly moved up the technology ladder to more skill- and technology-intensive products. The key to the PRC's rapid progress has been that it very effectively tapped into the global market for technology through all forms, including importing capital goods and high-tech components, FDI, extensive purchasing foreign technology through technology licensing, sending students abroad for education and training, effectively using its foreign diaspora, obtaining information

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8 World Bank Education Statistics. Available at: http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=education-statistics-~-all-indicators (accessed on 11 April 2012).

9 WDI database.

10 WDI 2013, Table 4.4.

and knowledge through scientific and technical publications and the internet, and copying and reverse engineering.[11]

There has also been a dramatic increase in the penetration of mobile phones per 100 people and the percentage of the population that uses the internet. The former increased from 0.3 per 100 persons in 1995 to 81 in 2012, and the latter from virtually 0% to 42% over the same period. Although the PRC has not yet achieved the penetration rates of high-income economies (average of 122 mobile phone subscriptions per 100 people and 73% of the population being internet users in 2012),[12] it has the largest number of mobile phone and internet users in the world. Moreover, the PRC is the largest producer and exporter of electronics and communications equipment in the world (US National Science Board 2012).

In 2011, the PRC launched its 12th Five-Year Plan (2011–2015),[13] which emphasized focus on higher-quality growth, reflecting concerns about the sustainability of the country's growth in terms of pollution, energy use, and resource depletion, as well as on inclusive growth, reflecting the need to address inequality. The plan also stresses the need to facilitate the transition of the economy to greater domestic consumption. It identifies seven priority industries whose share of GDP would be raised from 2% to 8% by 2015. These include three within the theme of sustainable growth—energy conservation and environmental protection, new energy (nuclear, wind, and solar power), and clean energy vehicles—as well as biotechnology (drugs and medical devices), new materials, new information technology (broadband networks, internet security infrastructure, and network convergence), and high-end manufacturing. The government has committed a substantial amount of money to support scientific research and product development in those seven industries.

Challenges Faced by the Economy in the People's Republic of China

Slowing Growth and Need for a Different Development Model

The PRC's growth will continue to moderate over the medium term. A recent joint study by the World Bank and the PRC's Development Research Center (2012) has argued that the PRC needs to change its development strategy, which has served it so well for the last 30 years. The core of the argument is that as the PRC approaches the technological frontier, it cannot get as much growth from a technological catch-up strategy. A recent report by the Asian Development Bank (ADB 2012) further develops the need for the PRC to switch its development strategy to avoid the middle-income trap. It is believed that from its current position of strength, the PRC could follow the path of the Republic of Korea by successfully transitioning to a more innovation-based growth model and become a high-income economy, or it could fail to make that transition like Argentina, which did not realize the potential it had and has been stuck in a middle-income trap (Fan et al. 2013).

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[11] See Dahlman (2011) for a comparison of the technological development strategies among Brazil, the Russian Federation, India, and the PRC (BRICs).

[12] WDI 2013, Tables 5.11 and 5.12.

[13] See http://www.china.org.cn/china/2010-10/27/content_21214648.htm (accessed 18 November 2012).

Ensuring Environmental Sustainability of the Growth Pattern

The PRC's growth has been based on a very intensive use of the environment, which has led to water, air, and soil pollution, plus high levels of carbon dioxide (CO_2) emissions. In 2005, the PRC became the largest CO_2 emitter in the world, and in 2009 it also became the biggest energy user in the world. Rapid growth has also led to natural resource depletion and environmental pollution, the costs of which have approached 10% of GDP, as per World Bank calculations.

Achieving a More Inclusive Growth Paradigm

Despite the spectacular growth rates that made the PRC the world's second largest economy, the PRC remains a developing country. Its per capita income is still a fraction of that in advanced countries. It ranked 114th in the world in 2011 in terms of gross national income per capita. While the PRC has been very successful in reducing the percentage of its population living below the international poverty lines, income inequality has risen sharply in the past decades. The Gini coefficient has worsened from 0.33 in 1990 to 0.47 in 2012.[14] The PRC faces the triple challenge of maintaining growth, reducing inequality, and attaining greater environmental sustainability.

Falling Productivity Levels

The PRC's productivity growth has been falling. Growth in terms of total factor productivity has fallen from an annual average of 4.7% in 2001–2007 to 2.8% in 2008–2010. Earlier rounds of market liberalization and privatization have largely run their course, and the mass reallocation of labor from low productivity agriculture to higher productivity manufacturing is coming to an end (Ernst & Young 2012). The previous generation of reforms needs to be followed by a new set of reforms to take the economy forward. This is also recognized in the 12th Five-Year Plan.

Rising Wages

The high degree of success enjoyed by the PRC in attracting FDI and in transforming into a manufacturing powerhouse has been largely due to the low wages for workers. However, wages have been rising in the PRC, which is beginning to erode its global economic advantages, its low labor costs. Wages in manufacturing have more than tripled between 2005 and 2014 (National Bureau of Statistics of PRC 2014). Average real wages are estimated to have more than tripled between 1997 and 2007 (Yang, Chen, and Monarch 2010).

Education and Skills Mismatch with the Market

On the one hand, the PRC can celebrate its success for having the fastest rate of growth in tertiary sector enrollment in recent years; on the other hand, however, it also needs to ponder the problems of graduate unemployment and skills mismatch. A total of 35% of employers surveyed in 2013 reported talent shortages and difficulties in filling a job, an increase of 12% from 2012. In

[14] (National Bureau of Statistics of PRC 2013).

relation to the degree of impact talent shortages have on the ability to meet client needs, 86% of the employers surveyed believe that talent shortages are having a medium to high impact on client service (ManpowerGroup 2013).

Assessment of the Four Knowledge Economy Pillars

This section makes a brief assessment of the state of development of each of the pillars of the KBE in the PRC. Its position in all the four pillars of the knowledge economy is at less than half the Organisation for Economic Co-operation and Development (OECD) average on all pillars except innovation. The PRC has been improving over the last 2 decades in the innovation, education, and the economic incentive and institutional regime pillars. The improvement has been greatest in the innovation pillar, which is also its strongest. The economic incentive and institutional pillar is its weakest. Although the PRC has made very impressive advances in information and communication technology (ICT), the index shows a decrease relative to other countries, in large part because some other countries (all of which have smaller populations) have rolled out ICT access faster. Table 2 provides a snapshot of the PRC's position in the Knowledge Economy Index between 1995 and 2012.

Table 2: People's Republic of China and the Knowledge Economy Index

Year	Rank	KEI	Economic Incentive and Institutional Regime	Innovation	Education	ICT
1995	100	3.99	3.46	4.07	3.68	4.77
2000	91	3.83	2.82	4.35	3.36	4.8
2012	84	4.37	3.79	5.99	3.93	3.79

ICT = information and communication technology, KEI = Knowledge Economy Index.
Source: World Bank Knowledge Assessment Methodology.

Table 3 summarizes some of the key challenges faced by the PRC across the four knowledge economy pillars and matches them up with actions that can be taken in each.

Table 3: Challenges across the Four Pillars of a Knowledge-Based Economy for the People's Republic of China

Challenge	EIR	Education	ICT	Innovation
Slowing growth	Reduce cost of starting up new businesses; stimulate non-tradable sector	Link content and output of education and training to the needs of the economy	Use ICT to reduce transaction costs to start up new businesses	Increase contribution of innovation to growth
Restructuring toward domestic markets	Reduce export biases; strengthen domestic consumption and services sector	Develop skills needed for knowledge-intensive service economy	Strengthen ICT infrastructure and use for service economy	Promote innovation in non-tradable and particularly in the service industries

continued on next page

Table 3 *continued*

Challenge	EIR	Education	ICT	Innovation
Reducing inequality	Strengthen focus on inclusive growth	Improve access to education for low-income groups	Improve access of poor and marginalized populations to ICT services	Strengthen support for inclusive innovation
Education quality and relevance	Improve regulatory regime that matches quality and relevance of education to needs of the economy	Strengthen higher education in general, including research universities plus formal technical and vocational education and training	Use ICT to improve access and quality of education and training	Improve pedagogy of education and training services
Climate change	Tax carbon-based fuels; develop service industries that are less environment intensive	Increase awareness of climate change in school; develop skills needed by green industries and services	Use ICT to monitor and improve energy use and efficiency (smart grid), as well as carbon dioxide emissions	Increase research on alternative energy sources and carbon sequestration

EIR = economic incentive and institutional regime, ICT = information and communication technology.
Source: Authors.

Economic Incentive and Institutional Regime

The PRC's weakest KBE pillar is the economic incentive and institutional regime. In the Cost of Doing Business ranking, which is a partial proxy for the economic incentive and institutional regime, the country ranks a poor 96th out of 189 countries (Table 4). Its worst rankings on this index deal with construction permits and starting a business, which are 185th and 158th, respectively. On the other hand, the PRC does well in enforcing contracts where it ranks 19th. Based on these rankings, other studies, and interviews with entrepreneurs, government officials, and researchers in the PRC, the most important constraints for the KBE are the poor business environment, the rule of law, the regulatory environment, and financial market development—all of which are related—as well as corruption. This is corroborated by surveys of major constraints to business from the World Economic Forum's annual Global Competitiveness Report (Figure 7).

The banking system essentially captures household savings, pays savers less than the rate of inflation, and allocates low-cost credit to privileged firms, particularly the state-owned enterprises (SOEs). SOEs benefit from this very low-cost credit. On top of this, they pay very low dividends to the government. Therefore, they get the double subsidy of low-cost credit and low dividends. The private sector has been stymied by difficulties in access to credit and government regulation.

In short, the PRC development model has to change:

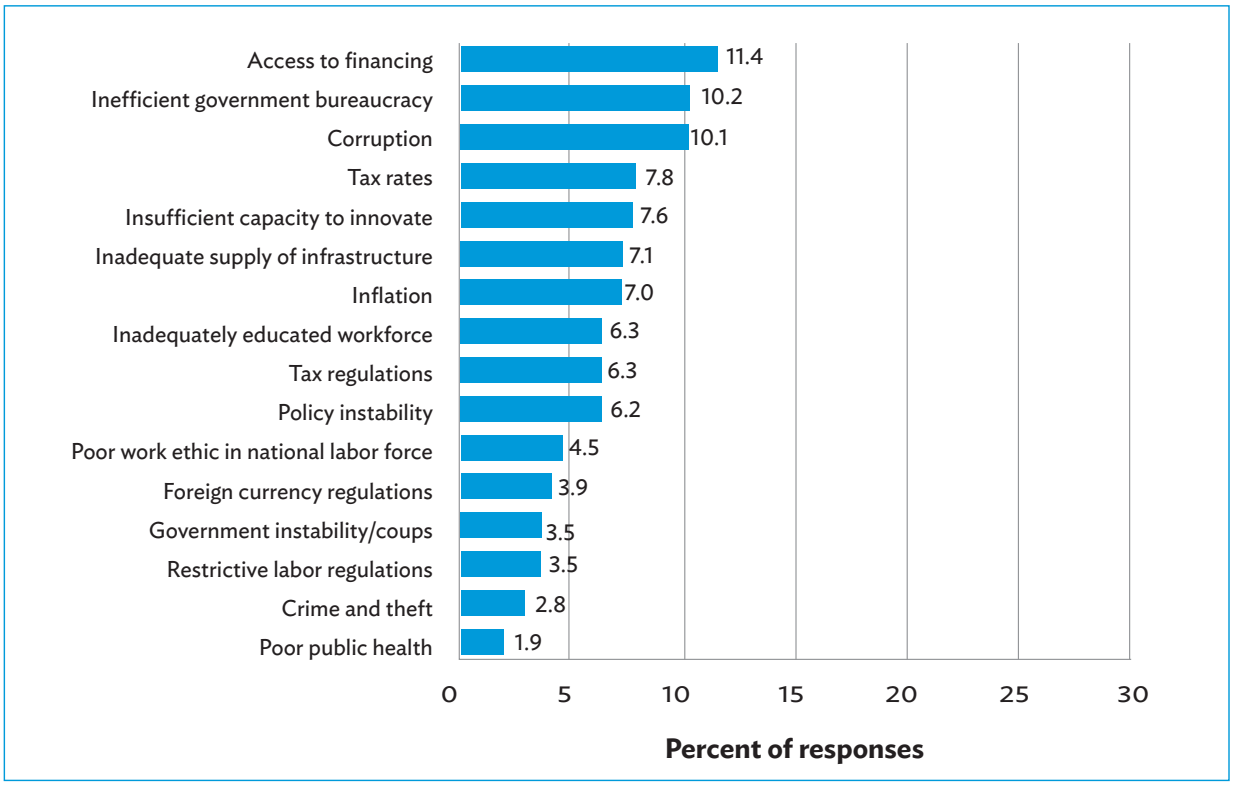
- from export-oriented to a domestic market
- from capital-intensive to knowledge-intensive
- from exhaustible resource-intensive to renewable resource-intensive
- from high CO_2 emissions to low CO_2 emissions
- from manufacturing-intensive to service-intensive, and within services toward more knowledge-intensive services

Table 4: Rankings of the People's Republic of China in the 2014 Cost of Doing Business Report

Overall Ranking	**96**
Subtopic Rankings	
Starting a business	158
Dealing with construction permits	185
Getting electricity	119
Registering property	48
Getting credit	73
Protecting investors	98
Paying taxes	120
Trading across borders	74
Enforcing contracts	19
Resolving insolvency	78

Source: International Finance Corporation, World Bank. Doing Business 2014. http://www.doingbusiness.org/data/exploreeconomies/PRC (accessed 31 October 2013).

Figure 7: World Economic Forum 2013—Most Problematic Factors for Doing Business for the People's Republic of China



Source: World Economic Forum (2013b, p. 156).

This will require significant changes in the economic incentive and institutional regime. The government is aware of the need to make these changes. The third plenum of the Communist Party's 18th Congress rolled out an ambitious plan to deepen economic reform in the next decade. The main goal of the reform is to allow the market to play a decisive role in allocating resources. To achieve this goal, the plenum announced a whole range of reforms that will bring the PRC economy closer toward a full-fledged market economy. In particular, the government will adopt the practice of negative lists to regulate firm entry as well as reform the finance sector to liberalize the interest rate regime and to open up the market to domestic capital.

Key Guidelines for the Economic Incentive and Institutional Regime Pillar

In terms of the economic incentive and institutional regime, labor market and financial market distortions are two of the most important institutional obstacles for the development of the knowledge economy in the PRC. SOEs have also distorted the business environment of enterprises.

- **Addressing labor market distortions and allowing free flow of workers.** Reform and gradual disbanding of the *hukou*[15] system will help remove obstacles to labor movement. The *hukou* system forces many people to stay in the rural and underdeveloped areas, which restricts their occupational choices to low-skilled industries, such as agriculture, construction, and low-skilled manufacturing. This leads to slow human capital accumulation and further hinders the development of a KBE in the PRC. In the reform plan newly rolled out by the third plenum of the 18th party congress, *hukou* reform is a priority, which is an important step in the right direction as it is not only an obstacle of economic efficiency, but also an impediment to inclusive development.
- **Freeing up financial repression and removing financial market distortions.** Studies show that the PRC's official interest rate is lower than market interest rates by at least 50%–100% (Bai et al. 1999) and that most low-interest rate loans flow into SOEs (Garnaut et al. 2001). Financial repression means that the relative price of capital is low, which leads firms to invest in physical capital rather than human capital. The Government of the PRC has accelerated interest rate liberalization in recent years and this needs to be further consolidated. A host of financial innovations are being used in the market, particularly internet or online finance and they do not yet have a legitimate regulatory framework.[16] Further development of the capital market is also crucial for knowledge-based industries. Small and medium-sized enterprises (SMEs) need access to finance without collateral. Going beyond the bank-based system, a

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15 Under *hukou* regulation, each citizen is required to register in one and only place of permanent residence in a city, town, or village. It defines a person's rights, such as access to education, medical services, and housing, linked to the place of registration, and it regulates and restricts population mobility between rural and urban areas. In its application, it is the basis for the most serious form of institutional exclusion against mainly rural residents, but also increasingly against young urban people who work away from their home cities. Currently, about 200 million PRC rural residents are working in the cities without urban *hukou*.

16 For example, Zhi-fu-bao, the PRC version of PayPal and connected with Taobao (owned by Alibaba), the largest B-2-C and C-2-C internet platform in the PRC, has begun offering its customers investment opportunities. Taobao buyers are required to open an account with Zhi-fu-bao, and their payments for their purchases in Taobao are drawn from this account. As a result, Zhi-fu-bao has billions of idle deposits left by its customers. Right now, it offers its customers a rate (4%–4.5%) slightly higher than the annual deposit rate of banks (3.5%) to attract them to move their idle deposits to a money market account. Funds in this account then are invested through Zhi-fu-bao. However, strictly speaking, Zhi-fu-bao's services are not legal under the PRC's current regulatory framework. However, this model is spreading quickly, and a new type of finance called "internet finance" is emerging. The market is anxiously waiting for the final words from the regulatory authorities regarding the legality of this new model of finance.

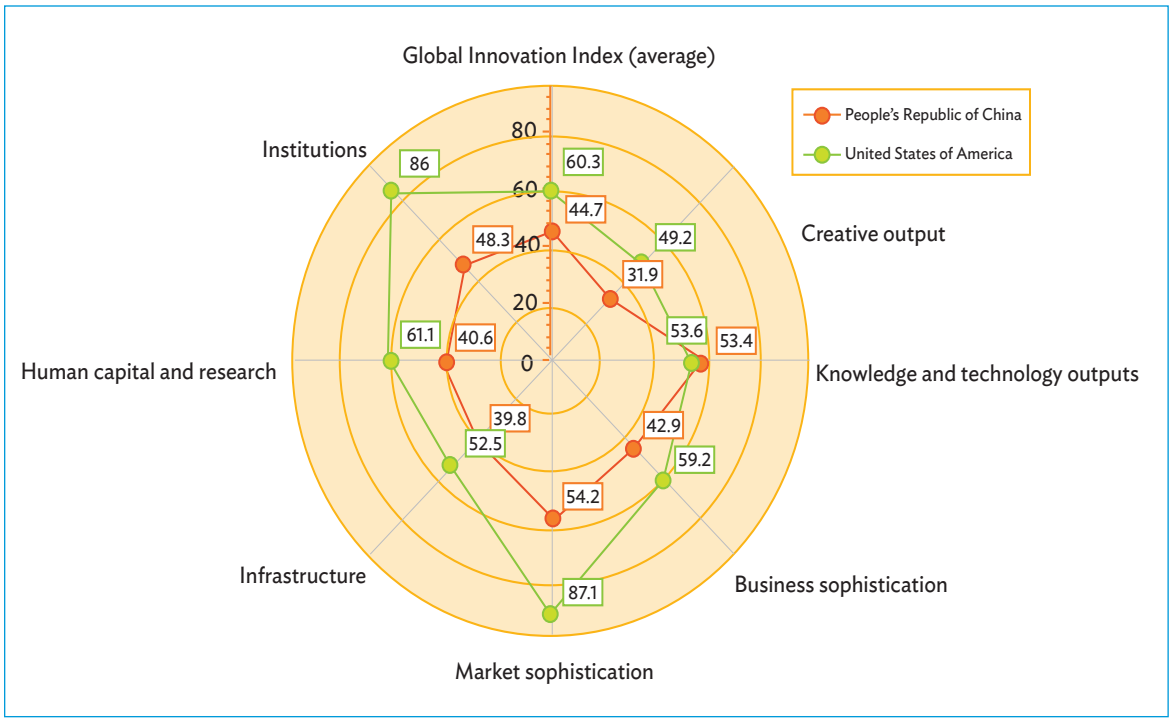
range of financial products need to proliferate, as does the development of venture capital markets that can serve a large and diverse country.

- **Reforming state-owned enterprises.** SOEs are one of the most important obstacles for the PRC's economic reform. Most SOEs enjoy monopoly power, lower capital cost, lower cost of finance, and lower land rents. Meanwhile, only a small part of their profit is shared with the public. SOEs have been known to distort the market and business environment by creating entry barriers by virtue of their monopolistic position, and unequal competition in product and factor markets impedes the development of non-SOEs, which may have higher productivity. Three approaches can be considered for the reform of SOEs: First, for industries with both SOEs and non-SOEs, the government should create a level playing field in the regulations so that the SOEs are not unduly favored. These industries include iron and steel, automobile, nonferrous metal, and so on. Second, for industries with only SOEs, the government should support their restructuring into competitive entities and create competitive conditions for their operation by encouraging non-SOEs to enter those industries. These industries include petroleum, telecommunications, electricity, and so on. And third, for all the SOEs, much of their profits should be mopped up by the state for public welfare, such as social security. In the long run, the promotion of a level playing field in market competition will ensure a healthy business environment in the PRC. This would be particularly valuable for high-tech start-ups, and allow successful entry and operations by SMEs.
- **Strengthening the foundations for a market-based economy.** The World Bank and PRC Development Research Center study (2012) puts an accent on redefining the role of government—while providing relatively fewer "tangible" public goods and services directly, the government will need to provide more "intangible" public goods and services like systems, rules, and policies that increase production efficiency, promote competition, facilitate specialization, enhance the efficiency of resource allocation, protect the environment, and reduce risks and uncertainties. It is the effective and timely provision of such intangible public goods that would be most beneficial in accelerating KBE development in the PRC.
- **Promoting a vibrant venture capital industry.** Enabling policies supportive of venture capital finance industry together with agencies offering knowledge-based capital services, patenting, trademark development, branding, marketing, and advertising to the PRC's knowledge-based industries and corporations would help them climb up global value chains. Specific measures for e-commerce and digital enterprises, backed by appropriate regulatory measures, are also crucial.

Innovation and Technological Adoption

The PRC performs the strongest in the innovation subindex of the KBE. In the "innovation and technological adoption" subindex of the World Bank's Knowledge Economy Index, the PRC's performance was closer to the OECD average compared to the other pillars of ICT, education and skills, and the economic incentive and institutional regime, where the PRC's index was less than half the OECD average. It ranks 35th out of 141 countries in INSEAD's 2013 Global Innovation Index (see Figure 8 for a comparison of the rankings of the PRC and the US). The PRC's strongest performance among the subindices is on knowledge and technology outputs (2nd worldwide) because of its superb record of knowledge creation (absolute number of scientific and technical journal articles, patents, utility models), knowledge impact (GDP growth per capita, new business established per 1,000 working-age population), and technology diffusion (technology licensing

Figure 8: INSEAD Global Innovation Index: Comparison of the People's Republic of China and the United States, 2013



Source: INSEAD *Global Innovation Index 2013* Data Platform.

receipts, technology intensity of exports, computer and telecommunication service exports, and net outward FDI).

The PRC has come a long way on the inputs to innovation. The PRC now has the largest number of scientists and engineers engaged in R&D in the world, having surpassed the US a few years ago. R&D expenditures as a share of GDP were 1.8% in 2012, up from only 0.5% in 1990. Moreover, the government has an ambitious plan to increase investments in R&D to 2.2% of GDP by 2015, and 2.5% of GDP by 2020. In 2012, the PRC was the world's second largest spender in R&D in PPP terms. The PRC spent 47% of what the US did, but it was 23% more than what Japan, the third largest spender, spent (Battelle 2012).

In terms of outputs too, the number of scientific and technical publications increased from 6,285 in 1990 to 74,019 in 2008, and the PRC is now the second largest publisher in the world in absolute numbers. In 2011, the PRC's State Intellectual Property Office registered the largest numbers in the world for all four main types of intellectual property patents, utility models, trademarks, and industrial designs (WIPO 2012). In 2012, the PRC's Patent Office overtook the US Patent and Trademark Office in number of patent applications and became the largest in the world, having surpassed the Japan Patent Office in 2010. In addition, the Trademark Office in the PRC has been the largest in the world since the early 2000s when it overtook the one Japan. In industrial designs, it has also received the largest number of applications since the late 1990s (WIPO 2012).[17]

[17] The majority of applications of the three types are by domestic residents in the PRC.

Despite these remarkable achievements, the structure of the PRC's R&D spending still needs to be rationalized to accommodate long-term growth. One of the problems is that spending on basic research as a share of GDP is low. In recent years, this share has been declining—from nearly 6% in 2003 to 4.7% in 2011 ([People's Republic of] China Statistics Press 2012). In advanced economies, this share is around 15%. For example, it is between 15% and 20% in the US, between 12% and 17% in Japan, and above 20% in France and Germany. The PRC spends a higher proportion on applied research and experimental product development, possibly aiming at a faster pace of technological catch-up. However, in order to transition from an upper-middle-income country to a high-income country, more investments in basic research to strengthen national technological capacities are crucial.

Going forward, the PRC needs to consider a more strategic approach to patenting. In 2010, the PRC only had six triadic patents (patented simultaneously in the three major markets—the US, Europe, and Japan) compared to about 300 in the US and Japan.[18] Another measure is the number of patents filed under the Patent Cooperation Treaty (PCT).[19] Here the PRC has made rapid progress, catching up with Germany, but it was still behind the US and Japan in 2011. The PRC suffers from low rates of commercialization of scientific and technological findings. According to Wang Zhizhen, an academician of the Chinese Academy of Sciences, the PRC's commercialization rate of scientific and technological findings was only 5% in 2011, far below that of developed countries which is usually 80%.[20] The intellectual property rights (IPR) regime is still weak in terms of enforcement and this is a disincentive for private firms to invest resources in R&D or in innovation of new products and services because of the concern that they will be copied by others and will not be able to recoup their investments (Yusuf 2012).

It is noteworthy that government R&D spending is mainly directed toward applied research and product development. The Ministry of Science and Technology (MOST) and the Ministry of Industry and Information Technology (MOIIT) are the two major ministries within the government that allocate R&D funds. Their total R&D budgets were 28.678 billion yuan and 29.055 billion yuan in 2012. The ratio between spending on basic research and applied research was 2:5 in MOIIT and 1:14 in MOST.[21] Even the Ministry of Education (MOE) spends more on applied research than on basic research. Its science and technology budget was 282.1 million yuan in 2012, but only 52.2 million yuan was spent on basic research, accounting for less than 20%. The PRC National Science Foundation (CNSF), the PRC's major funder for basic research, had a budget of 15 billion yuan in 2012. The spending of basic research in MOIIT, MOST, MOE, and CNSF combined thus was 20.3 billion yuan in 2012, 7.8% of the total R&D spending of the four government agencies. Overall, only 17% of public R&D expenditures are for basic research, compared to an average of more than 55% in OECD countries (OECD 2012, p. 267). In principle, applied research and product development should respond to market demand and should be the domain of private investments. The government's heavy involvement in this area may imply efficiency loss because government allocation may not adequately reflect market demand.

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18 See OECT Triadic Patent Database. http://www.oecd.org/sti/inno/oecdpatentdatabases.htm (accessed 31 November 2013).

19 The PCT is an international convention through which member countries can file a patent to be examined by other member countries, rather than to have to file in each country. The application does not automatically result in a grant. A search is done by an internationally recognized office. It is up to each member country to decide to accept the findings or conduct its own search to grant the patent. Presumably, patents that are submitted for such international scrutiny are believed to meet international standards, so it is a better measure than patent applications in a national office.

20 See http://www.cinic.org.cn/site951/cjyj/2011-01-20/448900.shtml (in Chinese).

21 See http://www.caigou2003.com/news/focus/news/20120430/news_316403.html (in Chinese).

The emergence of a large middle-class consumer market will stimulate further product and service innovations. By 2022, more than 75% of the PRC's urban consumers are expected to earn 60,000–229,000 yuan ($9,000–$34,000) a year (Barton, Chen, and Jin 2013). While only 4% of urban households in the PRC were in this income category in 2000, 68% of urban households were in this category by 2012. This foretells the need to expand products and services that will cater to a vast growth in domestic consumption by this growing middle class. In fact, the upper end of the middle class is projected to grow rapidly from about 14% of the total urban households to over half of the total urban households in 2022. This rapidly growing and diverse middle class will exert considerable influence on creating new market opportunities for consumption on which both domestic and international companies can focus. Trends indicate that a more diversified product range rather than standardized products is likely to be in demand. Innovations of products and services catering to this middle class are crucial.

Key Guidelines for the Innovation Pillar

- **Improving the productivity and effectiveness of R&D expenditures.** A key consideration for the PRC is realizing better returns from R&D in terms of improved competitiveness in higher value-added industries. With rising wages, low labor cost manufacturing advantages will diminish in the near future; therefore, building and strengthening competitiveness in emerging industries and higher value-added chains will be important to maintain a leading position in exports. As a middle-income country aspiring to be a high-income one, at least doubling the allocation of R&D to basic research may be needed to strengthen the base of domestic technological capability.
- **Improving IPR protection.** Although the PRC is leading in terms of the number of patents acquired, corporations perceive IPR protection as weak. Given the rise of new economy industries, and distributed models of manufacturing, value addition, and process innovations, the IPR and regulatory regime will need to be strengthened to provide greater support to entrepreneurial individuals and SMEs to patent their innovations and enhance IPR laws and their enforcement. The PRC could also consider establishing IPR courts. In addition, IPR laws should also be continuously updated to be in step with market movements. This would be particularly true for the explosive rise in e-commerce and digital enterprises. Externally, the PRC needs to increase its number of triadic patents.
- **Accelerating product and process innovations for the middle class and bottom-of-the-pyramid customers.** On the one hand, innovative companies that can offer a range of mid- to high-end products and services can take advantage of the huge wave of growth of middle-class consumers which is substantially increasing the market size for these products. Globally too, the mid-range technology sector is predicted to experience faster growth than high-end technology segments. In addition, the PRC's efforts to instigate and support innovations for bottom-of-the-pyramid customers will contribute to an inclusive KBE approach. Much attention has been paid in recent times to the potential of "frugal" innovation with sizable market opportunities. Support to technological diffusion to smaller cities, towns, and rural areas will help with such innovations. Grassroots networks of innovators and the availability of local technical, financial, and marketing support to entrepreneurs will spur local commercialization of small scale innovation.
- **Enabling decentralized innovation hubs and clusters.** Increasingly, the focus is on creating several bases of innovation, including in small towns and districts rather than just a few large ones. Following the opening of a free trade zone (FTZ) in Shanghai in 2013, more

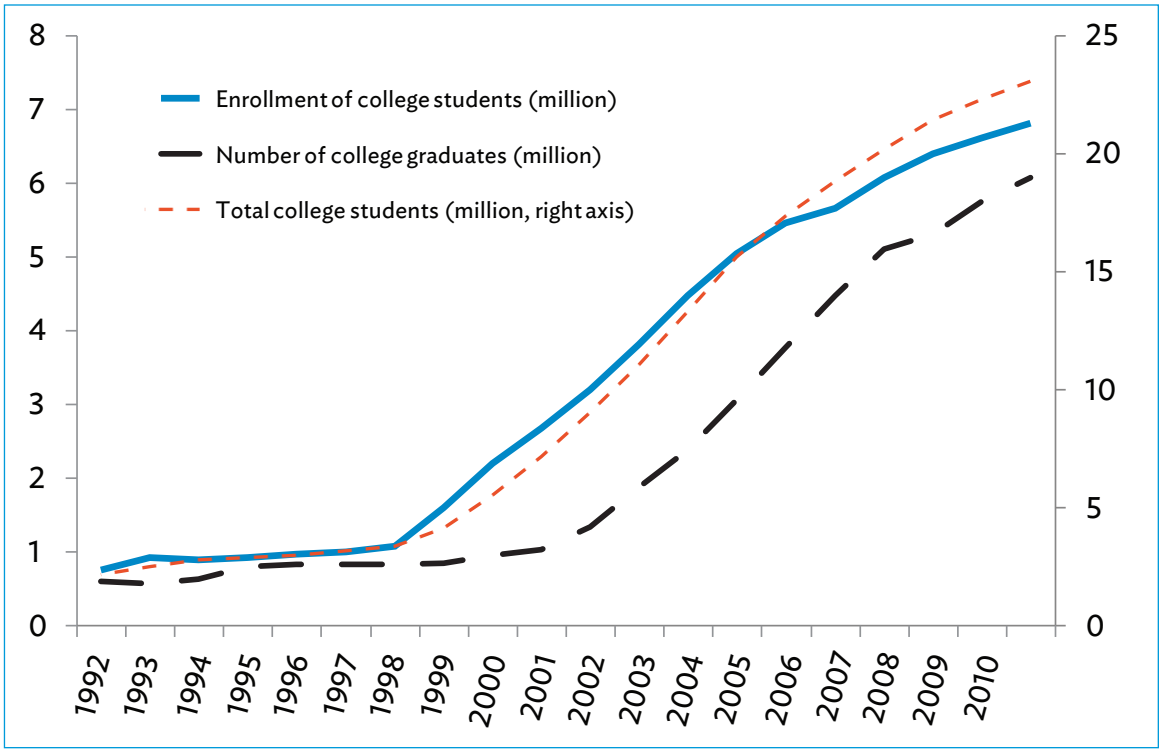
such zones are anticipated, which may well lead a new spurt of economic reforms that the special economic zones did in the initial phase of market reforms. It would be opportune to dovetail the potential opening of new FTZs with well-targeted innovation clusters. The new model for innovation hubs, particularly if it is to attract young entrepreneurs, requires the colocation of service industries ranging from banks, travel agencies, high-speed connectivity, entertainment, supermarkets, insurance, and logistics. The hubs need to be open for international collaboration and investments. The innovation hubs can cluster technology start-up firms, venture capital firms, business incubators and accelerators, human capital agencies, as well as housing and retail as the young generation seek to be connected to all modern amenities. Such models that are more compact and can be located in a number of urban and peri-urban locations would help to incubate a wide variety of technologies and innovations and also facilitate the spreading of benefits across geographies, an important consideration for inclusive innovation approaches.

- **Enriching university–industry collaborations in commercializing R&D.** The PRC has been the breeding ground for hundreds of international research collaboration projects in which multinational corporations have partnered with universities rather than local firms in research alliances. If the PRC aims to be a world-class center of research and innovation, more concerted action is needed to strengthen the role of research-intensive universities and to locate industry–university collaboration within an ecosystem for rapid commercialization of R&D which includes technology incubators, venture financing, and entrepreneurship education. Such collaboration also needs to be dispersed in the same fashion as innovation clusters and in fact linked to them to establish multiple partnerships rather than a few giant "Silicon Valley"-type concentrated models. Universities need more autonomy and financing to forge such partnerships. While international research partnerships should continue, the PRC will gain from providing strong impetus to local firms not just forging technology and R&D partnerships with universities but also developing long-term alliances in talent management to strengthen the country's technological readiness in the future.
- **Accelerating green innovation.** The PRC has the paradoxical dual distinction of being a world leader in green technologies but also the world's top polluter. The country needs to make a dramatic improvement in the latter and serve a number of developmental objectives, particularly energy security. The PRC is the world leader in clean energy investment, with $54 billion in investments in renewables in 2013, well above total US investments of $36.7 billion. The PRC accounted for nearly 30% of the Group of Twenty investment in clean energy in 2013. Taking forward the importance given in the 12th Five-Year Plan and the target to meet 20% of energy from renewable sources by 2020, the PRC has tremendous potential to turn these technological capabilities for development. Greater spread of renewable energy to rural locations will help increase employment and business opportunities in addition to improving energy security.

Education and Skills

Tertiary education will play a key role in upgrading the PRC's capabilities for KBE development. In terms of the expansion of tertiary education, the PRC has done a superb job, particularly in the last decade. The size of tertiary education has expanded very rapidly from the end of the 1990s onward (Figure 9). The tertiary enrollment rate was just 3% in 1990. From the end of the 1990s, the government has ramped up the expansion of higher education. The number of college students has since increased rapidly, reaching a tertiary enrollment rate of 26%.

Figure 9: Higher Education Expansion in the People's Republic of China



Source: People's Education Press. 2010.

Because of its large population, the PRC's cohort of students at the tertiary level is a staggering 31 million, the highest in the world. The pool of tertiary students can create a critical mass of educated and skilled workers, which is a principal input into a KBE. However, it is crucial to address the quality and relevance of tertiary education and strengthen the market demand for graduates, both of which have been problematic in recent years.

Both public and private sector higher education has increased. It is estimated that nearly 5 million students were enrolled in private higher education by 2007 (Altbach 2009). The expansion of private higher education has helped to respond to the rising demand. However, there are various problems. First, the overall quality of tertiary education is relatively low. It was estimated that only 10% of the graduates were of high enough quality to be hired by multinational companies (McKinsey 2005).

The second important factor for a knowledge economy is that the percentage of students studying science, technology, engineering, and mathematical (STEM) disciplines appears to be falling recently. By 2020, the PRC is likely to face a shortage of high-skilled workers and a surplus of low-skilled workers (Table 5).

Third, the unemployment rate among college graduates has risen. In May 2013, only 52% of students about to graduate had job offers, 7 percentage points less than the previous year (Chang 2013). Although the slowdown of the economy was a major factor, this trend suggests that the rapid expansion of higher education and supply of graduates has not been in tune with market needs.

Table 5: Projected Labor Demand and Supply by Skill Level in the People's Republic of China

Skill Level	Demand	Supply
High-skilled workers (college degree of higher)	140 million	117 million
Medium-skilled workers (High school or vocational training)	509 million	514 million
Low-skilled workers (primary education or no education)	172 million	192 million

Source: National Bureau of Statistics of the People's Republic of China and McKinsey Global Institute Analysis, 2012.

The fourth problem is one that is common in most Asian countries: a strong preference for formal academic education and degrees over vocational education and certificate and/or diploma programs. This preference exists despite evidence that there are many vocational, professional, and technical jobs in new-age manufacture, high-end technical occupations, auto repair, or maintenance engineering which pay better than many jobs requiring college degrees. Another important area neglected in the PRC, as in other countries in Asia, is the focus on soft skills compared to technical skills. Companies indicate that lack of soft skills has posed a much greater challenge than the absence of hard skills. Notable soft skills mentioned as the greatest human resources-related organizational challenge in the PRC include leadership, communication skills, and self-motivation (EIU 2014).

A fifth challenge is the need for constant upgrading of the skills of people already in the labor force, particularly those of migrant workers. Eighty percent of migrant workers have 9 years or less of education. This requires effective programs to retrain the people who have already left formal education.

A sixth issue is education finance. In order to increase tertiary education, the government has begun to charge students for public education. This has meant that students from poorer families have to find necessary resources on their own. This problem is becoming more serious as college graduates have had difficulties finding jobs and are often not paid as much as they expected.

Key Guidelines for the Education and Skills Pillar

- **Implementing reforms in higher education system management and governance.** This pertains to inculcating flexibility, university autonomy, and faculty governance that can more effectively pursue international standards and status in research and knowledge transfer with industry. While the country has been leading in research outputs, a lot more needs to be done to strengthen the link to successful commercialization of research. Given the mismatch of education and skills with jobs, universities and tertiary institutions need to consider renewing their curriculum and revamping courses in collaboration with industries and employers. More systematic collaboration and linkages need to be established. There is need to reexamine the range of disciplines and courses the country should focus on based on the human capital requirements of industry in general and high-tech corporations in particular.

- **Designating select R&D institutions as centers of excellence in key disciplines.** Given the vast base of R&D in the economy across various institutions, the identification and strengthening of key science and technology institutions as centers of excellence (COEs) to achieve world standards would further strengthen the PRC's national technological capabilities in emerging areas. A network of such institutions can share resources and reinforce mutual scientific capabilities. These COEs would need to be linked with the country's innovation system and tertiary education system. University–industry collaboration with clear incentives to universities in a shared revenue model for commercialization of R&D is required.
- **Developing a range of credentials across university and non-university tertiary education and training, to produce qualified and skilled workers with academic, technical, and professional qualifications.** The higher education system will need to become more seamless and flexible, by accommodating credit transfer for qualifications and career pathways in a changing system of education, training, and lifelong learning. The development of an effective national qualifications framework that encompasses a quality assurance and accreditation framework that is independent and professional would facilitate this process.
- **Improving the image and wage returns to technical and vocational education and training.** The PRC's manufacturing industry is incorporating information and micro-processing technologies at a stupendous rate to drive productivity gains. As per the International Federation of Robotics, the PRC bought one in five robots sold globally in 2013, overtaking Japan. In 2013, the PRC bought 36,560 industrial robots, a rise of almost 60% against 2012, compared to 26,015 bought by Japan and 23,679 by the US. The manufacturing giant Foxconn Technology Group intends to deploy 1 million robots in its factories in the PRC. With the rapid growth of precision engineering and other technologies in the manufacturing environment, there has emerged a great need for "gray collar" professionals who are not the traditional factory workers. On the one hand, a range of appropriate associate and technology degrees and professional qualifications needs to be devised for such high-skilled workers in the future; on the other, the image of such workers in the market needs to be elevated to attract youths to pursue such occupations.
- **Upgrading the skills of the existing workforce, particularly migrant workers.** Migrant workers are expected to continue as the backbone of the PRC's labor force. However, their education achievement is very low: 80% have only 9 years or less of schooling. This is far from adequate for the PRC to move to a KBE. An estimated 240 million migrant workers need skills upgrading. Given that enterprises, especially SMEs, spend very little on training, which they spend mostly on managers instead of ordinary workers, the government needs to consider putting in place training vouchers or other incentives for improving the skills of workers already in the job. Public spending on training needs to be increased.
- **Ramping up training for the services sector, which is key to a knowledge-based economy.** A stronger focus on the education and training needed to develop the talent required for the services sector is crucial. Finance, health care, information technology, advanced manufacturing, and professional services are sectors that are likely to see large increases in employment in coming decades and should be the focus of talent development. In addition, the support to the PRC's creative and digital enterprises would also help advance the knowledge economy. Expanding information technology literacy across the country would strengthen the human capacity needed for increasingly digital workplaces.

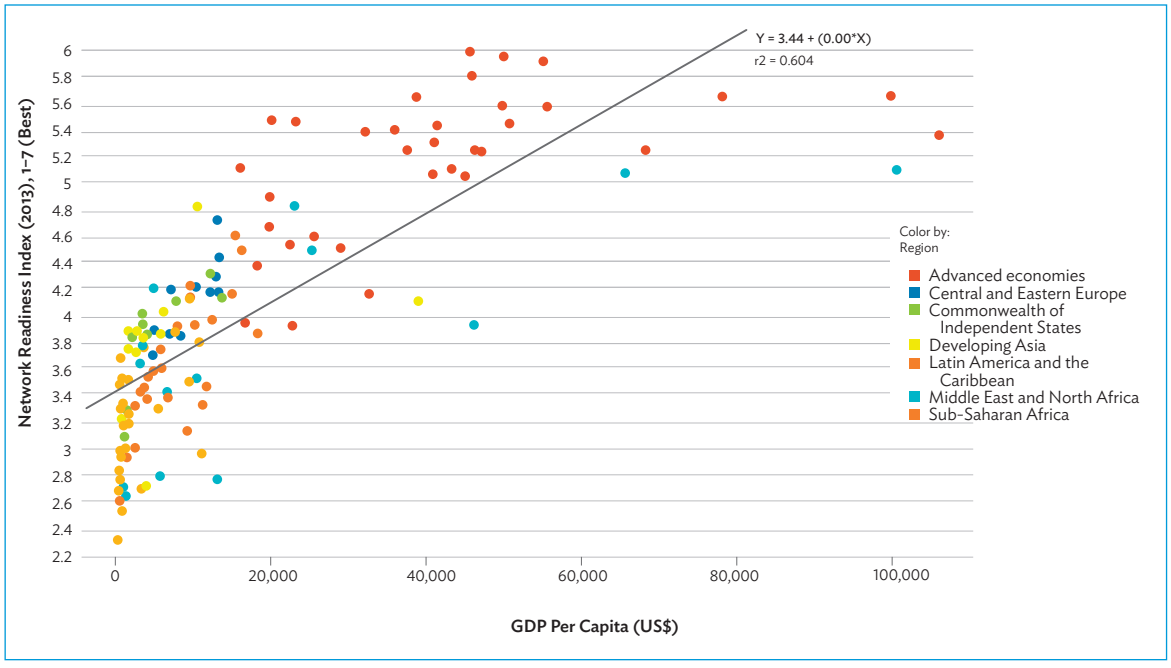
- **Developing new paradigms of education delivery and pedagogy through ICT.** This is a guideline that all developing economies in Asia can consider. However, the PRC could exploit its particular advantage in terms of the largest mobile phone network in the world and the stupendous growth of e-commerce to reengineer the way education and training is delivered. Mobile phone apps and delivery of short training modules, particularly for soft skills, have potential. The mobile phone can also be used extensively as performance support at the workplace as it does not take people away from their work for training. Given the extensive spread of computer and mobile games in the PRC, there are good opportunities to explore the use of educational games to implement interactive learning and personalized learning paradigms.

Information and Communication Technology

In spite of heavy investment in ICT infrastructure and rapid expansion of use, the PRC is falling behind other countries in the ICT pillar. The ICT subindex of the World Bank's Knowledge Economy Index for the PRC declined from 4.8 in 2005 to 3.8 in 2012. In the 2013 World Economic Forum Network Readiness Index, the PRC slipped from 51st to 58th position in 2012. However, its position is above the average for countries at its level of per capita income (Figure 10).

Among the 10 subindices, the lowest rankings are business and innovation environment (105th), infrastructure and digital content (83rd), individual usage (83rd), and economic impact (83rd). Best rankings are business usage (35th) and government usage (38th). However, the PRC does

Figure 10: Position of the People's Republic of China in the 2013 Global Information Technology Index Relative to Its Per Capita Income

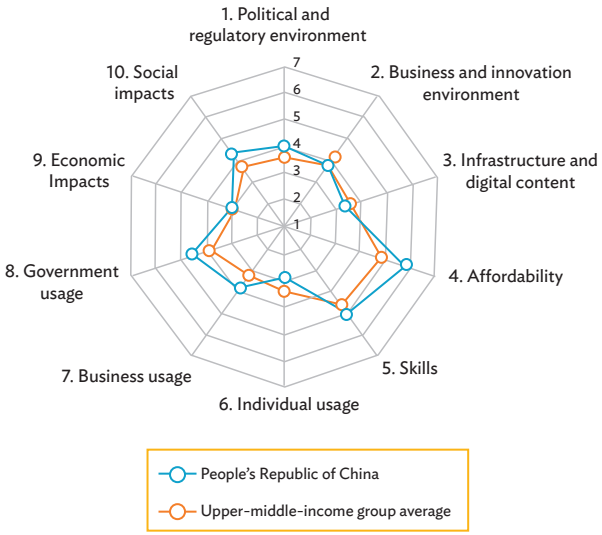


PRC = People's Republic of China.
Source: World Economic Forum Global Information Technology Index 2013 Data Platform (accessed 30 October 2013).

better than would be expected given its level of per capita income as noted in Figure 11. The poor ranking for individual usage is because of the large population and relatively low income levels in the rural areas, but there has been rapid dissemination. The PRC has the world's largest number of mobile phone and internet users, which gives it a great base over which to leverage content and applications.

Figure 11: Ranking of the People's Republic of China in the Global Information Technology Index

	Rank (out of 144)	Score (1–7)
Network Readiness Index 2013	58	4.0
Network Readiness Index 2012 (out of 142)	51	4.1
A. Environment subindex	71	3.9
1st pillar: Political and regulatory environment	58	4.0
2nd pillar: Business and innovation environment	105	3.8
B. Readiness subindex	66	4.8
3rd pillar: Infrastructure and digital content	83	3.5
4th pillar: Affordability	40	5.8
5th pillar: Skills	53	5.0
C. Usage subindex	58	3.8
6th pillar: individual usage	83	3.0
7th pillar: Business usage	35	3.9
8th pillar: Government usage	38	4.6
D. Impact subindex	55	3.7
9th pillar: Economic impacts	83	3.1
10th pillar: Social impacts	42	4.3



PRC = People's Republic of China.
Source: World Economic Forum (2013a, p. 168).

The PRC's telecommunications industry has undergone some degree of market-oriented reform over the last decade. With the reform of the industry, calling charges for mobile phones have been falling and an increasing number of people in the PRC are using mobile phones. However, the PRC's telecom charges are still on the high side. Although there are several telecom operators, they are all affiliated with the State-owned Assets Supervision and Administration Commission (SASAC) and there is little incentive for more comprehensive competition, so each company enjoys a monopoly position. The monopoly of telecom giants in the PRC hinders internet usage. High internet charges slow down the spread and application of new technologies and restrain innovation in the internet industry, which would impede the development of the PRC's knowledge economy. Numerous internet products need the operators' network to transmit; therefore, operators may inhibit innovations that are detrimental to their private interests through monopoly power. For instance, wei-chat, a product for transmitting information, pictures, and voice through the network by the internet giant Tencent was met with opposition from telecom operators as it would lower their revenues on mobile telephony.

Internet usage in the PRC's rural areas lags behind that in cities. While three-fifths of the urban population uses the internet, less than a quarter of the rural population does so, and the gap is growing. Access to the internet can enhance the lives of rural citizens, provide information about agricultural and off-farm livelihoods, deliver public services, and disseminate educational and

health knowledge. Public internet access centers should extend their portfolio by more deeply integrating wireless support. At the same time, considering the likely growth of smartphones and other Wi-Fi-enabled mobile devices, the government could consider supporting free wireless local area network access for rural areas (World Bank 2014).

The government announced plans to spend $326 billion on its broadband strategy to provide broadband to 25 million people and fiber broadband to 35 million by 2013, and nationwide coverage by 2020. The government is drafting a comprehensive law to promote the sustainability and development of e-commerce. The final drafting of the law is expected to be completed by June 2016. The PRC continues to rank poorly in both "hard" and "soft" infrastructure. Its national broadband plan will help improve broadband quality over the next 5 years, but unless the government improves citizen access to information, develops more sustainable energy policies, and improves regulatory predictability and transparency, data flows in and through the PRC will continue to remain bottlenecked.

Key Guidelines for the Information and Communication Technology Pillar

- **Implementing further reforms in the ICT industry.** First, it is necessary to reduce monopoly power and enhance competition in the ICT sector. Introducing more competition will reduce prices, give consumers more choices, and enhance customer value. With the continuous development of communication technology and the communications market, customer demand has been constantly increasing and services have been improved, far beyond the scope of voice calls. Second, establishing independent telecom regulators will help ensure fair competition and protect consumers. Third, more guidance and coaching for the general public on the use of telecom products will increase their uptake.
- **Reducing the digital divide between urban and rural areas.** Unlike other countries, the PRC does not have a universal access and service fund that can help bridge the digital divide through subsidies and other incentives. A special fund to roll out ICT hardware and services would be beneficial.
- **Universalizing high-speed broadband connectivity.** The PRC has articulated a national broadband policy that will play an important role in extending the coverage of broadband connectivity. It is estimated that for the PRC, every 10% increase in dial-up and broadband penetration may contribute as much as 2.5% to GDP growth. Availability of affordable and high-speed broadband in rural areas will help stimulate local entrepreneurs to start digital enterprises and also pave the way for more digital educational solutions.
- **Expanding the range of mobile apps, serving urban and rural customers.** With the world's largest mobile phone network, the PRC is uniquely placed to expand the range of services that can be provided through the mobile phone. Innovative revenue models are required in order to enable poorer sections of society to have the opportunity to benefit from mobile-based services, including mobile banking. Availability of low-priced smartphones would be a key advantage in spreading mobile applications.
- **Enabling greater application of e-governance.** Despite good progress, the PRC was ranked 78th out of 190 countries in 2012 for e-governance (United Nations, 2012). Continued efforts are needed to improve e-government performance for administrative efficiency and quality of integrated public services. It is also critical to make additional efforts to bring e-governance and service delivery through ICT to remote and isolated regions.

Development of Services and e-Commerce as Special Advantages

The share of the services sector in GDP in 2013 was only 45%, though it averaged 54% for upper-middle-income countries. While there are many causes, government policies also impede the development of the PRC's services sector. One of them is entry regulation. Finance, education, and medicine, as the most significant parts of the high-end service industries, are also the core of a knowledge economy and are very important for the PRC's development. However, entry into all of them is strictly regulated by the government. In spite of the higher profit rates earned by those high-end service industries, it is hard for private capital to enter.

The growth of the services sector is crucial for advancing the knowledge economy. A recent study reveals that while engineering firms have already established extensive training schemes, the banking and health-care sectors are also interested in establishing training programs in the future. In health care, there is an abundance of qualified specialists in various fields of medicine, but the absence of general practitioners in the PRC's health-care system means that patients are unable to receive personalized care. This service-oriented aspect of health care is gaining traction in the PRC as private care becomes more affordable for the country's growing middle class (EIU 2014).

The PRC has great potential to develop its services sector, in particular knowledge-intensive services, namely specialists in information technology, finance, business services (including management), scientists and engineers, and university professors. The PRC is relatively well positioned to develop knowledge-intensive services as it has the largest education and training system in the world as well as the largest stock of college-educated population (OECD 2010b). On the supply side, it will be necessary to expand and improve the quality of education and training for service industries. In the economic incentive and institutional regime, it will be necessary to examine the regulatory and tax constraints that may inhibit the start-up and expansion of knowledge-intensive service firms, and remove entry regulations and other barriers for the private provision of services. It will also be necessary to develop special financing for private service industries. Furthermore, it will involve examining the extent to which ICT can be used to facilitate the training and up-skilling of this high-level human capital as well as how to leverage ICT to provide services, both domestically and internationally. On the innovation pillar, it will involve opening up to trade in services in order to benefit from the many innovations in services that have been developed in advanced economies. However, it will also involve innovating for the local market.

Another area of services that has great potential for the PRC is manufacturing, which has grown in recent times in developed markets to bring value addition to manufacturing. The proportion of manufacturers in the PRC offering services increased from 2% in 2007 to 20% in 2009 (Neely, Benedetinni, and Visnjic 2011). In moving toward higher value addition in manufacturing, the PRC could greatly benefit from extending the range of manufacturing services so that its transition from a factory of the world to an advanced economy can be facilitated.

The PRC has also created a unique footprint in emerging as the e-commerce powerhouse of the world. The country has become the world's second-largest e-tail market, with estimates as high as $210 billion for revenues in 2012 and a compound annual growth rate of 120% since 2003. Its retail sector already is among the most wired anywhere—e-tailing commanded about 5%–6% of total retail sales in 2012, compared with 5% in the US (McKinsey 2013). The PRC is

now the foremost digital retail market in value and penetration (Bain & Company 2013). With a large proportion of educated university graduates, the promotion of entrepreneurship in digital enterprises would help to spread the benefits of the explosion of e-commerce. A related area is that of creative goods and services in which the PRC has carved itself a niche.

Way Forward

Although categorized now as an upper-middle-income economy, there is still a long way for the PRC to grow out of the middle-income range. To avoid being trapped in this range, the PRC needs to develop its KBE road map. The role of government will continue to be important in promoting policies and initiatives for KBE. However, there needs to be more focus on market-based mechanisms and private sector investments need to be sought. Collaboration between universities and the private sector is crucial.

The following is a summary of the key points under the different pillars:

Economic Incentive and Institutional Regime: A shift to an innovation-driven economy is a key priority for the PRC. It needs to improve its poor ranking in cost of doing business (except enforcing contracts) and improve IPR protection. Furthermore, the thin and government-dominated venture capital fund market needs to have more private participation.

Innovation: While the PRC has done very well on many fronts, it also faces challenges. R&D expenditure has increased from 1.1% in 2002 to 1.6% of GDP in 2012, the highest among emerging economies, and it is expected to reach 2.0% by 2020. The PRC is also leading in terms of patent applications. Commercialization of patents leaves much to be desired and there are considerable weaknesses in the enforcement of laws to protect intellectual property. The IPR regime is considered poor by foreign investors. On inputs to innovation—R&D personnel and R&D expenditures—the PRC has done very well. However, there is need to link R&D to commercialization and to long-term plans for competitiveness, as well as to promote greater private R&D, as advanced economies have done at the middle-income level.

Education: Tertiary enrollment in the PRC has seen the fastest growth in recent times. However, there is the growing problem of graduate unemployment. The dramatic increase in tertiary enrollment has not focused on market needs, nor specifically in building the human capacity needed for competitiveness in knowledge-intensive sectors, as Singapore ensured, for example.

Information and Communication Technology: The PRC needs to make up for lost ground in ICT network readiness and offer competitive prices for services. The promotion of competition in the telecom sector and the spread of the benefits of connectivity to rural and unserved areas will greatly promote inclusive growth. The dominant position achieved by the PRC in e-commerce can further spur competitiveness in high-end services sector occupations with well-orchestrated improvements in telecom infrastructure, universal broadband connectivity, and development of human capital for a digital economy.

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State of India's Knowledge-Based Economy

Introduction

Following the implementation of market-based reforms in the 1990s which led to the opening up of the economy and a wave of liberalization, India has achieved impressive growth rates. Currently, the Indian economy is the tenth largest in the world as measured by nominal gross domestic product (GDP) at $1.876 trillion[22] and the third largest by GDP purchasing power parity (PPP). However, in per capita terms, India was classified as a lower middle-income country with a per capita GDP of $5,401 in 2013.[23] The structural reforms triggered by a severe balance of payment crisis in the 1990s took the country forward from a closed economy to one that is more integrated with the world market by opening up to international trade and investment, phasing out quantitative restrictions, reducing tariffs, and instituting deregulation and privatization. In 2010, India's GDP grew at 10.1% compared to 10.4% growth in the People's Republic of China (PRC), 9.5% for developing countries in Asia, and 7.4% among emerging and developing economies. Although the growth rate slowed substantially to 7.7% in 2011, it was still higher than the average growth rate of emerging economies (6.4%). India's growth rate fell further to 4.4% in 2013, but the country is projected to grow at 6.4% in 2015, which is higher than the average projected growth rate of emerging and developing economies at 5.3% (IMF 2014). In 1990/91, the value of exports was $18 billion, which increased to $305 billion in 2011/12, and the value of imports increased from $24 billion to $489 billion at an annual growth rate of 15.4%. In 1995, the share of export of goods and services to GDP was 11% and increased to 25% in 2013.

India's economic growth in recent years has largely been driven by the growth in the services sector, which is the largest contributor to GDP. The share of services in GDP increased from around 40.3% in the 1980s to 53.7% in the 2000s, while the share of manufacturing increased slightly from 22.3% to 24.5% and the share of agriculture declined from 33.3% to 21.8%. In 2012/13, the share of the services sector in India's GDP was 58.8% compared to 25.3% for manufacturing and 15.9% for agriculture.[24] This growth of services was driven by the growth of knowledge-based subsectors such as business services (including information technology) and telecommunications (Mukherjee 2013). Services have become an important component of India's trade basket and exports of services are driven by exports of knowledge-based services, namely information technology (IT) and IT-enabled services (ITeS) and business services. India's rank in commercial services exports improved from 28th in 1998 to 8th in 2011 (World Bank 2012).

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22 GDP (current $). *World Bank World Development Indicators (retrieved 1 July 2014)*.

23 GDP per capita, PPP (current international $). World Bank World Development Indicators database (updated 1 July 2014; accessed 2 July 2014).

24 From author's calculations based on National Accounts Statistics, Central Statistical Organisation, Ministry of Statistics and Programme Implementation (MOSPI).

In recent years, the agriculture sector has seen a low growth rate and low productivity, but this sector has witnessed several innovations in the past. The "green revolution" in the 1960s and the "white revolution" in the 1970s helped India attain self-sufficiency in food grains and become the largest milk producer of the world.

Growth has become more effective at reducing poverty. Between 2005 and 2012, India lifted 137 million people out of poverty and reduced the poverty rate from 41.6% in 2005 to 22% in 2012. It is to be noted that a much larger fraction of the decline in poverty is taking place in low-income states, and the poorest 40% are increasingly sharing the benefits of growth. However, inequality has continued to increase—the Gini coefficient rose from 30.9 in 2005 to 32.3 in 2012—and growth of the bottom 40% has not yet fully caught up with the average (World Bank 2013). Thus, poverty and vulnerability are still important concerns that call for an inclusive approach to growth and development.

The importance of the knowledge-based sectors in India's trade and investment has increased over time. For example, computer and information services and business services are India's core strengths in exports of services. India's share in global services exports has steadily increased since the 1990s. In 2011 and 2012, India was the world's largest exporter of computer and information services (World Bank 2013).

India is likely to experience a dramatic increase in the size of its middle class (typically with an income of $10 per day) from 5%–10% of its population in 2010 to even 90% in 30 years. With a projected population of 1.6 billion for 2039, India could add well over 1 billion people to its middle-class ranks by 2039. Between 2015 and 2025, half the population is projected to surpass the $10 per day line, and enter the middle class (Kharas 2010). Growth in consumption by this middle class is no less dramatic. The global share of consumption by India's middle class (in 2005 dollar terms) is projected to be 11% in 2020 (compared to the PRC's 13%) and 23% in 2030 (compared to the PRC's 18%). Consumption by India's middle class in 2020 is estimated to be the third largest in the world, climbing to the top spot as the world's leader in 2030 (Kharas 2010). An increase in the size of its middle class leads to changes in demand and consumption patterns and an increase in discretionary consumption expenditure (McKinsey Global Institute 2007). Households are investing more in education and technology-intensive products such as mobile phones, laptops, and computers, thereby leading to an increase in technology adoption in India. IT spending in India is projected to total $71.3 billion in 2014, a 5.9% increase from $67.4 billion in 2013, which includes expenditures on mobile phones and electronic devices such as computers and laptops.[25] These changes in consumer demand patterns are likely to support the development of a knowledge-based economy (KBE).

A key policy issue in India is to overcome the middle-income trap through high but inclusive growth by developing as a KBE, leveraging on its strengths in human capital and sectors such as IT and ITeS. India's demography is also potentially highly advantageous with a population of 1.21 billion, of which around 65% is in the working-age group (15–64 years).[26]

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[25] For details, see http://www.gartner.com/newsroom/id/2610615 (accessed 15 May 2014).

[26] See Census of India, 2011 at http://censusindia.gov.in/ (accessed 8 July 2013).

Challenges Faced by the Economy in India

Unlike the PRC and other countries in East Asia and Southeast Asia, the share of manufacturing in GDP has been stagnant and the Indian manufacturing sector has not been a key contributor to the country's growth process (Banga 2005; Mukherjee 2013). In fact, the manufacturing sector largely constitutes labor-intensive manufacturing and the country has not been very successful in developing high-value manufacturing (Kathuria, Kedia, and Balakrishnan 2014).

Slowing Growth and the Need for Refining Development Approaches

India's economic growth during the last decade has largely been derived from the abundant supply of a low-cost workforce. During the decade from 2000 onward in particular, India enjoyed exemplary growth rates. In the past few years, economic growth has started to slow down. In 2012, the growth rate decelerated to about 5%, after having averaged 8% in the previous decade. To sustain economic growth, Indian policy makers have argued that the country needs to focus on enhancing productivity and efficiency, and move toward high-value and technology-intensive manufacturing, and focus on further development of knowledge-based services. This requires supportive policies to make a transition from labor-intensive productive sectors to technology- and knowledge-intensive growth processes. In recent years, environmental sustainability and inclusiveness of growth have also come to occupy important priorities.

Slowing Process of Reforms

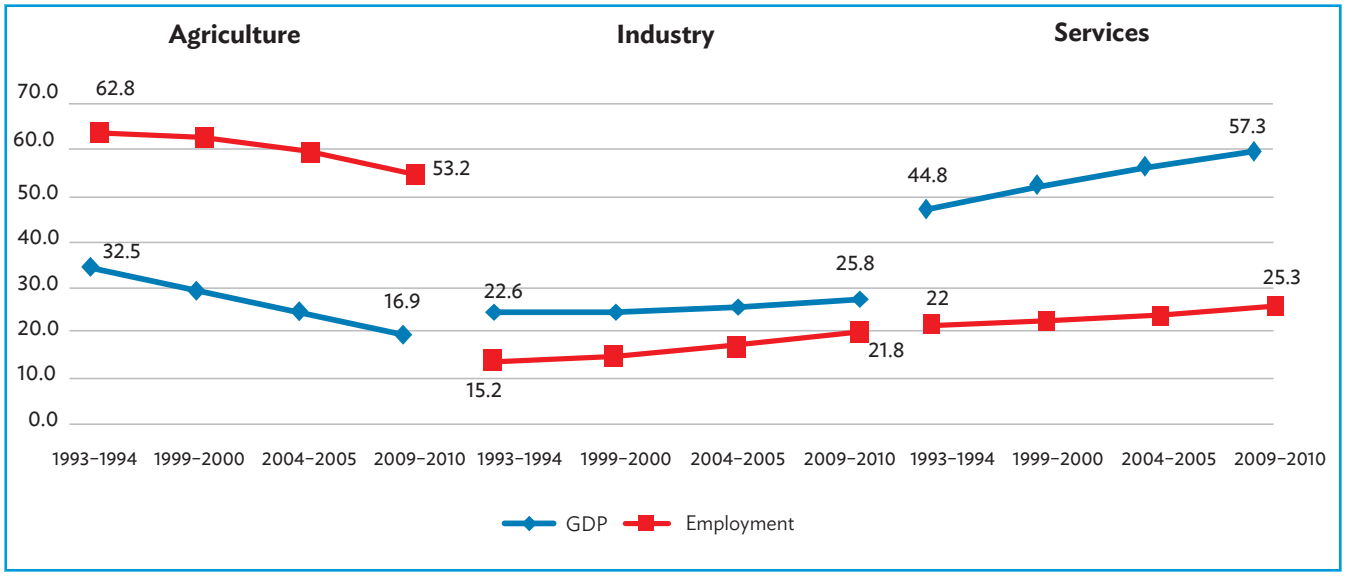
In recent years, the reform process has slowed down. The momentum of earlier reforms needs to be sustained and new ones need to be generated within the context of the contemporary global order. Some of the key concerns include rising food prices, rising inflation, lack of adequate job creation, and weakening of the rupee. India has the potential to regain the high growth rates of the past by giving attention to reducing administrative and regulatory barriers to companies, containing the budget deficit, and taking forward reform of tax and foreign investment rules. Barriers to international trade and investment remain high in some important sectors, and the financial sector needs further reforms to ease flow of funds to new and innovative companies. Labor market regulations need to be reformed to support the creation of more and higher-quality jobs. Promoting good governance is essential in in the public sectors. Industrial and infrastructure projects, including information and communication technology (ICT), need speeding up (OECD 2011). Several bills that are crucial for developing India as a knowledge economy are pending in Parliament. These include the Higher Education and Research Bill, 2011; the Educational Tribunal Bill, 2010; the National Accreditation Regulatory Authority for Higher Educational Institutional Bill, 2010; and the Foreign Educational Institutions (Regulation of Entry and Operations) Bill, 2010. The country has yet to implement labor reforms and reforms to remove distortions in the product and land markets (Mukherjee 2013).

Eroding Value of the Manufacturing Sector

India has not been successful in developing the manufacturing sector to the extent of its potential or in becoming an integral part of the global production network. Manufacturing

growth decreased from 9.2% in 2004–2005 to 3% in 2011–2012.[27] Unlike other countries where structural transformation led to a shift in economic activity from agriculture to industries and then to services, in India there has been a shift from agriculture to the services sector, almost bypassing the manufacturing sector focus. In addition, the shift in economic activity from agriculture to services in terms of share of GDP has not been matched by commensurate growth in employment generation in the services sector (Figure 12). These trends have triggered concerns of unemployment growth in the services sector and disguised unemployment in the agriculture sector (Banga 2005; Bosworth and Maertens 2010; Kochhar et al. 2006).

Figure 12: Share of Different Sectors in Gross Domestic Product and in Employment in India



GDP = gross domestic product.
Source: Author's calculations based on the National Accounts Statistics, Central Statistical Organisation, Ministry of Statistics and Programme Implementation and National Sample Survey Office Reports on Employment and Unemployment in India, various issues.

Slackening Productivity Levels

Indian manufacturing and services suffer from low labor productivity, albeit with subsectors that have positive trends. For instance, financial, business, and communications services have high labor productivity (Bosworth, Collins, and Virmani 2007; Bosworth and Maertens 2010; Eichengreen and Gupta 2010). Overall productivity growth in India has been steadily going down, from 5.8% in 2011 to 3.1% in 2012 and to 2.4% in 2013. This is despite a marginal decline in employment growth (from 1.8% in 2012 to 1.7% in 2013) as output declined much faster (from 5% in 2012 to 4.2% in 2013) (The Conference Board 2014). Lack of adequate labor market reforms and slow opening up to foreign direct investment (FDI) has hampered productivity growth. A severe lack of skilled employees has triggered high-skilled wage rates, thereby making businesses less competitive. Slowing productivity is a cause for concern, particularly from the point of view of making India a KBE.

[27] See Economic Survey of India 2004–2005 and 2012–2013 at http://indiabudget.nic.in/ (accessed 8 July 2013).

Inadequate Integration with and Value Creation in the Global Economy

India's integration with the global economy is low compared to other emerging markets. The country has been experiencing a rising deficit in trade in goods. The share of trade in India's GDP has been low even though India's trade in services as a percentage of GDP is one of the highest. India has a large and growing negative trade balance in goods trade, which is a cause for concern for policy makers. Compared to the PRC, India's impact on world manufacturing value added and world manufactures trade is negligible—at 2.02% and 1.73%, respectively, in 2010 compared to the PRC's 15.3% and 14%, respectively (UNIDO 2013).

India's exports basket has limited diversification and largely comprises primary products, while the country imports finished products. Considering only the exports of special economic zones (SEZs) in the country, in 2010–2011, 76% of the total exports consisted of computer software, chemicals and pharmaceuticals, and gems and jewelry.[28] SEZs in India have high import content and focus on processing with limited value addition. In contrast, economies such as the PRC, the Republic of Korea, and Taipei,China have used SEZs to move into high-value manufacturing and have concentrated on products such as ICT equipment, electronics, and semiconductors.

Inadequate Human Capital Base and Skills Mismatch

The share of people in India with a secondary education is only half that of the PRC, which could continue to exert limitations on the availability of medium-skilled workers. Between 2010 and 2030, India will add 28 million workers to the labor force, compared to 13 million by the PRC. However, the growth in tertiary education workers in India in the same period is projected to reach 27 million compared to 30 million in the PRC (McKinsey Global Institute 2012). Lack of high-skilled workers will impede the advancement of a KBE in the country. In a survey of employers across 42 countries, 64% of employers in India reported difficulties in filling jobs against an average of 36%. The survey places India as the third most talent-short economy (ManpowerGroup 2014). India's National Skill Development Corporation has forecast an incremental shortfall of 240 million–250 million people by 2022 in high growth sectors of the Indian economy and the informal (unorganized) sector.

Assessment of the Four Knowledge Economy Pillars

India's performance in the Knowledge Economy Index (KEI) has worsened since 2000 compared to other economies in the region who did better, such as Indonesia (108th), Malaysia (48th), the PRC (84th), Sri Lanka (101st), and Thailand (66th) (see Table 6). India's KEI value is about 2.5 times lower than the average for the Organisation for Economic Co-operation and Development (OECD) members. With the exception of the innovation subindex, India's performance on the other three pillars is below even the average of the Asia and Pacific region.

[28] Data provided by the Directorate General of Commercial Intelligence and Statistics during survey.

Table 6: India and the Knowledge Economy Index

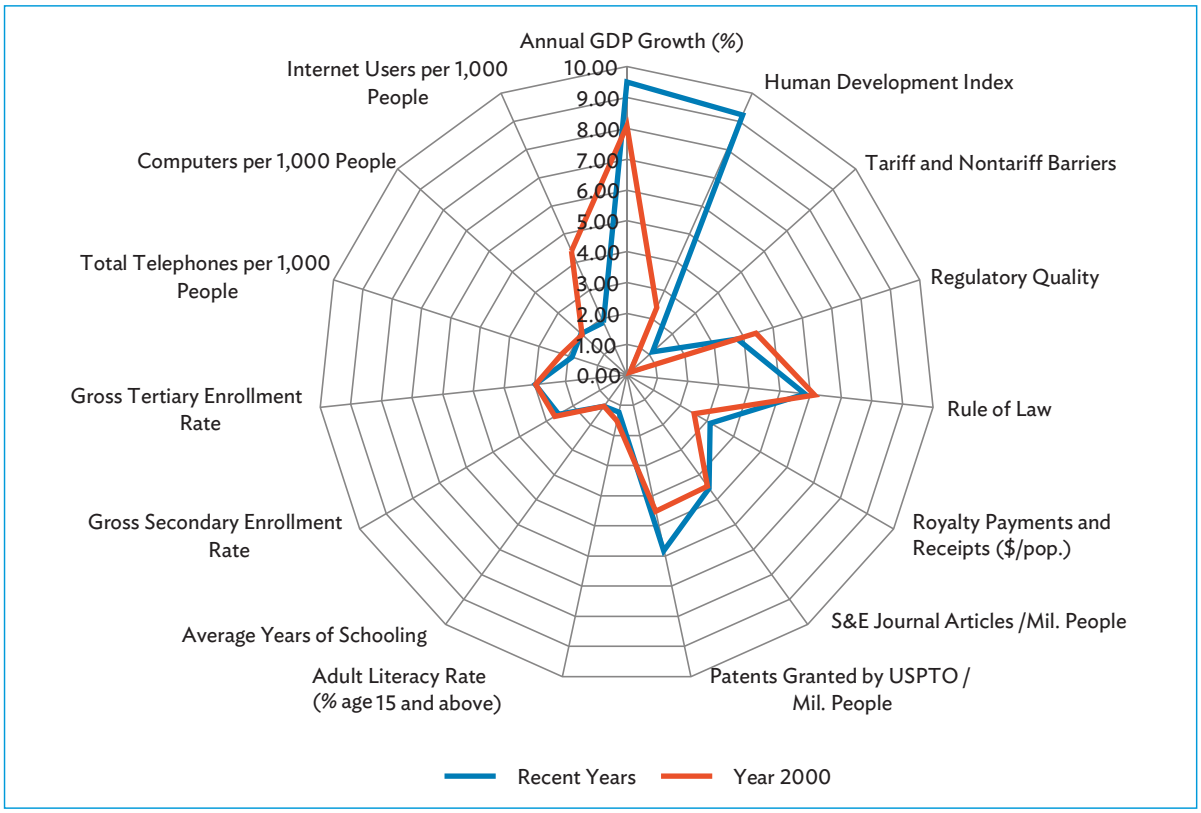
Year	Rank	KEI	EIR	Innovation	Education	ICT
1995	106	3.57	3.57	3.70	2.51	4.50
2000	103	3.14	3.56	3.83	2.30	2.85
2012	109	3.06	3.57	4.50	2.26	1.90

ICT = information and communication technology, KEI = Knowledge Economy Index.
Source: World Bank, Knowledge Assessment Methodology. http://www.worldbank.org/kam.

The KEI uses several variables as proxies to analyze the performance of a country on the four pillars. Figure 13 presents India's score on these variables in 2000 and in 2012.

Figure 13 shows an improvement in annual GDP growth rate, the Human Development Index, and patents granted by the US Patent and Trademark Office. All the other indicators have not shown improvement. In the context of developing as a KBE, the gross enrollment ratio in secondary and tertiary education and the availability of telephones, computers, and the internet are causes for concern. The poor quality of regulations and the presence of several tariff and nontariff barriers to trade have affected India's overall rank on the KEI.

Figure 13: India's Knowledge Economy Scorecard on Select Variables, 2000 and Most Recent Period



GDP = gross domestic product, S&T = scientific and technical journal articles, USPTO = United States Patent and Trademark Office.
Note: Each of the 80 variables in the Knowledge Assessment Methodology is normalized on a scale of 0 to 10 for 146 countries. The fuller the scorecard, the better poised a country is to embrace the knowledge economy. However, an economy should not necessarily aim for a perfect score of 10 on all variables because the scorecards may be shaped by the structural characteristics of an economy or by trade-offs that characterize different development strategies.
Source: World Bank, Knowledge Assessment Methodology. http://www.worldbank.org/kam.

Economic Incentive and Institutional Regime

India scores low on regulatory quality and rule of law. In 2013, the World Bank's Doing Business Indicators ranked India 132nd among 185 countries, which is much lower than the ranks of Malaysia (12th), the PRC (91st), the Republic of Korea (8th), Sri Lanka (81st), and Thailand (18th).[29] With 13.7% average tariffs, India has one of the highest tariffs in the world.

India has not been able to attract significant FDI in manufacturing (23% of total FDI in 2010–2011) compared to the services sector (43%).[30] The Inward FDI Performance Index of UNCTAD[31] shows that India (ranked 97th in 2010 among 141 countries) has been attracting less FDI than other emerging markets such as Brazil (69th), the PRC (79th), and Mexico (84th). While additionally India ranked 3rd among 182 countries in terms of inward FDI potential, it ranked 59th among 182 countries on the inward FDI attraction index in 2011, thus revealing that it has not been able realize the potential that exists for FDI.[32]

Economic incentive and institutional regime (EIR) policies need to draw on India strengths, such as democratic governance, sound and independent judiciary, diverse scientific and research base, good intellectual property rights (IPR) laws, presence of a robust private sector, and a growing middle class that is willing to spend on education and technology. The government's Science, Technology and Innovation Policy of 2013 also supports the development of a KBE. The government has set up various committees to suggest policies and reforms for the knowledge economy sectors. Once these policies and documents are consolidated, India can easily develop a vision document for KBE development to move toward a KBE.

In terms of new policies, two are likely to be beneficial for advancing the knowledge economy. The National Manufacturing Policy of 2011 aims to increase the share of manufacturing in national GDP to at least 25% by 2022 and create 100 million additional jobs. By January 2014, 12 national manufacturing investment zones (NMIZs) had been announced; these zones will encompass SEZs, industrial clusters, integrated townships, world-class logistics infrastructure, training facilities, and single-window administrative procedures. In 2013, the Ministry of Commerce and Industry proposed a National Services Competitiveness Council to provide an institutional framework for the growth of the services sector that would enhance its global competitiveness and diversify the exports basket. This is similar to what Singapore did to help its services sector move up the value chain and is thus in the right direction. The Science, Technology and Innovation Policy aims to establish world-class infrastructure for research and development (R&D) in India and to position the country among top five global scientific powers by 2020. These policy measures are all highly supportive of development of a KBE; however, implementation quality will be critical to their success.

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29 See the World Bank Doing Business Report 2013 at http://www.doingbusiness.org/~/media/GIAWB/Doing%20Business/Documents/Annual-Reports/English/DB13-full-report.pdf (accessed 8 July 2013).

30 For details, see http://www.rbi.org.in/scripts/bs_viewcontent.aspx?Id=2513 (accessed 20 May 2014).

31 For details, see http://archive.unctad.org/Templates/WebFlyer.asp?intItemID=2471&lang=1 (accessed 18 May 2010). The index ranks a country on the basis of a ratio of the country's share in global inward FDI flows to its share in global GDP.

32 For details, see UNCTAD (2013).

Key Guidelines for the Economic Incentive and Institutional Regime Pillar

- **Dismantling barriers to trade and investment.** If India needs to progress rapidly from a low middle-income country to a high-income country, the next wave of economic reforms are required. A further round of liberalization and streamlining is called for. In the case of trade in goods, India still maintains one of the highest tariff rates and one of the most complex tariff structures, losing markets to countries like the PRC. India has included preferential tariffs under its different trade agreements, but studies have shown that this has led to trade distortions that put manufacturing facilities in SEZs within India at a disadvantage vis-à-vis firms located outside India. FDI, linked to technology transfer in key industries, needs to be further facilitated. Improved regulatory policies for investment protection are required to stimulate domestic investments.
- **Diversifying trade in goods and services.** India's exports in goods are largely concentrated in primary products and the country is a net importer of high-technology products such as electronic goods. Even though India exports $70 billion of software services, it imports $50 billion worth of IT hardware.[33] By 2020, India's electronics import bill is likely to reach $400 billion, surpassing India's fuel import bill (Deloitte 2013). This is a concern for policy makers. Although India has a positive trade balance in services exports, exports of IT and/or ITeS services constituted 33.45% of India's total services exports in 2013 followed by other business services (33%).[34] India is a net importer of transport and infrastructure services. The country's comparative advantage in computer and information services has been declining in recent times. India's IT and/or ITeS exports are largely concentrated in a few markets. For instance, the United States (US) accounted for 58.25% of the computer software and/or services exports in 2012–2013, followed by the European Union (27%).[35] Much greater product and market diversification is required for advancing KBE development.
- **Renewing regulations and enacting new ones for a knowledge-based economy.** The development and penetration for technologies such as cloud computing require supporting regulations in India. Government policies and regulations should take into account the evolving nature of knowledge-based sectors such as IT, telecommunications, and business services as well as their linkages with other sectors. The IT sector has become increasingly linked to other services, such as financial services and logistics and the use of mobile banking or e-tailing for service delivery can help develop knowledge-based sectors. The government has imposed restrictions on foreign investment in e-tailing and India does not have a robust e-commerce regulation. There is also need for a sound IPR regime that takes into account such new economy occupations.
- **Using technology to enhance transparency in governance and reduce corruption.** The unique identity project, the *Aadhaar* Scheme, will provide every Indian national with a unique identification number that can be used for efficient delivery of welfare services and effective monitoring of various government programs and schemes. E-governance needs to be ramped up also.

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33 See http://iii.gov.in/index.php?option=com_content&view=article&id=263:it-hardware-import-bill-to-surpass-fuel-import-costs-by-2020-fears-govt&catid=69:archive-news&Itemid=213 (accessed 16 May 2014).

34 Calculated from UNCTAD Statistical database. http://unctadstat.unctad.org/TableViewer/tableView.aspx (accessed 16 May 2014).

35 See Electronics and Computer Software Export Promotion Council (2011).

- **Incentivizing the development of high value services sector.** While this has been a clear area of strength for the economy, contributing to a great extent to the high growth story of the economy, there is an important need to ensure India's capabilities to move up the global value chain. Along with spurring manufacturing, India would benefit significantly by building capabilities in manufacturing-related services such as business services, financial intermediation, wholesale, design, R&D, engineering, branding, advertising and marketing, transport, and other services. This will help add value to the manufacturing sector, which has not seen robust growth in India.
- **Developing innovative financing options.** To mitigate the high cost of borrowing there is need to develop innovative financial products to serve the needs of small and medium-sized enterprises (SMEs) and micro-, small, and medium-sized enterprises (MSMEs) to operate in knowledge-intensive sectors. The proliferation of venture capitalists should be encouraged to finance innovators and start-up businesses that develop new technologies and technology commercialization.
- **Supporting the development of entrepreneurship.** A growing number of entrepreneurs are undertaking initiatives to establish start-ups, for which they require a conducive environment and infrastructure. The government can work with research and academic institutes to set up incubation centers for the training and development of entrepreneurs. Entrepreneurs need space and seed funding, which could be channeled through government and private sources. Venture capitalists can be encouraged through policy incentives to support entrepreneurs.

Education and Skills

India's recent 5-year plans (FYPs) have provided substantial budget allocations to education. In the 11th FYP (2007–2012), the plan outlay for education increased fourfold compared to the previous FYP to Rs3 trillion (approximately $66 billion)[36] and then to Rs4.5 trillion (approximately $72 billion)[37] in the 12th FYP (2012–2017). The 1990s and most of the 2000s were dedicated to expanding access to primary education across the country, which has led to tremendous progress in increasing enrollment and school participation in India, even in the most remote districts of the country. In recent years, the emphasis on secondary and tertiary education has been building up. More recently, the Government of India has started focusing on higher education. The Right to Education Act of 2010 makes education a right for every child in the 6–14 age group. The country is implementing nationwide programs for elementary (Sarva Shiksha Abhiyan), secondary (Rashtriya Madhyamik Shiksha Abhiyan), and higher education (Rashtriya Ucchatar Shiksha Abhiyan) for universal access across all levels. India has a large pool of graduates and postgraduates. In 2012, this was nearly 4.4 million, of which about 25% (nearly 1.1 million) had technical qualifications in computer science, information systems, and design engineering (Nasscom 2012). India can build on this base of qualified people who can contribute to the development of a KBE.

The 12th FYP has provided high priority to skills development. A large number of policy initiatives and implementation mechanisms have been put in place to increase skills development with the ambitious target of reaching 500 million skilled workers by 2022. The setting up of institutions

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[36] Calculated by using the average exchange rate of $1 = Rs45.37 for the period 1 April 2007–31 March 2012, from the Reserve Bank of India.

[37] Converted using current exchange rate of $1 = Rs62.15 from www.oanda.com (accessed 2 December 2013).

such as the National Skill Development Corporation (a private–public partnership to scale up skills development across the country) and the National Skill Development Authority to provide an overarching framework for quality assurance through the National Qualification Framework are important steps in the right direction. Considerable achievements are already in evidence.

Table 7 shows that the majority of migrants to the OECD region across different professional categories are from India.

Table 7: Number of Migrants to OECD Countries by Professional Category (in November 2013)

Professional Category	PRC	India	Indonesia	Kazakhstan
Physicists, chemists, and related professionals	725	855	65	11
Mathematicians, statisticians, and related professionals	75	54	12	4
Computing professionals	4,238	15,184	926	63
Architects, engineers, and related professionals	2,646	5,504	3,084	111
Health professionals (except nursing)	1,834	18,953	2,724	116
Nursing and midwifery professionals	889	1,052	169	15
Teaching professionals	113	111	41	..
College, university, and higher education teaching professionals	3,862	4,334	393	53
Secondary education teaching professionals	719	3,004	3,293	114
Social science and related professionals	769	1,489	131	46
Legal professionals	237	1,459	45	22
Total of above categories	**16,107**	**50,540**	**10,883**	**555**

OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China.
Source: Compiled from OECD Statistics. http://stats.oecd.org/ (accessed 5 May 2014).

Public expenditure on education has continuously increased over the past two decades. On average, the combined central and state government expenditure has risen at an annual rate of around 6% in real terms since the early 1990s. However, this is not enough to meet the needs of the growing population and the role of the private sector in higher education has been increasing, especially in areas such as engineering and management. In 2008–2009, the private sector accounted for 67% of total expenditure in higher education (Ernst & Young 2011).

With the entry of private enterprises, there is a need to compare and evaluate the courses and curricula offered by different institutions. The government has started to focus on the quality of education and learning outcomes and a national qualification framework is currently under development. The Regulatory Authority for Higher Education (2010) to provide mandatory accreditation in higher education has been set up. At present, accreditation is voluntary; as a result, less than one-fifth of the colleges and less than one-third of all universities have obtained accreditation.

There is a mismatch between demand and supply in higher education at three levels: low enrollment numbers, disparity in access, and poor quality of education (Ernst & Young 2011). First, the gross enrollment ratio in higher education is low at 20.4%[38] compared to other countries, such as Australia (77%), Brazil (34%), the PRC (26%), the United Kingdom (57%), and the US (83%) (Ernst &Young 2011). Technical and vocational education and training (TVET) has far lower coverage. Only 5% of the population in the 19–24 age group had acquired skills under vocational education by 2010.[39] Second, there is wide disparity in access to education across gender, states, regions, and communities. In 2010–2011, the gross enrollment ratio in Delhi was 31.9%, while in Assam it was 8.3%. Third, the quality of higher education is poor. According to a report by Federation of Indian Chambers of Commerce and Industry (FICCI) in 2010, India produces about 350,000 engineers and 2.5 million university graduates every year,[40] but about 5 million graduates remain unemployable at any given point because they are inappropriately skilled. A survey by McKinsey Global Institute showed that only 25% of Indian engineers are employable.[41]

The lack of well qualified faculty and outdated curricula, along with relatively poor infrastructure, makes it a daunting challenge to increase quality. According to Ernst & Young (2011), 45% of the positions for professors, 51% for readers, and 53% for lecturers were vacant in Indian universities in 2007–2008. Several private engineering colleges are closing down in India due to lack of quality faculty.[42]

Unlike countries that have entered into mutual recognition agreements with their trading partners for easier movement of professionals across countries, India has not done so. The Washington Accord signed in 1989 is an international agreement among bodies responsible for accrediting engineering degree programs. It recognizes the substantial equivalency of programs accredited by those bodies and recommends that graduates of programs accredited by any of the signatory bodies be recognized by the other bodies as having met the academic requirements for entry to the practice of engineering. Economies such as Malaysia, Taipei,China, Japan, the Republic of Korea, and Singapore are signatories to this agreement. India has provisional status. If India signs this agreement, it will facilitate free movement of Indian engineers among the signatories and the signatories will recognize each other's degrees. Another example is the India–Singapore Comprehensive Economic Cooperation Agreement (2005), wherein there is a provision for mutual recognition agreements in the fields of medicine, nursing, dentistry, chartered accountancy, company secretary-ship, and architecture, but no progress has been made. India's competitive advantage in exporting skilled professional services can be realized better if the country signs international agreements that facilitate professional movements. This is increasingly vital for a borderless global economy.

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38 All India Annual Survey on Higher Education, Ministry of Human Resource Development, 2011–12. http://mhrd.gov.in/sites/upload_files/mhrd/files/AISHE2011-12P_1.pdf (last accessed on 20 May 2014).

39 For details, see http://www.ide.go.jp/English/Events/Ideas/pdf/2010/dutt01.pdf (accessed 12 January 2013).

40 See http://business.outlookindia.com/article.aspx?264961 (accessed 8 July 2013).

41 See http://business.outlookindia.com/article.aspx?264961 (accessed 8 July 2013).

42 See http://www.universityworldnews.com/article.php?story=20130221160706547 (accessed 19 May 2014).

Key Guidelines for the Education and Skills Pillar

- **Implementing reforms in higher education system management and governance.** Lightening the regulatory framework, enabling the private sector to invest, and improving the governance of higher education are crucial to strengthen the quality and relevance of tertiary education. The cluster of education bills awaiting parliamentary clearance need to be expedited to clear the ground for reforms for improving quality and governance, foreign investment, and collaboration.
- **Developing world-class tertiary education system through partnerships.** India can learn from the example of Singapore in developing higher education by collaborating with leading foreign universities of the world. The government provided world-class infrastructure facilities, quality of governance, strict regulation on intellectual property, and a strong basic education system that attracted 16 foreign universities to Singapore within a decade. Singapore has now become the "Boston of the East" with the country raising the share of education services to 5% of GDP from 1.9% in 2004 (Kapur and Crowley 2008).
- **Focusing on the quality of education.** In addition to improving the availability of good faculty, good infrastructure, and a good curriculum, there is need to strengthen the relevance of education in the job market. The national qualification framework should be based on a robust mechanism of quality assurance for educational infrastructure and standards for teaching professionals and student learning.
- **Aligning education and skills development and industrial policies.** Linking education policies with the talent needs of industrial clusters and the newly formed national manufacturing investment zones would help to create adequate human resource capacity to spur economic activity. Industrial corridors such as the Delhi–Mumbai Industrial Corridor (DMIC), which aims to develop new industrial cities as "smart cities" by applying next-generation technologies to infrastructure development, would also need access to high-skilled workers. DMIC is expected to serve as a global manufacturing and trading hub and thus expand India's manufacturing and services base. Such clusters of high-potential economic activity need to be supported with clusters of educational and training institutions. The location of community colleges, polytechnics, and technical/engineering institutions will help to build the talent required. Developing and strengthening industry–university partnerships in such clusters will go a long way to build the talent pool needed for knowledge economy occupations.
- **Targeting talent development for the high-tech sector.** Next-generation technologies like mobility solutions, cloud computing, and analytics will not just create new sources of demand in India but will give birth to new business and service models. Qualified professionals are required to realize the potential such technologies offer as economic activities to take the growth rates forward in the country. Courses and curriculaneed to be developed for such emerging occupations.
- **Applying ICT in education to develop transformational pedagogy.** In a country with a large pool of IT professionals and strong capabilities in the sector, there is need to develop a blueprint for ICT in education that produces new approaches for a "digital generation" of learners. Breaking away from past legacies, India stands to gain tremendously by applying forward-looking technical solutions to serve education. In addition to Indian Institute of Technology (IIT) Bombay, which entered into a partnership with edX, set up by the Massachusetts Institute of Technology and Harvard University to launch massive open online courses (MOOCs) in India, other players also need to consider the potential of online learning systems. The plans under way to develop partnerships with other IITs and industry stalwarts

like Infosys, TCS, and Cognizant together with the IT industry association Nasscom to launch free online courses, initially in computer science, would contribute to scaling up access to high-quality education and job readiness. Leading Indian educational institutions need to expand their international and national outreach in finding technology solutions to increase tertiary enrollments. A nationwide digital literacy plan is important to build workforce skills for an increasingly digital workplace. The National Digital Literacy Mission aims to make at least one person in each household digitally literate by 2020. To achieve this objective, over 240 million Indians would need to become digitally literate. Intel's partnership with the Government of India is a good example to consider for scaling up.

- **Facilitating the setting up of corporate universities.** Given the extensive involvement of Indian companies in establishing their own academies and training facilities, the government would do well to enable procedures to recognize, accredit, and provide certification for on-the-job training and enterprise-based training.

Innovation and Technological Adoption

India improved its performance significantly only in the innovation pillar of the KEI, compared to the year 2000. India's R&D expenditure as a percentage of GDP was only 0.9% in 2011, which needs to increase at least to 1.5% to enable a critical mass of high-quality R&D to support the transition to a high-income economy. Although India doubled its R&D spending between 2007 and 2012 to $40 billion, it still lags behind the PRC's spending of $200 billion. Nevertheless, both the PRC and India are now recognized as important global spenders on R&D. The number of patent applications in India is much lower than in several other emerging economies. More nonresident Indians file patent applications than resident Indian, whereas in the PRC and the Republic of Korea, residents have filed more patent applications. IPR protection is considered weak although the laws by themselves are considered robust.

India has a diverse science and research infrastructure. In addition to the network of the Council of Scientific and Industrial Research as well as research institutes, laboratories, and field stations, private participation in R&D has increased in recent years. There are several private initiatives to facilitate research and innovation. For instance, the ICICI Knowledge Park (IKP) located in Hyderabad (Andhra Pradesh) has a wet laboratory with utilities for customized R&D centers. They undertake business-driven research. Companies such as IBM India also have a research lab for product development and knowledge-intensive activities.

In recent years, the government has taken various measures to promote research and innovation. In 2010, the government set up the National Innovation Council to formulate a road map for innovation for 2010–2020 with a focus on inclusive growth. The aim is to strengthen industry clusters and linkages between innovation, education, and the development of entrepreneurs. The establishment of the India Inclusive Innovation Fund, a venture capital fund, is an important step to instigate innovation with social benefits. As of 2012, 22 state innovation councils and 24 sectoral innovation councils have been set up. The reports of the sectoral innovation councils propose sector-specific reforms to ensure growth of knowledge-intensive sectors and R&D and innovation in India.

In 2013, the government announced the Science, Technology and Innovation Policy that aims to position India among the top five global scientific powers by 2020 by promoting scientific research and innovation, creating world-class infrastructure for R&D, promoting skills development, and

attracting talent in science and technology, among others. The policy identifies 10 sectors where resources can be deployed for R&D (including agriculture, health, and drug discovery). It stresses the need to enhance private participation in R&D through public–private partnership models, as well as to enhance the R&D intensity of the services sector focusing on modernization of technology-based services and the creation of a regulatory and legal framework for sharing of IPR between investors and Innovators.

India is also fast gaining credibility as a global R&D hub. Research reveals that Fortune 500 companies operate captive R&D facilities in India. Companies want lean and nimble innovation hubs in emerging markets that do not take the traditional "captive" route of owning all resources. Instead, these hubs partner with local universities and start-ups to build scale and speed in taking cutting-edge ideas to market. The hubs aim to design offerings that suit low-income and culturally diverse populations.

To enhance international collaboration in knowledge-based sectors, the government has signed agreements and memorandums of understanding for collaboration in science and technology with over 70 countries and is undertaking over 400 R&D projects with international collaboration.[43] Science and technology cooperation is a key component of India's bilateral free trade agreements. For instance, India's comprehensive economic partnership agreements (CEPAs) with the Republic of Korea and Japan have provisions for cooperation in the fields of science and technology, while India has a separate chapter on science and technology in its comprehensive economic cooperation agreement with Singapore. After the signing of the India–Republic of Korea CEPA, the two countries set up a joint cooperation fund of $10 million for the period 2011–2015 to implement joint research projects in science and technology. In January 2014, they agreed to create an additional joint fund of $10 million (with a contribution of $5 million by each side) to promote mega projects, which will be conducted jointly by industries, academia, and institutes.[44] The projects will focus on research leading to application and techno-commercialization.

The sectoral council report Sectoral Innovation Council on Industrial R&D[45] highlights the need to increase expenditure to 2% of GDP from the current 1%; set up more than 100 world-class research institutes and universities in collaboration with institutes in the US, Europe, and Japan; facilitate a reverse brain drain; enable the quick "productionization" of an idea; offer grants to in-house R&D units; convert ideas into products and market them; make innovation an integral part of engineering courses; commercialize products; and make technology transfer mandatory. The council has set quantitative targets for the creation of new research domains and innovation complexes as well as the number of scholars and postdoctorates that have to be achieved by 2020. There are also provisions for grants and funds to achieve this.

Key Guidelines for the Innovation Pillar

- **Increasing inputs for innovation.** On the one hand, India should increase spending on R&D and increase the number of scientific personnel; on the other, it should also improve the quality and productivity of R&D. Although India produces a large number of scientists

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43 For details, see Department of Science and Technology website http://www.dst.gov.in/ (accessed 2 July 2013).

44 See http://www.mea.gov.in/bilateral-documents.htm?dtl/22752 (accessed 14 May 2014).

45 For details, see http://www.innovationcouncil.gov.in/images/stories/sectoral/reports/DSIR_whitepaper_on_Industrial_RD.pdf (accessed 20 May 2014).

and engineers, the country has not successfully taken advantage of its human resource base. The country aims to increase R&D spending to 2% of GDP. It should increase to at least 1.5% of GDP as early as possible.

- **Increasing private sector participation in R&D.** Instead of tax benefits and/or subsidies, the government should have a low direct tax regime, which will encourage industry to invest in R&D, as for example in the case of Singapore. The 2% mandatory contribution for corporate social responsibility (CSR) that companies need to make can be broadened to include R&D. This will encourage the private sector to invest in R&D. Private R&D expenditure is concentrated in software and IT services with around 30% of expenditure directed toward this sector. Thus, R&D expenditure needs to be increased and diversified. Less than 10% of R&D is reported to be commercialized. Indian universities need to offer incentives for undertaking research. Like in the US, earnings from commercial patents can be shared with the innovators, which will encourage innovation and commercialization of R&D.
- **Improving IPR protection and updating IPR laws.** Indian companies, especially pharmaceutical companies, such as Ranbaxy Laboratories, are facing issues related to the sale of their products in the US. The US has placed India on its watchlist due to poor IPR and poor enforcement of copyright. Unless India has a strong IPR and copyright regime, the country cannot develop as an R&D hub. Software is under copyright and is not patented, but the majority (30%) of R&D in India is in the software and IT sector. Thus, Indian companies in the software sector must have their products patented in countries such as the US. New laws are required for software.
- **Enhancing the quality of research institutions.** There need to be greater linkages and networking among science and technology R&D institutions as well as greater coordination of R&D conducted by the research laboratories, education institutions, and industry. Science and technology parks and knowledge hubs need to be created in partnership with local industry and universities. These can be developed in cities such as Bangaluru (Karnataka), Hyderabad (Andhra Pradesh), Pune (Maharashtra), and Gurgaon (Haryana) where companies are already investing in R&D and innovation. In line with the recommendation of the Sectoral Innovation Council for Industrial R&D, 100 world-class research institutes and universities are to be set up. These should be established as centers of excellence close to industry clusters that have the potential to become leading players in global value chains. Increasing the notion of "innovation clusters" is gaining ground rather than very large innovation and technology parks. The bulk of the 100 centers should be established in this way.
- **Attracting foreign direct investment in R&D.** India still needs to cover much ground in attracting foreign investment in R&D. In addition to multinational corporations, domestic firms also need to invest in R&D. In services, India has attained global recognition in software outsourcing. Indian companies have developed competence in medical diagnostics, architecture design, and accounting. The country should strive to move up the value chain into outsourcing R&D services and this can be possible by attracting foreign companies to develop their R&D centers in India.
- **Enabling *frugal* or *jugaad* innovation for customers at the bottom of the pyramid.** India has been fairly successful in frugal innovation or *jugaad* (Krishnan 2010). Such innovations are beneficial for inclusive KBE strategies and to serve the needs of price-sensitive customers. Given this scenario, innovators in India can develop simple, cost-efficient innovations to replace more costly products from advanced countries or customize them for the Indian market. This has been particularly helpful in the Indian health-care system in areas such as medical equipment and eye surgery. Some frugal innovations in India have received global

recognition and are now used in other countries. Several frugal innovations in India are aimed at overcoming infrastructure challenges. For instance, many rural areas do not have access to electricity, so SELCO Solar provides low-cost and sustainable energy solutions and services to underserved households and businesses in rural areas. Through innovation, the company has reduced the cost of solar energy and widened electricity connectivity. Such trends need to be accelerated.

- **Establishing science and technology agreements.** Although India has signed bilateral science and technology agreements with several countries, these agreements are weak and mainly focus on collaboration rather than setting clear targets and implementation strategies. In its comprehensive agreements with Japan, Malaysia, Singapore and the Republic of Korea, India has separate chapters or sections on cooperation in the field of science and technology. However, these focus on cooperation, which is not legally binding. Most of the trade agreements are used for marketing products rather than for cooperating in the field of innovation to develop new products. India can take inspiration from the US and European Union trade agreements that have strong IPR clauses, going beyond the provisions in WTO. Trading partners such as Singapore have benefited from them in developing centers of excellence in R&D. Appropriate science and technology agreements may help attract R&D to India.

Information and Communication Technology

The ICT sector in India has seen double-digit growth in the post-liberalization period, although the extent of growth varies widely across different segments. Mobile telephones and the IT/ITeS sector witnessed very high growth, while the penetration of fixed telephone lines lagged behind. Communication services registered an average growth rate of 25.26% in 2000–2010. During 2008/09–2009/10, the sector grew by 32.2%, making it the fastest growing services sector in India.[46] Within communication services, the telecommunications sector witnessed significant liberalization and growth in this sector has been driven by mobile penetration. In 2010, mobile phones accounted for 96% of the total telephone subscribers[47] and India has the second largest wireless or mobile telecommunications network in the world (after the PRC) (DoT 2011). Although the number of internet and broadband subscribers has increased,[48] it is low compared to the population of the country. Due to competition, mobile call charges have substantially declined and are among the lowest in the world.

According to Nasscom estimates, industry revenues are likely to be $118 billion in 2014–2015, growing at 8.8% over 2013–2014. The Indian IT industry is a large employer, and it is estimated that in 2014–2015 the industry would provide direct and indirect employment to 13.1 million people (Nasscom 2014). With a large, educated, English-speaking workforce, India has developed as the top outsourcing destination in the world. A large proportion of the revenue of the Indian IT/ITeS sector comes from exports. In the financial year 2014, exports from India are likely to grow by 13% to reach $86 million. Within this, the share of IT exports is likely to be 64%, followed by business process management (23%) and software products (18%) (Nasscom 2014).

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46 Calculated by the authors from CSO data. The figures are at 2004/05 constant prices.

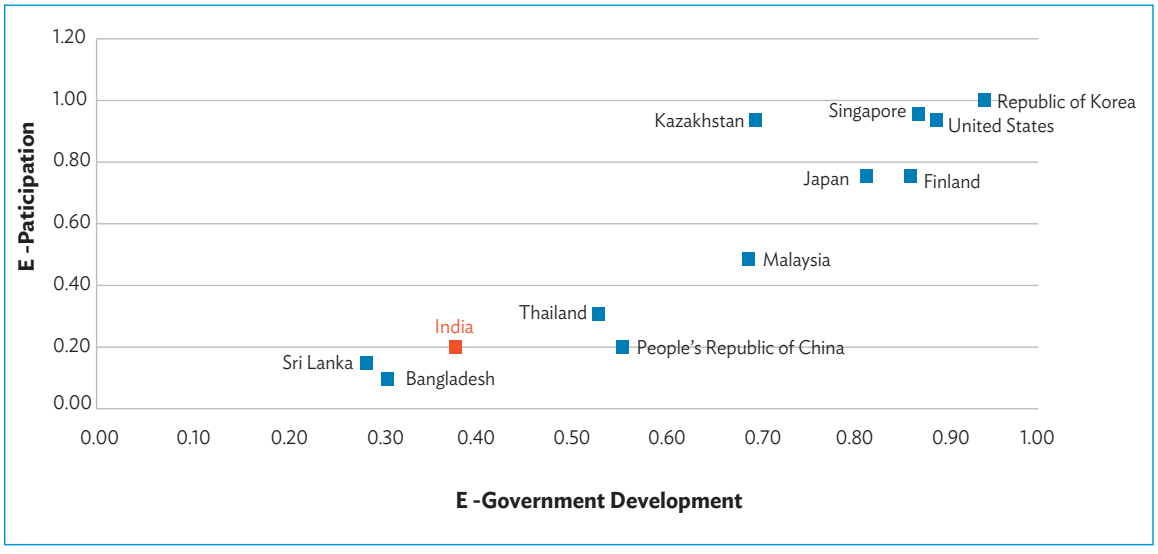
47 Calculated by the authors from data extracted from the International Telecommunication Union ICT Statistics Database (accessed 16 April 2012).

48 The number of broadband subscribers increased from 0.2 million in 2005 to 12.83 million in September 2011 (Department of Information Technology 2011; TRAI 2011).

Prior to the reforms, the telecommunications sector was a government monopoly, but the IT/ITeS sector has always been driven by the private sector. Privatization and the entry of foreign companies led to growth in this sector. In the post-liberalization period, India has created its own business models to deliver ICT services to large masses at low rates. India is known for its low average revenue per unit (ARPU) for mobile telephony across the world. ARPU in the United Kingdom and the US are in the range of $25–$50, but the corresponding figure for India is only $7.[49] The government has initiated several policy measures to promote the growth of the ICT sector and to support inclusive growth. For example, the National Telecom Policy 2012 aims to provide equitable and quality telecommunication services especially in rural and remote areas. The focus of the policy is to transform the country into a KBE using telecommunications as a platform. The government initiated the National e-Governance Plan in 2006 to provide public services to the common person at affordable rates. To ensure balanced development of ICT in all regions, the Universal Service Obligation (USO) Fund has been created to fund the expansion of services in rural and remote areas.

Despite these developments, India ranked 68th among 144 countries in the World Economic Forum's Networked Readiness Index in 2013. It got the top rank in affordability and the 40th rank in government usage, but performed poorly on individual usage (121th) and infrastructure and digital content (111th). This is because a large part of the population still does not have access to ICT (especially broadband and internet) and there is a digital divide between the urban, rural, and remote areas. Although India has been actively promoting e-governance in order to improve administrative efficiency and the quality of public services, the level of e-governance is still far lower than in other developing economies. According to the United Nations e-government performance index, India was ranked 125th in 2012, while Kazakhstan, the PRC, and Indonesia

Figure 14: E-Government and E-Participation



Source: United Nations 2012.

[49] Vodafone Group (2009) and introductory remarks by Rajat Kathuria, Director and Chief Executive, ICRIER at the international conference "Indian Telecoms Last Mile: So Near yet So Far," organized by ICRIER on 7 March 2014 at the Claridges, New Delhi, India.

were ranked 38th, 78th, and 97th, respectively. Compared to its rank in the previous year, India dropped from 119th place, while the ranks of the three other countries improved. As Figure 14 suggests, India has very poor performance in e-participation compared to other countries.

There is still an unfinished agenda in telecom reforms. There are multiple regulators where no single agency or government body can take a holistic decision for the growth of this sector. A unified approach is important because of the convergence between telecommunications, IT/ITeS services, and, therefore, audiovisual sectors and policies cannot be designed in isolation. The ICT sector in India suffers from fragmented policies, slow implementation of reforms, and regulatory uncertainties. With the convergence of technology a comprehensive bill called the Convergence Bill was initiated in 2000, but it has not been implemented so far. In 2010, the Telecom Regulatory Authority of India (TRAI) made recommendations regarding licenses and spectrum allocations to increase efficiency. In 2011, TRAI recommended that no single operator should possess more than 25% of the total spectrum available in a specific circle. These recommendations have not yet been implemented.

ICT is crucial for the development of large and diverse emerging markets such as India into KBEs and for the delivery of services to the bottom of the pyramid. India is cited as a case of technology leapfrogging in the ICT sector. Studies show that mobile and broadband penetration can benefit the bottom of the pyramid and lead to inclusive growth. Kathuria and Kedia (2011) found that every 10% increase in the mobile penetration rate leads to a 1.5% increase in GDP with evidence of network effects, while a similar increase for internet subscribers leads to a 1.08% increase in GDP. The study shows that poor people in India have access to information, client, markets, etc., through technology. There are successful examples in India where private initiatives, such as the e-choupal initiative by ITC, have linked rural farmers through the internet to their market and suppliers. Online access has helped reduce information asymmetries and farmers now get a better price for their products.

Audiovisual, Animation, and Digital Enterprises: A Special Advantage

Audiovisual services play an important role in promoting digital technology and enhancing the learning potential of a country (Herani et al. 2007). Hence, this sector has become part of the ICT sector. The Indian audiovisual sector was estimated at $10.3 billion in 2013 (KPMG 2013). The sector is projected to grow at around 26.5% between 2012 and 2017. India is the world's largest film-producing country, producing an average of 1,000 feature films annually in 27 different languages.[50] It is the world's third-largest television market, and the radio and terrestrial broadcasting network is one of the largest in the world. According to statistics provided by the World Trade Organization, India's trade in audiovisual services increased from $389 million in 2010 to $460.7 million in 2012, showing an average growth of 8.8%. India has a positive trade balance in audiovisual and related services.

In recent years, technological developments, such as digitization and the emergence of multiple delivery platforms, have contributed to the growth of the audiovisual sector in India. The sector is now closely linked with telecommunications and IT/ITeS services. The sector is labor-intensive

[50] In 2010, India was the largest film-producing country, with 1,274 films followed by the US (754), the PRC (526), and Japan (408). See Screen Australia. http://www.screenaustralia.gov.au/research/statistics/acompfilms.aspx (accessed 10 September 2013).

and according to the National Skill Development Corporation (2009), employment in the industry is expected to increase to 2.7 million by 2018 and 4 million by 2022 from 1 million people in 2008.

With the availability of a large pool of skilled human resources at competitive prices, India has emerged as an important outsourcing hub for audiovisual post-production, sound recording, animation and gaming, and other skill-intensive services. The average cost of making a film in India (including marketing and distribution) is around $5 million, compared with $60 million in the US.[51] India accounts for around 10% of the global animation outsourcing market (Deloitte 2010) due to its competitive cost structure. The cost for flash animation content for 30 minutes is around $20,000 in India compared with $80,000 in the US. Similarly, the cost for 3D animated content for 30 minutes in India is estimated to be $90,000 compared with $360,000 in the US (FICCI–KPMG 2010). Cities such as Bengaluru, Chennai, Hyderabad, Mumbai, and Thiruvananthapuram have emerged as animation hubs. About 70%–80% of the revenue of the animation industry comes from outsourcing; the US and Europe are the major markets.

Key Guidelines for the Information and Communication Technology Pillar

- **Improving and renewing regulations.** In a fast changing industry with rapidly moving technology, the government needs to have a sound regulatory regime that is updated with the times. Without it, new technology such as cloud computing cannot grow at a rapid pace and become a platform for widespread delivery of services, such as for education. At present, there is no regulation on cloud computing in India, while countries such as Singapore already have a policy in place. India has yet to come up with an e-commerce regulation that is comparable to the regulations of developed countries. For instance, Australia has a strong e-commerce regulation. The Australian Guidelines for Electronic Commerce has provisions for business practices, advertising, disclosure of business location, contracts, and complaints, and a dispute resolution mechanism.[52] The EU follows the Electronic Commerce Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the internal market. The Electronic Commerce Directive, adopted in 2000, sets up an internal market framework for electronic commerce that provides legal certainty for business and consumers alike. It establishes harmonized rules on issues such as the transparency and information requirements for online service providers, commercial communications, electronic contracts, and limitations of liability of intermediary service providers.[53] There is a need for similar regulations in India.
- **Ensuring infrastructure and human capital.** The main concerns of this sector are lack of adequate infrastructure such as electricity and R&D facilities, lack of IT adoption in sectors such as education, agriculture, and health. Poor internet connectivity, low rural penetration, and poor optical fiber infrastructure have affected the rate of IT adoption in rural areas. There is a need to improve infrastructure. An acute shortage of a qualified and trained workforce, high attrition rates, and rising salaries are key problems faced by the IT/ITeS industry. Educational and training institutes are only able to meet a third of demand

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51 See CelebMirror. http://www.celebmirror.com/2011/10/27/hollywood-vs-bollywood.html (accessed 5 August 2013).

52 For details, see http://archive.treasury.gov.au/documents/1083/PDF/australian_guidelines_for_electronic_commerce.pdf (accessed 20 May 2014).

53 For details, see http://ec.europa.eu/internal_market/e-commerce/directive/index_en.htm (accessed 30 May 2014).

(Electronics and Computer Software Export Promotion Council 2011). There is a need to ensure effective training and capacity building of the workers so that a talent pool is always available to the IT sector.

- **Universalizing high-speed broadband.** There is an urgent need to design innovative financing mechanisms to support the penetration of ICT infrastructure, especially that for broadband and internet, particularly in rural and remote areas. The government should finance the ICT infrastructure in areas where commercial investment is not feasible or not profitable. The Universal Service Obligation Fund should be used properly to develop broadband connectivity. India has accumulated close to $4 billion in unused funds, yet continues to impose a 5% levy on operator revenues. Instead of focusing on fixed-line connectivity, this fund can be used to roll out the wireless infrastructure. The government also needs to facilitate and support the development of more cost-effective devices and services for expanding penetration of mobile broadband in rural and remote areas. This will help narrow the rural–urban divide. The private sector should be encouraged to invest in improvements in connectivity and services quality particularly in urban areas.
- **Focusing on brand building and marketing.** The government and industry should work together to diversify export markets and baskets and to build Indian brands. Specifically, the Indian audiovisual and content development industry should focus on product diversification and a wider global audience base.
- **Applying ICT for service delivery.** Technologies such as mobile phones can be used to deliver services such as financial services. In 2002, 95% of the transaction of an Indian private bank took place in physical branches of the bank, but now less than 15% of transactions take place in the branch; the remainder is done through the internet, call centers, and mobile phones. The government's National e-Governance Plan is a step in the right direction, where the government has involved private companies such as Srei Infrastructure Finance, Oracle, Airtel, and Microsoft in the *Sahaj* program to set up common services centers at the village level to provide information. Such measures will help the government reach the bottom of the pyramid. Given the overarching benefits of ICT in promoting e-governance, financial inclusion, knowledge sharing, e-learning and training, and connections for farmers and SMEs to their markets, the government should expedite the process of giving access to the population, especially speeding up the process of broadband and internet connectivity. Measures should be taken so that broadband and internet connectivity reaches the rural and remote areas.

Way Forward

The following is a summary of the key issues relating to the four pillars of the KEI:

Economic Incentive and Institutional Regime: There are still considerable barriers to doing business and high tariffs that impede trade. The limited trade diversification in terms of both a narrow export basket and geographic trade partners has constrained progress in international markets. The manufacturing sector has been stagnant, and the time is ripe to incentivize the development of high-end manufacturing.

Innovation: There is need to increase R&D investments, both public and private. Strengthening IPR protection, including for the software sector, would stimulate innovation and its commercialization. India has made exemplary progress in frugal (or *jugaad*) innovation. Greater allocation of public funding for technologies relevant for bottom-of-the-pyramid customers will be valuable. The recent announcement of the India Inclusive Innovation Fund is a step in the right direction.

Education: Tertiary education reforms are not yet extensive and impactful. Although the high priority attached to skills development and to expanding tertiary education is commendable, there is a long way to go to improve the quality and relevance of education and redressing the acute skills–jobs mismatches. Reforms to facilitate public–private partnerships for tertiary education are yet to be implemented with impact. There is a great need for rationalizing regulations in higher education as well as to redress the lack of linkages between research and teaching in the tertiary sector and promote extensive industry–university alliances. The planned industrial corridors could benefit from the colocation of tertiary institutions for research and commercial incubation of technology.

Information and Communication Technology: ICT infrastructure is still skewed in favor of urban locations. There is need for R&D in the IT sector and greater focus on high-value IT services, with expanding digital literacy and high IT skills. The exemplary price competition for mobile telephony should be extended to high-speed broadband by putting to good use the Universal Service Obligation Fund. There is need to capitalize on mobile penetration with extensive "apps" for development.

The Government of India should examine the successful cases of other countries and design a "National Vision to Develop a KBE by 2025." The blueprint should have clearly defined short-term (5 years) and long-term (10 years) targets and implementation strategies. Since multiple government bodies are involved in KBE, a nodal agency can be considered under the Prime Minister's Office known as the "Knowledge-economic Council" (or KeC) constituted of members from different departments of the central and state governments, industry associations, academic and research organizations, and sector experts. The council should have representation of private educational institutes, academic experts, and the corporate sector. It should be responsible for implementing the vision document. A designated fund can be considered to to support the knowledge-based economic development in the country. It is important to involve young people and entrepreneurs in such policy bodies. While different aspects of KBEs have been handled in the past by multiple committees and councils a consolidated and holistic approach would ensure synergies across the four pillars of education, innovation, ICT, and economic incentive and institutional regime.

The work of the National Innovation Council is crucial for strengthening knowledge-based development processes. The setting up of the Inclusive Innovation Fund is particularly noteworthy. The times are opportune for India to strengthen the institutional framework to give a rapid boost to innovation-led growth and development in the country.

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State of Indonesia's Knowledge-Based Economy

Introduction

Over the past 10 years, Indonesia's gross domestic product (GDP) growth has averaged over 5.8% a year, well above growth in the previous decade, to establish an impressive track record of economic performance. Although GDP growth has been slower in 2013, dropping to below 6% compared to 2012, the country's economic potential is large and steadily growing. With an estimated population approaching 250 million, which includes a middle class of around 45 million, the economy is a significant player in the region and in the world. Indonesia, already the largest economy in Southeast Asia, is projected to be the world's seventh largest economy by 2030 (McKinsey Global Institute 2012). Strong economic growth has helped the country reduce poverty levels, with the World Bank reporting that between 1999 and 2011, the national poverty rate fell from 23.4% to 12.5%. Despite such good progress, poverty levels remain relatively high for a low middle-income country. Indonesia spends 0.5% of GDP on household social assistance, compared to a regional average of 1.0% of GDP and developing countries' average of 1.5% of GDP (IMF 2013).

Indonesia's economic turnaround since the Asian financial crisis in 1997/98 has also been impressive. In little more than a decade, Indonesia has gone from a low middle-income country in political, financial, and economic crisis to a democratic, stable, and confident member of the Group of Twenty. Between 2001 and 2012, total GDP almost doubled from $580 billion to $1.1 trillion (15th largest economy in the world). During the same period, GDP per capita jumped from $2,737 to $4,272 (all in constant 2005 US dollars in terms of purchasing power parity [PPP]). These shifts reflect a gradual recovery in economic growth post-1998: despite a 13% contraction in 1998, real GDP growth rebounded to an average annual rate of 4.7% in 2000–2005, then picked up to 5.7% in 2006–2010 and 6.0% in 2011–2012, demonstrating Indonesia's strong resilience to the global economic downturn in 2008.

Indonesia's middle or "consuming" class now numbers around 45 million and is forecast to increase to 135 million by 2030. These estimated additional 90 million consumers, with annual net incomes of $3,600 or more will provide a considerable boost to the economy (McKinsey Global Institute 2012). Rising Indonesian demand for consumer goods and services, particularly in education, finance, health care, information and communication technology (ICT), and tourism is expected to provide a significant economic impetus to the country. The exemplary growth rate experienced by the country earned it a firm place in the Group of Twenty.

The commodities boom Indonesia experienced during 2003–2012 brought considerable benefits to the economy. The massive income and wealth effects of the commodities boom helped GDP to grow and consumption and investments to rise. The economy has also been undergoing some degree of structural diversification whereby the services sector has expanded to become the largest sector in the economy both in terms of production and employment relative to agriculture.

The services sector expanded significantly over the past decade to become Indonesia's engine of growth and employment. The sector contributed an average 3.3 percentage points to total GDP growth against 1.8 percentage points for industry and 0.6 percentage points for agriculture in 2003–2012. The expansion of the services sector was driven by a large addition of new workers—82% of the total 20 million new jobs created in 2001–2011 were in the services sector.

Yet, the structural transformation process in the country is further in need of developments. The relative decline of agriculture (as a share of total production and employment) over the past 3 decades has been slower in Indonesia than in other economies, such as the People's Republic of China (PRC). While the share of agriculture in GDP declined, the share of employment has not moved in the same proportion. While some part of agriculture in Indonesia benefited from the commodities boom of the past decade (palm oil, rubber, and, to a lesser extent, coffee and tea), there has been less progress on food crops and increase of food security. Traditional non-tradable services (e.g., wholesale and retail trade; hotels and restaurants; and community, social, personal, and government services) grew faster than modern services (e.g., transport, storage, and communications; finance; insurance; real estate; and business services). The expansion of the services sector has been in lower value-added services rather than in modern services.

Indonesia is also home to a growing number of consumers with rising household incomes. The number of families with household incomes exceeding $10,000 is predicted to double by 2020 (McKinsey Global Institute 2012). Average disposable incomes in the country are expected to increase at 3%–5% per year, spurring demand for economic activity.

Another report by the Boston Consulting Group (2013a) reinforces the McKinsey projections in terms of a dramatic growth in household income over the next decade, arising from a growing number of middle-class and affluent consumers in Indonesia (projecting them to almost double from 2012 to 2020, from 74 million to 141 million). Such consumers are expected to spend more on areas such as education, consumer durables, health care, and home renovations, driving up economic activity. However, shaping the direction of further growth toward more knowledge-oriented sectors and processes is critical to sustaining the high levels of economic growth and strengthening Indonesia's position in the Association of Southeast Asian Nations (ASEAN) toward and beyond 2015.

While, on the one hand, Indonesia has achieved remarkable growth rates, there are considerable challenges on the other that can prevent such positive trends from continuing or bringing the requisite returns to its population.

Challenges Faced by the Economy in Indonesia

Losing Competitiveness in Low Skill-Intensive Products and Not Gaining Competitiveness in High Skill-Intensive Products

Since around 2000, Indonesia's international competitiveness index of low skill-intensive products has declined, though at a slow rate, but the index of high skill-intensive products has shown no improvement. Moreover, since 2006, the international competitiveness index of both types of products has declined sharply. If this trend continues, in the coming years Indonesia

will become a net importer of low skill-intensive products, while the deficit of trade in high skill-intensive products also continues to grow (Tran 2013).

Low Levels of Productivity

Productivity increases and innovation are crucial for Indonesia's growth to be sustained. Total factor productivity (TFP) explained only 33% of growth in Indonesia during 2000–2007. In the PRC and the Republic of Korea, TFP explained more than 50% of growth during that period (Van der Eng 2008).

The aggregate productivity level of Indonesia—measured by average value-added per worker—is also low by regional standards. Malaysia's average productivity per worker is more than five times that of Indonesia. Average labor productivity in Indonesia is also lower than in Thailand, the Philippines, and the PRC. A recent World Bank report (2014) argues that the country has the potential to rise and become more prosperous and equitable but that the risk of "floating in the middle" is real. This report identifies three priority areas to foster productivity-driven growth: (i) closing the infrastructure gap (roads, ports, electricity, water and sanitation, and irrigation networks); (ii) closing the skills gap; and (iii) improving the functioning of product, labor, land, and capital markets. Addressing these priorities is needed to boost productivity in key sectors, including agriculture (which will release labor) and manufacturing and high-end services (which would absorb labor), and to accelerate structural transformation. Table 8 shows that productivity of low-end services and manufacturing industries is particularly low.

Table 8: Labor Productivity Differences across Sectors Remain Significant (sector labor productivity in real terms compared with labor productivity in agriculture)

Sector	2000–2003	2005–2008	2009–2012
Agriculture	1.0	1.0	1.0
Low-end services	2.4	2.5	2.2
Manufacturing industries	5.7	5.8	5.0
Transport and communication	2.8	3.5	5.5
Financial services	21.5	20.5	14.6
Mining and quarrying	46.8	26.7	18.0

Source: World Bank (2014).

Need to Stimulate High-Value Manufacturing

Since 2005, commodities have overtaken manufacturing as Indonesia's largest exports (65% of total exports). While the robust growth of commodity exports has brought good growth returns to the economy, such high reliance on commodities hinders the country's progress as a knowledge-based economy (KBE). Moreover, with falling commodity prices, the manufacturing sector would need to strengthen competitiveness and value addition, and there is need to stimulate the manufacturing and industrial base in the country.

Indonesia's manufacturing output expanded by an average of 12% a year from 1998 to 2008, faster than the Organisation for Economic Co-operation and Development (OECD) average (9%), but well short of the 22% average annual growth in the BRIICS[54] group during 2000–2008. From 2000 to 2008, exports in medium- to high-technology industries increased by 15%, which was also below the 25% achieved across the BRIICS group (OECD 2010). Medium- to high-technology industries contributed only modestly to trade during this period and much of the manufacturing trade balance to date still relies on low-technology industries. KBE development requires greater stimulus to high-technology industries in manufacturing.

Human Development Indicators Need to Improve

According to the *2013 Human Development Report* by the United Nations Development Programme, Indonesia's Human Development Index (HDI) only slightly improved to 0.629 in 2012 from 0.617 in 2011. Even though the country moved up to 121st place in 2012 from 124th in 2011, Indonesia's HDI is still below the world average of 0.694 and the East Asia and Pacific regional average of 0.683. Indonesia is classed in the "medium human development" category along with 45 other countries. Another worrying feature is rising inequality in the country as measured by the Gini coefficient.

Education Systems Need to Become Much More Effective and Relevant

Recent results of OECD's Programme for International Student Assessment (PISA) tests show that 15-year-old students in Indonesia have learning levels far below their peers in Viet Nam, even though per capita income is higher in Indonesia. The country's education system is struggling with quality. For KBE development, there is need to expand workers' skills with adequate education and training to gain entry into manufacturing and high-end services (e.g., finance, business services, communications, etc.), which are crucial for productivity growth. While the education subindex in the Knowledge Economy Index (KEI) has improved in Indonesia, much of public policy has so far focused on access and/or enrollment of education only. Indonesia will probably boast one of the largest numbers of college-bound students in the world in years to come. Over the past 5 years, the share of the labor force with tertiary and secondary levels of education has increased annually by more than 1 million and more than 2 million, respectively. If recent trends in enrollment continue, the number of Indonesians with a tertiary education could more than double in the next decade. However, without adequate quality and match with employers and markets, education will not bring the required returns in employment and productivity increases in the economy nor provide the human capital needed for innovation.

All these challenges need to be addressed effectively through policies for KBE development.

The finance sector is dominated by banks (78% of assets) and its claims to the private sector stand at only 35% compared to close to 100% on average for Malaysia, Thailand, and the Philippines.

[54] The BRIICS countries are Brazil, Russian Federation, India, Indonesia, People's Republic of China, and South Africa.

Assessment of the Four Knowledge Economy Pillars

Indonesia's overall KEI rank is lower compared to most other Southeast Asian nations (see Table 9). While Indonesia has indeed established itself as an important emerging market economy in the world and as a particularly strong member of ASEAN, the country still needs to address different facets that facilitate KBE development. The country's growth rate of an average 6% during the decade between 2001 and 2010 is one of the highest in the world, next only to that of the PRC and India.

Table 9: Knowledge Economy Index Rankings, Selected Countries

Rank 2012	Country	KEI		EIR		Innovation		Education		ICT	
		recent	2000	recent	2000	recent	2000	recent	2000	recent	2000
48	Malaysia	6.1	6.37	5.67	6.11	6.91	6.62	5.22	5.41	6.61	7.34
66	Thailand	5.21	5.47	5.12	6.67	5.95	5.74	4.23	4.44	5.55	5.03
73	Kazakhstan	5.04	4.58	3.96	3.03	3.97	3.92	6.91	7.2	5.32	4.17
84	PRC	4.37	3.83	3.79	2.82	5.99	4.35	3.93	3.36	3.79	4.8
92	Philippines	3.94	4.59	4.32	4.56	3.77	4.05	4.64	5.35	3.03	4.41
101	Sri Lanka	3.63	4.3	4.04	6.03	3.06	3.24	4.61	4.31	2.8	3.63
104	Viet Nam	3.4	2.72	2.8	2.74	2.75	2.4	2.99	2.82	5.05	2.92
105	Uzbekistan	3.14	3.25	0.92	1.06	3.13	3.97	5.65	4.96	2.87	3
108	Indonesia	3.11	3.02	3.47	3.44	3.24	2.26	3.2	2.84	2.52	3.54
110	India	3.06	3.14	3.57	3.56	4.5	3.83	2.26	2.3	1.9	2.85
117	Pakistan	2.45	2.12	1.93	1.67	2.84	2.3	1.44	1.3	3.6	3.22
137	Bangladesh	1.49	1.77	1.51	1.59	1.69	1.54	1.75	2.11	1.01	1.84

EIR = economic incentive and institutional regime, ICT = information and communication technology, KEI = Knowledge Economy Index, PRC = People's Republic of China.
Source: World Bank, Knowledge Assessment Methodology and KEI. http://info.worldbank.org/etools/kam2/KAM_page5.asp (accessed 31 July 2014).

Indonesia's overall KEI values and rank worsened between 1995 and 2012 (see Table 10). While the innovation and education subindex improved between 1995 and 2012, the economic incentive and institutional regime (EIR) and ICT subindices worsened. Table 11 provides a summary of some of the weaknesses in the KEI pillars.

Table 10: Indonesia's Performance on the Knowledge Economy Index, Selected Years

Year	Rank	KEI	EIR	Innovation	Education	ICT
1995	102	3.68	4.08	2.38	3.07	5.2
2000	104	3.02	3.44	2.26	2.84	3.54
2012	107	3.11	3.47	3.24	3.2	2.52

EIR = economic incentive and institutional regime, ICT = information and communication technology, KEI = Knowledge Economy Index.
Source: World Bank, Knowledge Assessment Methodology and KEI. http://info.worldbank.org/etools/kam2/KAM_page5.asp (accessed 31 July 2014).

Table 11: Summary of Key Weaknesses in the Knowledge-Based Economy Pillars in Indonesia and Possible Actions

Key Weakness	Possible Actions
Economic incentive and institutional regime	
High cost of: – starting a business – getting credit – registering property – getting electricity – enforcing contracts – inefficient bureaucracy – corruption	• Lighten regulation and process for starting a business • Future investment options for infrastructure that is impeding economic development (Build operate transfer, Build operate lease, foreign direct investment) • Ministry of Law Discussion Group recommended introducing an international "think tank" with experience in introducing positive bureaucratic reforms
Education	
• Poor levels of education in the workforce • High attrition rate in secondary education • Rising levels of unemployed youth • Shortage of employable knowledge workers • Shortage in supply of science and technology professionals and of research and knowledge transfer to relevant economic sectors • Quality issues in tertiary education • Lack of cross-fertilization of ideas and creativity between tertiary education with productive sectors of the economy • Inadequate support to the needs of lifelong learners • Lack of innovative modes of delivery to strengthen flexibility, access, and affordability of tertiary education • Lack of success in blending seamless pathways between formal vocational and academic qualifications	• Capitalize on building program and qualifications flexibility around the new National Qualifications Framework • Develop strategies required to strengthen collaboration between tertiary institutions and state enterprises (183 companies) and the private sector through applied research, knowledge transfer, and support for innovation initiatives (scientists, professionals, and entrepreneurs) in the workplace • Ministry of Education and Culture (MOEC) partners with Ministry of Creative Economy and mobilizes private sector investment to develop high-end creative industry "model campuses of best practice" for creative industries that will: • Provide a knowledge center for applied and investigative research • Establish or develop centers for advancing creativity and new knowledge for industrial development

continued on next page

Table 11 *continued*

Key Weakness	Possible Actions
Innovation	
• Weak support from institutional regime, including policies and incentives • Lack of financing for entrepreneurs in knowledge-based and creative enterprises • Lack of coordination between different stakeholders inadequate incentives for advancing R&D in the workplace • Focus on "hard" skills rather than on developing and applying "soft" or higher-order skills and competencies to increase production and efficiency in the workplace • Insufficient attention to developing entrepreneurship capabilities and supporting young entrepreneurs and technology start-ups	• Review policies that emphasize science, technology, and innovation (STI) as a priority for higher education development, including meeting demand for STEM graduates and embedding soft skills development across curricula • Revitalize national policy on STI through National Innovation Committee • Assist with establishing an Indonesian Design Council to represent the design industry for advancing creativity, innovation, and design industry standards—similar to Malaysian Design Council (www.mrm.gov.my), Taipei,China Design Center (http://www.tdc.org.tw), and Thailand Creative and Design Center (http://www.tcdc.or.th) • Promote initiatives that support greater innovation and productivity in the workplace • Introduce financing mechanisms for larger firms as well as for entrepreneurs • Hold competitions for innovation in the economy • Develop efficient use of alternative private funding for innovation
Information and communication technology (ICT)	
• Rate of infrastructure improvement increasing, but lagging behind regional partners • Rapid increase recently in use of computers and internet but still much to be done to catch up with regional neighbors • Basic connectivity provided by MOEC, but use can be further optimized • Slow to catch up in e-governance • Inadequate initiatives for rural absorption of ICT	• Develop special policy initiatives that increase penetration and use of computers and internet • Launch new initiatives that have a stronger social and economic impact across isolated geographic, semi-urban, and rural locations • Revitalize projects where ICT strengthens and enables more innovative forms of higher education delivery that: – are quality-led – increase coverage – strengthen affordability – accommodate lifelong learners

R&D = research and development, STEM = science, technology, engineering, and mathematics.

Source: Compiled by the authors.

The sections that follow provide a review and assessment of the state of play of the four pillars of the KEI in Indonesia and key guidelines for action to strengthen them for KBE development.

Economic Incentive and Institutional Regime

Indonesia is known for difficulties of doing business in an overregulated operating environment. In a survey of expatriate business executives released by the Political & Economic Risk Consultancy

(2013) in January and March 2013, Indonesia's bureaucracy was again rated low compared to many of its regional neighbors, an assessment that is mirrored by the World Bank KEI ratings. Indonesia was ranked 128th out of 178 countries in the 2013 "Ease of Doing Business" survey. It cited red tape, and confusing, conflicting, and overlapping regulations, along with difficulties acquiring land as the main problems (IFC 2013).

The pathway toward a stronger KBE in Indonesia will be predicated on an effective economic incentive and institutional regime (EIR) that will develop efficiency in regulatory administration and governance, with more flexible regulations and processes for starting a business. An effective EIR will also work closely with relevant ministries in KBE development to ensure it develops macroeconomic stability, competition, and positive regulatory policies that will help to mobilize investment and strengthen capacity in each of the education, ICT, and innovation pillars of KBE development. In addition, the regulatory and legal regime will be important for fostering investment and development of entrepreneurship and support for private enterprise.[55]

Indonesia is classified in the negative side of all indicators of governance (voice and accountability, political stability, government effectiveness) and the regulatory system (rule of law, regulatory quality index). Regarding the control of corruption, the index in Indonesia was −0.7 in 2009 (ADBI 2014; data from the ASEAN 2030 project).

Intellectual property registrations have risen in past years due to increasing awareness. The number of registered trademarks had grown significantly from 20,660 in 2003 to 62,455 by the end of 2012, according to Indonesia's Directorate General of Intellectual Property Rights (HAKI) of the Ministry of Law and Human Rights. The patent registration and application processes have become more streamlined, and revised intellectual property prehearing procedures now considerably reduce both time and expenses.

The manufacturing sector makes a significant contribution to the economy with a 25% share of GDP, yet it has lower competitiveness compared to other ASEAN countries such as Malaysia, Singapore, and Thailand. Although Indonesia slightly improved its rank of industrial competitiveness from 41st in 2005 to 38th in 2010 (UNIDO 2013), it still ranks below Malaysia (21st), Thailand (23rd), and far below Singapore (6th).

The key problems faced by the manufacturing industry in Indonesia include heavy dependence on imported raw materials, lack of adequate tax and nontax incentive schemes that explicitly support the manufacturing industry, and changeable tax regulations that affect predictability and lack of integration in taxation between upstream and downstream industry (Indiastuti and Setiawan 2013). Infrastructure development is not clearly tied to the growth of the business sector. The high cost of product distribution and market access also impede the competitiveness of the manufacturing sector. Inefficiencies in the supply chain and obstacles to starting a new business are also impediments.

Furthermore, Value addition along the supply chain is not optimal. It is estimated that only 6% of exported products have value added (Lukito 2013). There is need for much stronger linkage between the manufacturing industry and other economic sectors in Indonesia. There is also insufficient synergy between the small, medium-sized, and large enterprises in business processes.

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[55] Drawn from focus group discussions in December 2012 with officials from Indonesia's Ministry of Law and Human Rights.

Key Guidelines for the Economic Incentive and Institutional Regime Pillar:

- **Strengthening the manufacturing industry base and facilitating its moving up the value chain**. Incentives are required for developing synergy and integration between upstream, intermediate, and downstream industries. In order to build on existing comparative advantage, developing natural resource processing industries to create value addition would be important. The application of the 2014 law that bans producers from exporting raw materials of mineral and coal may be supplemented with supportive measures to help domestic industry create more value added for exports.
- **Increasing the productivity and efficiency in the value chain.** Increasing product diversification in basic industries such as steel and chemicals would be beneficial. In addition, the government should support export promotion for intermediate and finished products in the form of technology and investment facilitation and taxation measures.
- **Facilitating access to imported technology and creation of domestic technological capability.** Advanced technology development should be aligned with the needs of well-identified industry sectors, including specifically high-tech sectors.
- **Targeting support to the large base of small and medium-sized enterprises (SMEs).** Indonesia needs to put in place stronger support to SMEs in accessing technology, know-how, and product development, particularly in high-tech sectors.
- **Improving infrastructure development to foster KBE development.** There is need to extend support to knowledge infrastructure such as research and development (R&D) institutions and science parks, technology and innovation institutions, and business incubators.
- **Enhancing the quality of human resources.** Given Indonesia's youthful population, the workforce readiness of young people can be improved by integrating and aligning education and training institutions with economic development institutions.

Innovation and Technological Adoption

Indonesia will benefit from establishing a revitalized national policy for the development of its innovation regime. It currently ranks 54th out of 134 countries in the Global Competitiveness Index (World Economic Forum 2012). One of the main variables in its competitiveness ranking is the strength of the innovation regime where Indonesia ranks 40th, behind India (28th) and the PRC (29th). Symptomatic of the low ranking is underdeveloped innovation capacity (58th) and efficiency (58th).

Indonesia's R&D investment has doubled in the last 5 years (Roland Berger Strategy Consultants 2012). The government now identifies R&D as a principal driver to develop the economy. Yet, at 0.08%, Indonesia has considerably lower R&D investment as a share of GDP in developing Asia, compared particularly to the PRC and India. However, there is a long-term goal to increase R&D investments from less than 1% of GDP to 3%. Indonesia's innovation performance compares poorly with the BRIICS group as well as with other countries in Southeast Asia. Despite increases in gross expenditure on R&D, it is still a very low proportion of GDP and most national R&D is being performed by public research organizations. Despite growing intellectual property registrations, the number of patent applications as well as of scientific and technical publications have also been relatively small (OECD 2010). University–industry research collaboration in Indonesia is also quite modest. There is need for universities to tap more into investment

in R&D by the private sector by strengthening their strategies for industry collaboration transfer.

In 2012, Indonesia reemphasized science, technology, and innovation (STI) as a priority area for higher education development and as a source of future competitiveness (Ministry of Education and Culture 2012). To revitalize its STI policies, a National Innovation Committee (KIN) was established in 2009–2010 as an autonomous body consisting of 30 members, reporting directly to the President of Indonesia. While it is too early to assess its impact, this is a step in the right direction. The impact of innovation will be strengthened with higher coordination between the research performed in public research organizations and the needs of local industry. This requires greater harmonization in the policies and objectives of higher education, industry, and science and technology across productive sectors of the economy (OECD 2010).

Positive trends include that many prominent international companies, such as Unilever, have recently launched R&D hubs in Indonesia. RIM began R&D activities in 2011, the same year Nissan set up an R&D center. Daihatsu intends to use Indonesia as a base to expand regional activities, and in 2011 the automaker inaugurated an R&D center on the site of its new manufacturing plant. The economy needs to shift the sources of its competitiveness from traditional productive sectors involving low-cost labor production, to high value-added products and services.

According to a survey conducted in 2010 by the Agency for the Assessment and Application of Technology (BPPT) of 202 large manufacturing companies in Indonesia, 56% of companies surveyed indicated that the company does not have an R&D division or unit. Of the surveyed companies, 58% said that the source of technology was abroad while only 30% said it was local. A total of 29% of the companies sourced technology from Japan, 27% from Europe, 15% from the PRC, and 7% from Taipei,China. The top six sources of foreign technology were from other economies in Asia. Developing regional cooperation in R&D and science and technology, particularly within ASEAN, would be beneficial.

The State Ministry of Research and Technology (RISTEK) has a leadership role in fostering innovation. RISTEK has seven high-priority areas for the development of innovation in the economy: food security; renewable energy; transportation; health and medicine; use of information and communication technology; advanced materials through nanotechnologies; and defense and national security.

Establishing centers of excellence (COEs) is also a major priority of RISTEK. One COE in each of six geographic corridors across the archipelago is proposed to be established, of which three have been established so far—in Medan (palm oil production), Surabaya (research in medical treatment of tropical diseases), and Jember (food security in cacao and other local crops). Additional COEs are planned for Kalimantan (forestry) and Sulawesi and Maluku (marine development and production of seaweed for commercial use). A further COE will be established in Bali to develop the tourism industry.

Key guidelines for the innovation pillar in Indonesia include the following:

- **Increasing investment in R&D to about 1.5% of GDP.** Given the low level of R & D spending by Indonesia, such an increase is required to provide a critical mass to advance as a KBE.
- **Colocating COEs in R&D with industry and tertiary institutions.** A "knowledge triangle" between science, industry, and education for commercially relevant innovation is needed. Such partnerships are not yet robust in the innovation ecosystem.

- **Ensuring subnational policies and strategies for science and technology innovation.** The national innovation system needs to incorporate an organic approach for developing regional and local innovation systems given the largely decentralized economy of Indonesia.. Fostering innovation and creativity through local institutions therefore needs to be nurtured with access to technology, finance, and human capital.
- **Providing incentives for SMEs to innovate**. This can be done possibly through tax incentives or subsidies for R&D. Strengthening innovation will require a strong focus on the needs of SMEs and microenterprises in strengthening the innovative capacities; there are more than 440,000 registered SMEs and entrepreneurs across the archipelago.
- **Strengthening innovative capacities of industrial clusters.** This will help to enhance industrial competitiveness and the transition to higher value-added products and services; development of innovation intermediaries to augment investments in knowledge-based capital such as trademarks, brand building, software, and knowledge-based services is required to promote high-technology and knowledge-intensive sectors.
- **Enhancing entrepreneurship development, more specifically facilitating high-tech start-ups.** If undertaken in a decentralized fashion, this will benefit the country by spreading the flow of knowledge- and innovation-diffusing technology adoption in a range of sectors and industries and across the country.

Education and Skills

The advancement of Indonesia's KBE will be dependent on a workforce with relevant competencies and skills for public and private enterprise and to compete in a changing global economy. Of the 240 million people in Indonesia, over 60% of the population is under 39 years of age, providing a dynamic workforce. In today's information societies, it is the acquisition, advancement, dissemination, and use of knowledge that drive economic growth and development. In more developed countries, it is the higher education sector that has typically been the main source of that knowledge.

Indonesia has made impressive improvements in education over the past 40 years. Suharti (2013) noted there are three substantial improvements: enrollment, literacy rates, and average years of schooling. There is near full enrollment in primary education. The average number of years schooling (15 years or over) rose to 7.9 years in 2010. The adult illiteracy rate fell from 15.6% in 1993 to 7.1% in 2010. In recent years, the government has allocated up to 20% of the national budget for education and is currently implementing universal 12-year basic education. The gross enrollment ratio in higher education has been rising between 2005 and 2010 to reach 24.7% in 2010; however, it is far below other ASEAN countries, such as Malaysia and Thailand, and only about one-third the OECD average (Hill and Wie 2012). Fahmi and Satriatna (2013) found that there is a significant gap in literacy rates between males and females and between urban and rural population.

Learning outcomes in school education need to be improved. Learning outcomes are assessed through several standardized international tests such as Trends in International Mathematics and Science Study (TIMSS), Progress in International Reading Literacy Study (PIRLS), and Programme for International Student Assessment (PISA). The performance of Indonesian students in the 2011 TIMSS was expectedly lower than of those in Singapore, the Republic of

Korea, and Taipei,China (Mullis, Martin, and Foy 2011). Most Indonesian students had scores below 550, the lowest benchmark, whereas none achieved the highest benchmark of 650 points. In the 2011 PIRLS, only 66% of grade 4 students scored above 400 points (the lowest benchmark) and only 4% scored above 550 points (the high benchmark). In the 2012 PISA, Indonesia performed poorly as it was ranked 64th out of 65 countries (OECD 2012).

Education and skills mismatch with jobs is another challenge for Indonesia. The unemployment rate of diploma or polytechnic qualification holders is higher than of those with university or institute qualifications (ACDP 2013). High unemployment for diploma holders indicates that technical and vocational education and training (TVET) institutions and polytechnics need to strengthen the practical orientation in their training and the market readiness of their students. The workforce is predominantly made up of people with low qualifications—about 55% with just primary school, 20% with middle school, 17% with high school, 10% with vocational school, 3% with diplomas, and 9% with university education.

The quality and vibrancy of higher education institutions are a crucial determinant of the ability of a country to foster KBE development. In 2009, around 44% of all academic staff in both the public and private universities in Indonesia was underqualified. Only 8.4% of academic staff had a doctorate degree, and around 70% worked in public higher education institutions (MOEC 2012). The levels of qualifications of academic staff across the tertiary system remain a big challenge in strengthening and upgrading the capacity and quality of the education system. The Ministry of Education and Culture (MOEC 2012) plans to fund 10,000 in-country PhD scholarships plus an additional 3,000 overseas PhD scholarships per year. During 2013, 75% was allocated for science, engineering, and agriculture, with the remaining 25% covering art and culture, languages, and social sciences (Kompas 2013, p.12). Through the upgrading of teaching qualifications, the MOEC also plans to increase the ratio of total lecturers with master's degree qualifications from 43% to around 78% as well as those with doctorates from 7% to 15% over the next 3 years. The MOEC has set in place priorities to revitalize and enhance the broader higher education disciplines in engineering, agriculture, and science. These initiatives are crucial for the strengthening of the tertiary education base for knowledge economies.

Indonesia needs to augment human capital for science and technology. Across OECD countries, average human resources in science and technology occupations represented more than a quarter of total employment in 2010, while in Indonesia they accounted for less than 10%. Between 1998 and 2008, employment in science and technology occupations across all OECD countries also increased at a faster rate than total employment. By 2020, 40% of the global workforce is predicted to be knowledge workers with a need for tertiary qualifications (OECD 2010). This means that Indonesia has much ground to make up in human capital formation and the development of its services sectors if it wants to become more competitive with its large trading partners and neighboring economies.

Of the 4 million students enrolled in higher education in 2010, the share of students enrolled in engineering was a little over 11% and those in science close to 4%. The target is to increase enrollment in engineering to over 15% in 2015 and 25% in 2025. For science, the target is to increase enrollment to over 5 % in 2015 and 10% in 2015 (MOEC 2012).

The higher education institutions are still far from producing high-quality graduates who can meet the requirements of both the manufacturing and service sectors. Another serious problem of higher education is a lack of links to industry. Indonesia already faces a shortage of middle

managers, but, by 2020, the gap between supply and demand is projected to reach as high as 56%. By 2020, top companies in Indonesia will only be able to fill about half of their entry-level jobs with fully qualified candidates (Boston Consulting Group 2013b). Skills–jobs mismatches are also an important constraint to economic growth as the skills profile of graduates has not evolved with the demands of the labor market (World Bank 2010b). Moreover, universities have a long way to go in being able to create innovation through applied research and technology. Most, if not all, university R&D facilities are not adequately prepared to undertake R&D for industry, even on the smallest scale. There is always a gap between university R&D output and industry needs (ACDP 2013). For KBE development, the country needs to urgently bridge this gap through industry–university collaborations.

Although the gross enrolment ratio at the tertiary level is still low for Indonesia in relation to the need to develop the human capital base of a highly skilled workforce for a KBE, the country has nevertheless achieved a dramatic increase in higher education participation. The percentage of students enrolled in higher education has increased by 50% since 2006, with nearly 3 million additional seats having been filled at Indonesian colleges and universities over that period. Going forward, given the youthful demographic profile of the country, the tertiary education cohort is expected to rise even more dramatically. By 2020, Indonesia will be home to the fifth largest tertiary education system in the world with an estimated 7.8 million students (British Council 2012). The country needs to therefore prepare for a strong expansion of its tertiary education system, offering education of quality and relevance. The country's universities will be crucial stakeholders in Indonesia's future economic strategy and in providing the human capital that is best suited to its economic ambitions.

Partnerships with the private sector are an important way to enhance tertiary education and training capacities that a fast-growing country such as Indonesia requires. Corporate universities and private sector-led community colleges need to be considered. A good example is Multistrada Community College. When Indonesia's Education Qualifications Framework (EQF) was launched by the MOEC, Multistrada applied for a license to become a formal higher education and degree-granting institution and use the framework to provide formal in-company higher education and training for company employees. The transformation of the Multistrada Learning Center to become Multistrada Corporate University (and now Multistrada Community College – MCC) was driven by the need to improve the quality of human capital across the company. The parent company (PT Multistrada Arah Sarana Tbk) is an Indonesian tire manufacturer producing tires for Indonesia's large motorcycle, car, and vehicle market as well as for international brands. MCC required an integrated approach to improve the competencies and skills of its human capital through in-company face-to-face and e-learning. The integrated approach of in-class, on-site learning processes along with applied learning projects contributed to improving worker employability. Providing "certified" education and training aligned with a national EQF is an important modality for executives, professionals, technicians, and skilled workers to make the company's operations more efficient and competitive in the national and regional economy. The pathway for corporate universities in the EQF is thus an important strategy that needs to be promoted so that workplace-based training can receive formal certification and accreditation.

The education sector will benefit from ICT spending for e-learning software and hardware as the government has set the target to increase the current ratio of students to computers from 1:3,200 to 1:20—and with the current student population at 53 million, this will require 2.5 million computers. The establishment of cloud computing networks for schools and university campuses is another area of focus that will benefit education (Global Business Guide Indonesia 2013).

Key guidelines for the education and skills pillar in Indonesia include the following:

- **Investing in a robust expansion of the tertiary education system.** The country will need to invest to ramp up appropriate educational opportunities to a large cohort of the young population, while addressing quality and relevance. This requires a composite strategy that includes collaboration with leading foreign universities to expand offerings, expansion of tertiary institutions in the country, franchise agreements, corporate universities, and incorporation of ICT-based education delivery and blended programs that go beyond the limitations of brick-and-mortar tertiary institutions and formal degree programs.
- **Grooming research universities and preparing 10–20 universities to concentrate on research.** Support to research-intensive activities should be facilitated through government support. Shared goals between RISTEK and the MOEC for complimentary R&D objectives in their respective strategies should ideally be optimized through partnerships with industry.
- **Revitalizing the role of SMKs, polytechnics, and community colleges.** These institutions have an important role to play in all districts and municipalities across Indonesia, particularly with a view to developing an array of technical credentials that serve new economy occupations within the overall National Qualifications Framework. Giving particular attention to creative industries so that Indonesia can develop world-leading comparative advantages in creative goods and services is crucial.
- **Aligning economic and educational policies.** The Masterplan for Acceleration and Expansion of Indonesia's Economic Development (MP3EI), which has clustered six development corridors for economic thrust, should be linked to specific areas with tertiary institutions. Colocating universities and centers of excellence for R&D will strengthen the backbone of these economic corridors with sufficient investments in industry–university collaborations, science parks, connectivity, and innovation ecosystems for high-tech start-ups to flourish in their respective areas will strengthen national competitiveness.
- **Promoting on-the-job training.** Incentives should be offered to companies and corporations to invest in the training of its employees and encourage them to set up corporate universities, particularly addressing talent development for economic sectors of the future.
- **Catalyzing ICT for education.** ICT needs to be applied extensively in education for a range of objectives in academic, vocational, and professional courses: extending higher education services to communities that do not have access to traditional modes, providing distance education and open university courses with requisite learning services and assessment systems, introducing face-to-face and blended education models to cater to expanding tertiary enrollment, developing innovative and flexible pedagogies and delivery models using ICT for professional studies but also for generic soft skills most in demand by employers, and expanding information technology (IT) literacy in a big way to pave the way for the skills needed in increasingly digital workplaces but also to serve demand from digital enterprises.

Information and Communication Technology

Indonesia did well in the World Economic Forum's Network Readiness Index 2013 rankings, advancing from 80th place in 2012 to 76th in 2013. Indonesia's network usage ranking also improved 15 places from 85th place in 2012 to 70th in 2013. However, the country still remains weak in the number of computers per capita and internet use. In connectivity, Indonesia ranks 80th in the world (INSEAD 2012), behind Thailand (77th), Sri Lanka (71st), and India (69th). The country ranks even lower (103rd) with regard to internet use, at less than 10% of the

population (INSEAD 2012). Use of computers in schools also remains low (0.06 per student) compared to other countries in developing Asia.

In 2008, Indonesia had one of the lowest expenditures on ICT as a percentage of GDP compared to its South and Southeast Asian neighbors. However, by 2011–2012, Indonesia had become the largest spender on ICT in Southeast Asia and was ranked 19th globally (International Data Corporation).

Table 12 shows that mobile phone penetration is by far the most pervasive ICT sector in Indonesia.

Table 12: Indonesia's Information and Communication Technology Sector

Fixed telephone line penetration	18%
Mobile phone penetratio	107%
Unique mobile phone subscribers	58%
Internet penetration	25%
Wireless subscribers	17.1%
Fixed line broadband	3%

Source: Global Business Guide Indonesia. 2013.

Indonesia spent $10.9 billion on IT in 2011, according to the International Data Corporation, and sales of hardware made up the majority of IT spending at over 80%. IT spending is forecasted to reach $17.8 billion by 2016. However, the key challenge is to increase access to ICT beyond Jakarta and the cities in which it is currently concentrated. Indonesia has the fourth largest number of users of Facebook in the world. While mobile phones and social media put Indonesia's usage among the highest in the world, indicating significant growth potential for use of ICT devices and applications, Indonesia still lags behind its regional neighbors and global trading partners in deployment and use of ICT across the economy. Addressing the digital divide in rural areas and for SMEs is key to ensuring an inclusive approach to KBE development.

E-commerce in Indonesia, while being a nascent sector, is projected to grow at a rapid pace. Online transactions are expected to rise from $266 million in 2012 to $736 million by 2014 (Indo Telko). The sector offers great potential, not only within the context of the success of the industry in mature markets, but the key advantages that it offers to a market such as Indonesia. The lack of an e-commerce foundation outside of the main cities poses a major challenge for IT suppliers. This has resulted in the weak diffusion of ICT products and services. Access and connectivity issues that arise from limited development of infrastructure are one part of the constraint for ICT development but they need to be viewed in conjunction with issues that have constrained e-commerce development. There is need for active support to entrepreneurial start-ups in e-commerce, online payment systems, consumer protection measures within overall industry standards, and most of all accessible and affordable broadband.

The Ministry of Communications and Information Technologies (MCIT) has launched a number of positive initiatives in recent times to tap the power of ICT for development and improve connectivity across the archipelago with the priority on assisting marginalized regions and local government agencies in e-procurement processes. The following are some of MCIT's initiatives that will support further KBE development:

- **Information and Communication Technology for e-Business Support for Local Entrepreneurs**

There are an estimated 53 million SMEs and microenterprises across Indonesia. Between 2009 and 2014, MCIT has a target of reaching 10% of Indonesia's SMEs with e-business or e-commerce training through a government-funded communications initiative that connects subdistrict towns in rural locations. The private sector has responded positively and competition has come up for e-service options across local enterprises and in civil society. MCIT is optimistic that their target will be achieved (MCIT 2012).

- **Connecting Rural Towns, Villages, and Schools**

Indonesia has over 76,000 registered villages in just over 4,000 subdistricts (Bps 2012). In 2010, MCIT launched an internet connectivity scheme to enable internet connection for 7,000 villages by 2014. By 2012, more than 5,000 locations had already been connected using a variety of communication modes, including VSAT, broadband, and wireless. Since 2009, more than 10,000 schools and over 1,200 higher education institutions in marginalized regions across the country have been connected to the internet through another MCIT initiative in partnership with the MOEC. Until 2012, the government regulated against the use of ICT in education, while more developed economies have been able to advance the quality and use of ICT in distance delivery to such a degree where education outcomes today in many cases are at least equal to or can exceed on campus learning outcomes (Babson Research Survey Group 2012).

- **e-Procurement and Public Information**

MCIT, in collaboration with the Public Procurement Agency, has developed an online procurement application that it provides free of charge to government agencies for managing their own tendering and procurement systems. The applications are designed to improve the efficiency of procurement systems and reduce corruption. Outside of data and information that are protected by security or privacy laws, it is government policy to have an open system where public information is made available to the citizens of the country.

Key Guidelines for the Information and Communication Technology Pillar

- **Strengthening market competition in the telecom sector.** This is crucial to extend ICT goods and services across the archipelago, particularly to bridge the digital divide between urban and rural areas. While IT spending in the country has been on the rise, more strategic focus on IT services that put ICT infrastructure to work is required to increase demand for ICT.
- **Universalizing and improving the quality of the country's domestic broadband connectivity.** This will pave the way for offering of appropriate e-services to the nation. The rationale and rules for the use of universal access and service fund ought to be updated and the fund should also be deployed for high-speed broadband connectivity.
- **Undertaking appropriate policy reforms for ICT expansion.** The potential of ICT development for Indonesia's KBE can be realized only if policy makers and industry stakeholders can draw on international best practice to implement reforms for e-commerce,

e-banking, and e-governance. Appropriate regulatory frameworks for digital banking and mobile banking will serve as important enablers of financial inclusion. If national identification systems, e-commerce, and e-banking system development are implemented, there will also be significant economic activity in ICT-based services that engage SMEs across the country.

- **Promoting ICT-oriented creative economy industries and digital enterprises.** Creative industries as an important economic sector need appropriate support to entrepreneurship development, broadband connectivity, and financing for start-ups. Given the rise of digital enterprises for goods and services, the intellectual property right (IPR) laws need to be reviewed and remodeled where required to suit the specific needs of digital technologies. Piracy of software and enforcement of IPR laws are also seen as impediments toward the absorption and use of ICT, and are a disincentive for IT suppliers to strengthen their supply chains across the country.
- **Ensuring appropriate policies and a supportive environment for the adoption of cloud computing technologies.** Indonesia has made good progress in adopting cloud computing, which is forecast to grow at a compound annual growth rate of 48% from 2010–2014 (Frost and Sullivan 2014). A survey by IDC conducted in 2011 showed that 50% of the end-user organizations surveyed expressed interest in adopting or exploring cloud computing services. The promotion of cloud computing with sufficient government support and a regulatory framework, including for data protection, will help Indonesia extend state-of-the-art ICT services to a range of stakeholders in the country, including educational institutions and SMEs.
- **Enabling the education sector to assimilate crucial ICT-based applications and interventions.** This will transform the landscape of education delivery and pedagogy. ICT can be a critical launchpad for appropriate education and training opportunities for the next generation of learners that are "IT savvy" in an increasingly digital society. The extensive implementation of IT literacy among the workforce is also crucial to ensure adequate human capacity and talent required to implement e-governance, e-commerce, and other initiatives on an extensive scale. The new law enacted by the government opens up new ways of implementing ICT-based distance delivery that holds the promise of strengthening social inclusion in the higher education system.
- **Harnessing synergies between mobile technology and social media platforms.** Such actions will serve a range of developmental applications particularly targeting the youth. Given the high usage of social media platforms and extensive mobile penetration, the development of mobile applications, will extend a range of developmental services to remote populations and locations.

Creative Industries: A Special Advantage

A presidential directive of 2009 gave prominence to the role of the creative economy for Indonesia. A creative economy is defined as the economic activity which is based on creativity, skill, and individual talent having potential economic value and welfare creation. UNCTAD (2010) defines the creative industries as the cycles of creation, production and distribution of goods and services that use creativity and intellectual capital as primary inputs. Creative industries also comprise a set of knowledge-based activities that produce tangible goods and intangible intellectual or artistic services with creative content, economic value, and market objectives. Cultural industries whose products have symbolic and expressive elements are also a part of creative industries (UNCTAD 2013).

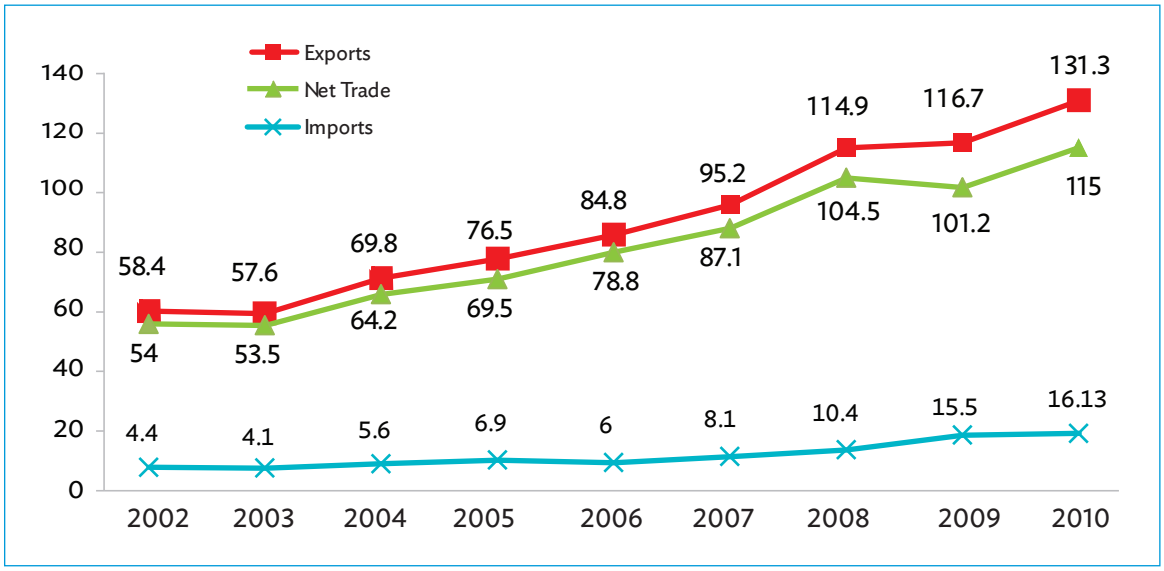
In 2011, a new Ministry of Tourism and Creative Economy was established. The new ministry mirrors the British model to strengthen research, knowledge sharing, innovation, and export of services in the creative industries where digital technology and global networking have made the creative industries one of the fastest-growing sectors in the world with average annual growth of between 5% and 20% (Simarmata and Adiwidjaja 2010). There are 14 subsectors of the Indonesian creative industry according to the ministry's classification and Presidential Directive No. 6 of 2009: advertising; architecture; arts; handicraft; design; fashion; video, film, and photography; interactive games; music; performing arts; printing and publishing; computer service and software; television and radio; and R&D.

Digital technology and global networking have made the creative industries one of the fastest-growing sectors in the world with average annual growth of between 5% and 20%. The average GDP contribution of creative industries in Indonesia for 2002–2010 was 7.74% of total GDP. Creative industries' export value reached Rp131.3 billion, accounted for 10% of total national exports (Simarmata and Adiwidjaja 2011), employed 8.5 million workers, and contributed Rp468.1 billion to GDP in 2010 (see Figure 15).

Sectors in Indonesia such as fashion; video, film, and photography; and television and radio had export values of more than $1 billion during 2010–2012. Creative industries such as fashion and creative services (e.g., design, and games and animation) hold much promise for the country (Simatupang, Rustiadi, and Situmorang 2012).

Digital technology and global networking have made the creative industries one of the fastest-growing sectors in the world with average annual growth of between 5% and 20%. Creative industries make up around 6.1% of the global economy and the proportion is steadily rising (World Bank 2005). While creative industries can also have a major impact on innovation and

Figure 15: Exports, Imports, and Net Trade in Creative Industries in Indonesia (Rp trillion)



Sources: BPS (Ministry of Trade). 2012; Simarmata and Adiwidjaja (2011).

value creation in more developed KBEs, their impact has tended to be more marginalized in less developed economies. In Indonesia, land has always been a main source of wealth and income in the agriculture sector and rural societies across the archipelago, with capital and machinery following in the 1970s and 1980s to become important in developing Indonesia's industrial societies. Looking ahead, the creative economy can add significant value to Indonesia's social and economic development and should be the government's main strategy in the next wave of developing the country's KBE. The strategy is intended to provide a source of competitive advantage and create "soft power" across local communities that not only will contribute to growth, job creation, and poverty alleviation, but also become a source of national pride and nation branding for the country (Pangestu 2012).

Indonesia should position itself stronger to take advantage of the global growth of the creative economy and keep up with the performance of a number of economies in Asia. Seven of the top 10 exporters of creative goods in 2008 were from Asia (PRC; Hong Kong, China; India; Thailand; Singapore; Republic of Korea; and Malaysia). Indonesia can enhance its competitive strength and this should be a key priority for KBE strategies of the country. Table 13 provides examples of actions that can be undertaken to strengthen the country's capabilities in the creative industry.

Table 13: Key Actions for Promoting the Creative Economy in Indonesia

Key Areas	Actions for the Creative Economy
Human resource development	• Support more scholarships for people who cannot go into secondary and tertiary education after finishing primary school and direct them to vocational education. The talent screening should be done in the selection to get the future appropriate knowledge-intensive skill human resources. • Link the curriculum and study disciplines in vocational education to support the 14 sectors in the Indonesian creative economy, with the priority on the target sector (advertising, handicraft, recreational services) and/or on the most potential and productive sectors (fashion, and computer science and software). • Government should support and facilitate the entrepreneurs or human resources in the creative industry to gain and apply the knowledge through better technology and ICT, infrastructure, such as the application new technology and fast and stable internet connection. • Knowledge and skills in creative tourism management, promotion, and advertising should be encouraged to foster the potential export of personal, cultural, and recreational services.
Technology and innovation	• Support and train firms in the creative industry to use the latest technology, computers, and the internet to design, produce, and market products. • Link the creative industry with the scientific research institutes in developing products and services. • Government should make it easier for the creative industry to apply for patents through incentives (e.g., reduction and subsidies).
Marketing and sustainable trade	• Government should facilitate the export promotion of the creative industry, including intensive advertising abroad. • Government should facilitate the creative industry's efforts to apply international standards for product and services. • Facilitate the creative industry's promotion of products in national and international exhibitions to gain the competitive advantage.

continued on next page

Table 13 *continued*

Key Areas	Actions for the Creative Economy
Resources	• There is an obligation for the firms producing the raw material based on the local resources to supply the creative industry and SMEs. The regulation should be issued. • Improve electricity, telephone, internet, road, and port infrastructure to foster the development of the creative industry in all regions in Indonesia.
Institution	• Provide appropriate support for IPR specifically tailored to the creative economy and increasing law enforcement on IPR violations.
Financing	• Ensure easy access to financing for the firms in the creative industry. Existing credit schemes, such as Credit for the Business Public (KUR), should be continually encouraged and improved for the creative industries.

ICT = information and communication technology, IPR = intellectual property right.
Source: By author.

Way Forward

This concluding section provides a snapshot of the main areas of action under each of the four KEI pillars for Indonesia. It also offers suggestions on key aspects of coordinated action across various institutions and agencies in the country for strengthening KBE development in Indonesia.

The following is a summary of the key points under the different pillars:

Economic Incentive and Institutional Regime: The manufacturing sector makes an important contribution to GDP, yet suffers from low competitiveness compared to other ASEAN member states. Greater support to expanding the industrial base and improving the productivity and efficiency of natural resource processing industries for intermediate and finished products is required. Support for creating IPR protection for the creative industries will help build global competitiveness and value addition. In anticipation of the ASEAN Economic Community in 2015, there is need to promote well-identified industries for technological upgrading through imported technologies and development of national technological capabilities. Review of IPR policies so that they address the needs of sectors of comparative advantage, such as creative industries and services, is important.

Innovation: Support for technological and non-technological innovation in creative industries and in SMEs is needed. Development of the ecosystem for innovation such as brand equity, labeling, and marketing will help the move toward greater participation in global value chains. There is an important need to increase both public and private R&D. Given the large and decentralized country, there is great scope for regional and local innovation systems that draw on the strengths of regional endowments and local talent. There is need to embrace more interactive and innovative knowledge adaption models with industry groups embracing applied research and knowledge generation that strengthen competitiveness and productivity in the workplace. This should be considered for the 35 priority industrial clusters identified by the government.

Education: Although mean years of schooling have increased, there is need to improve the quality and relevance of postsecondary education, particularly higher-order skills development. The country's public and private tertiary institutions lack organizational and financial autonomy,

which limits innovation. Private higher education institutions particularly lag in quality. The roles of higher education and research are crucial to a KBE, as is industry–university collaboration. There is need to develop COEs in education to support the economic development corridors of the country's economic master plan. Establishing CoEs to support applied research and knowledge advancement in creative industries has the potential to create a major impact on innovation and value creation across both the formal and informal creative economy. There is need to consider public–private partnership models that bring in private sector investment to fund the development of specialized campuses or "model campuses" in partnership with quality Indonesian and international tertiary providers to promote commercially relevant applied research.

Information and Communication Technology: The country scores quite poorly on the ICT subindex compared to the average for Asia and the Pacific. Still, Indonesia had the fourth-largest user base of Facebook in the world in 2013 and is active in social media channels. The rollout of a national broadband plan with universal access and service funds and other means will contribute greatly to inclusive growth. The support to digital enterprises as part of creative industries to tap into the ever-growing global markets for digital entertainment and games will help knowledge-intensive services to grow. The country would also benefit from augmenting social media channels and extensive use of ICT for education. Facilitating the transition to cloud computing and making next-generation technologies available at affordable costs will be beneficial to Indonesia.

Developing a National Action Plan for Knowledge-Based Economic Development

The experience of advanced economies suggests that coordinated actions over a period of time are crucial to implement successful initiatives that promote KBE development. To that end, the following three points are suggested:

1. **Establishment and strengthening of knowledge-based economic institutions**
   This could include the establishment of a national committee for providing a vision and implementation plan for KBE development. A national committee needs to be supported by regional committees with adequate talent and capacities to prepare road maps and initiatives that serve as KBE processes. Key ministries such as the ministry of education, ministry of ICT, ministry of research and technology, ministry of home affairs, and other related ministries need to be represented in such a committee that goes beyond the confines of individual ministries and provides a holistic vision for KBE development. Another aspect would be to create a network of KBE institutions drawing in universities, research institutions, think tanks, scientific bodies, and industry associations. Such national networks further need to connect with appropriate international networks in order to draw lessons from international best practice in KBE development.

2. **Action plans for the four pillars of the knowledge economy**
   Key ministries and institutions need to develop time-bound and costed plans for strengthening the four pillars of the knowledge economy. The report's many recommendations for action can be considered for developing concrete road maps and incorporating the initiatives within ongoing government programs, yet also linked to an overarching national KBE development agenda. Sufficient allocation of financial and human resources is critical.

3. **Monitoring and evaluation of knowledge-based economic development**
   This entails adequate mechanisms and resources for ongoing monitoring, review, and evaluation of activities and initiatives for KBE development. Well-structured diagnostic studies and surveys would be required for evidence-based planning and implementation, particularly for analyzing the effectiveness of KBE investments. Establishment of adequate databases, information systems, and a regular reporting mechanism at national and provincial levels will enable the successful tracking of KBE development efforts.

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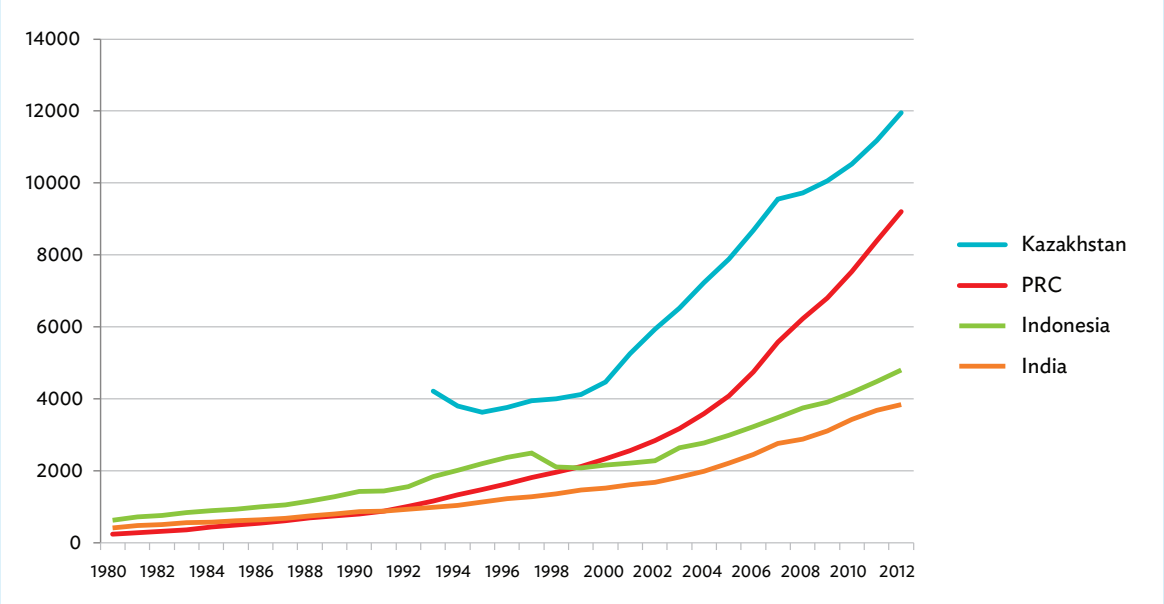
State of Kazakhstan's Knowledge-Based Economy

Introduction

Kazakhstan is a vast, landlocked country (2.7 million square kilometers, ninth largest in the world) with a population of 17.5 million and a gross domestic product (GDP) output of $232 billion in purchasing power parity (PPP) in 2012, making it the largest economy in Central Asia in terms of GDP. The economy is heavily dependent on oil and gas, uranium, and other mineral extraction, which account for close to 80% of its export in recent years. With its vast arable land resources, the country is also a major producer and exporter of agricultural goods. Such rich natural resources are primarily responsible for the relative high per capita income of the country (around $13,720 PPP in 2012). After suffering negative growth in the first 6 years of political independence as the economy struggled to transit from a Soviet-style command economy to a more market-based one, the economy started to grow strongly in the latter part of the 1990s on the back of its extractive industries. This rapid economic growth was temporarily halted by two major shocks on the economy: one domestic—severe banking credit and real estate crunch in 2007–2008; and one external shock—the global financial crisis in 2008–2009 followed by a steep decline in oil prices. Despite such setbacks, the economy was able to resume its upward growth path along with the global economic recovery, achieving a high average growth rate of over 8% per annum between 2000 and 2012 (see Figure 16).

Figure 16: Purchasing Power Parity Per Capita Gross Domestic Product Growth



PRC = People's Republic of China.
Source: World Economic Forum, Global Competitiveness Report, various years.

In 2013, Kazakhstan's economy recorded 6.0% real GDP growth (according to the Statistics Agency's first assessment). The manufacturing industry's real value added grew only by 1.6% while services increased output by 7.6%.

The economy has increasingly opened up to foreign investment over the last decade. In 2002, it became the first country in the former Soviet Union to receive an investment-grade credit rating, and by 2011 had attracted over $150 billion in investment cumulatively. However, it should be noted that an overwhelming part of this foreign direct investment (FDI) is concentrated in the extractive industries. Despite policy announcements to diversify the economy, Kazakhstan's GDP and investment growth have remained highly concentrated in the natural resource extraction sectors.

Kazakhstan has also made good progress in international trade liberalization. In 2010, Kazakhstan joined the Belarus–Kazakhstan–Russian Federation Customs Union in an effort to boost foreign investment and improve trade relations. In early 2012, this evolved into a Common Economic Space where nontariff barriers to trade will be significantly reduced. The government expects to join the World Trade Organization (WTO) soon, and recently announced plans to apply to join the Organisation for Economic Co-operation and Development (OECD) as well.

The state remains dominant in many sectors of the economy, despite extensive privatization since political independence (OECD 2012). The state holding company Samruk-Kazyna controls a large share of the economy through its holdings in state-owned enterprises such as Kazakh Telecom in telecommunications and the national oil and gas company KazMunaiGaz. In 2010, Samruk-Kazyna is estimated to hold stakes equivalent to 60% of the country's GDP (UNECE 2012, p.3). Recognizing the need to reduce the state's dominant role in the national economy, the president announced at the end of 2012 a "People's IPO" policy to partially privatize some of the state-owned enterprises (by allowing the public market to purchase minority stakes in these enterprises) and to spur further market liberalization. Kazakhstan has also performed very well in rankings of the World Economic Forum Global Competitiveness Report. The country continues to attract more foreign investment than all the other Central Asian republics combined and its businesses are already prominent investors in many foreign countries even beyond Eurasia.

Externally, Kazakhstan's negotiations with trade partners on WTO accession continue. Kazakhstan, the Russian Federation, and Belarus signed a treaty to establish the Eurasian Economic Union in May 2014, which will come into effect in January 2015. The union will help cut down trade barriers and allow the free movement of people between the countries comprising over 170 million people. This is the largest common market in the ex-Soviet sphere. Endowed with enormous natural resources, the emergence of a common market has significant scientific and technological potential.

In December 2012, the new development strategy "Kazakhstan – 2050" was released with the main goal of positioning Kazakhstan among the world's top 30 developed states by 2050 and knowledge and professional skills set as one of the priority areas for implementation. In January 2014, a complementary concept of how Kazakhstan is to achieve a place among the top 30 most developed nations was approved by presidential decree.

On the social sphere, at the international poverty line, as measured by the PPP-corrected $2.50 a day per capita, poverty in Kazakhstan fell from 41% in 2001 to 4% in 2009.

In 1997, Kazakhstan launched the "Kazakhstan – 2030" Development Strategy, which became a basis for the strategic development plans for 2001–2010 and 2011–2020 as well as for most sector and territorial development programs released subsequently. The main document that shaped the policy for the development of a knowledge-based economy (KBE) was the Strategy of Industrial-Innovational Development of the Republic of Kazakhstan for 2003–2015 (IID Strategy) with the preliminary annual implementation budget of $1.2 billion. The IID Strategy was aimed to ensure sustainable economic development of the country on the basis of diversification of the economy and shift from extraction to processing, as well as preparing conditions for a transition to the service- and technology-based economy in the long run. The following were the major objectives of the IID Strategy:

- maintenance of average annual growth rate of processing industries within the range of 8%–8.4%;
- at least threefold growth in labor productivity by 2015 against 2000;
- twofold reduction of energy intensity of GDP;
- increased productivity of fixed assets of processing enterprises;
- cultivation of a business-friendly environment;
- establishment of institutional settings to stimulate the private sector, encourage a competitive edge, and strive for greater value added;
- introduction of incentives to establish science-intensive high-tech export-oriented enterprises;
- diversification of the export potential of the country in favor of products and services with high value added;
- transition to world standards of quality; and
- enhancement of integration into the regional and global economy, with participation in global innovation processes.

To achieve the objectives and goals within the framework of the IID Strategy, purpose-built "institutes of development," such as Kazakhstan Investment Fund, Corporation of Export Insurance, and National Innovation Fund were created.

In the aftermath of the global financial crisis 2008–2009, which has adversely affected Kazakhstan's growth, and in response to the poor results of 2003–2015 IID Strategy achieved to date, a new State Program of the Accelerated Industrial and Innovative Development (PAIID) for 2010–2014 with a total implementation budget of T6.5 trillion (about $ 35.7 b) was launched in early 2010 with the main goal of ensuring sustainable and balanced economic growth through diversification and increased competitiveness of the economy. PAIID was elaborated in the framework of the Strategic Development Plan for 2011–2020 that was put into place earlier in 2010, setting a target for Kazakhstan to enter the top 50 countries with the most favorable business climate by 2020.

Challenges Faced by the Economy in Kazakhstan

Continuing Bias for Extractive Industries

Even in 2010, the structure of Kazakhstan's economy remains extraction-oriented. The economy faces low efficiency of labor resources (e.g., in 2008, 31.5% of the population was involved in agriculture while its share in GDP was 5.8%), the share of processing industries in GDP decreased

from 16.5% in 2000 to 11.8% in 2008, and the share of extraction industries in GDP increased from 13% in 2000 to 18.7% in 2008. If the country is to meet the objective of being among the top 30 most developed countries by 2050, it would need to diversify away from dependence of natural resource growth toward a more balanced growth path.

Managing Complexities in External Economic Relations

As the economy proceeds on the path of integration with the global economy, Kazakhstan faces a complex trade policy environment in the medium term. The economy joined the Eurasian Customs Union in 2010 and is pursuing an accelerated schedule of further integration into the Common Economic Space by 2015. Kazakhstan is also expected to join the WTO in the near future while its trade strategy lists several free trade agreements to be negotiated. The country would need to effectively tackle across different trade agreements.

Promoting Greater Industrial Diversification and Innovation

The key economic development challenge facing Kazakhstan is the urgent need to diversify its economy through KBE development. As part of the IID Strategy announced in 2003, a National Innovation Fund (JSC NIF) was established with the aim to promote innovation-related activities in the country, including offering support to develop technology-intensive enterprises. Although the number of enterprises with product and process innovations almost tripled between 2010 and 2012, their share in total enterprises has been steadily decreasing. The number of enterprises and organizations with research and development (R&D) activities declined by 23% in 2012 compared to 2010 (Science, Innovations and Information Society, Statistics Agency 2013).

Avoiding the Middle-Income Trap

The natural resource endowments have served the country well in increasing GDP per capita. However, further growth can be sustained only by moving beyond resource exports to other sustainable economic sectors. The country needs to seek out new international markets and become a global competitor and generate alternative sources of economic growth.

Strengthening Human Capital Development and High-Skilled Workers

The economy needs to address the creation of a highly skilled workforce that can provide the capacity needed to deliver innovation- and knowledge-based economic growth. Although the country has high attainments in human capital development, the relevance of skills to the needs of the economy needs to be strengthened.

Assessment of the Four Knowledge Economy Pillars

The country's position in the World Bank's Knowledge Economy Index (KEI) is somewhere in the middle with a rank of 73rd among 145 countries covered. In terms of the four component pillars of the KEI, Kazakhstan scores quite high compared to other emerging economies in the region.

Between 2000 and 2012, Kazakhstan's overall KEI score has improved from 4.58 to 5.04. In terms of the four component pillars, Kazakhstan has achieved considerable improvement in the economic incentive and institutional regime (EIR) and information and communication technology (ICT) pillars, but little change in the innovation pillar, and actually registered a decline in the education pillar. Despite including a KBE development objective as part of the country's strategic goals more than a decade ago, the country has underperformed in terms of investing in human capital development and innovation activities relative to income level, although progress in developing the ICT pillar has been greater. It is plausible that the abundance of natural resources, particularly oil and gas, may have partially shielded the economy from external competitive pressures and blunted the sense of urgency to invest in innovation and education and to diversify into new industries where the acquisition of advanced knowledge and development of innovative capacity are more critical to becoming competitive. To avoid the middle-income trap, the country needs to diversify its economy and intensify efforts to shift toward economic activities that have higher knowledge and innovation intensities and reduce the higher dependence on natural resource extraction which may become a "natural resource curse."

Economic Incentive and Institutional Regime

The World Bank Ease of Doing Business Index confirms Kazakhstan's relatively investor-friendly environment in recent years, ranking it the highest overall (47th) when compared with the People's Republic of China (PRC; 91st), Indonesia (129th), and India (132th) in 2012. Kazakhstan scores particularly well in terms of investor protection, property rights registration, and contract enforcement. Besides growing openness to foreign investment and external trade, Kazakhstan has achieved steady improvement in its overall regulatory environment for business over the last decade. In 2012, Kazakhstan ranked 49th in the world in terms of the Ease of Doing Business Index (World Bank 2013), up from 58th in 2011.

However, Kazakhstan performed less well on corruption, ranking 105th out of 178 countries by the Transparency International's Corruption Perception Index in 2010. The ranking has further deteriorated in 2011 and 2012 to 120th and 133th, respectively, putting the country among the worst performers among middle-income countries. Indeed, the very low ranking of Kazakhstan in the Ease of Doing Business subindex of getting construction permits (155th) may be partly linked to perception of non-transparency in the granting of government licenses and approvals in general. In the World Bank Enterprise Survey of Kazakhstan's private sector firms in 2009, high tax rates and corruption were the top two most highly cited "main obstacles" for doing business. In the same survey, over 30% of the firms indicated a need to resort to bribery to get a business license, over 25% when meeting tax inspectors, and over 50% for securing government contracts. These rates are significantly higher than the average for countries in Eastern Europe and Central Asia as revealed in similar surveys (World Bank 2009a).

While Kazakhstan scores relatively well in terms of regulatory hurdles for starting businesses as measured by a number of World Bank Doing Business subindices, the rate of new business formation is not high, and there is a perceived lack of entrepreneurial spirit among the population. Young people aspire to work in large enterprises and government sectors rather than start their own business. A positive recent development is the establishment of the National Chamber of Entrepreneurs (NPP), which by law has mandatory membership of all business units in Kazakhstan is expected to exercise a significant impact on improvement of the business climate. The National Chamber may potentially develop into a powerful champion of business climate improvement, provided there is sufficient government support.

Key Guidelines for the Economic Incentive and Institutional Regime Pillar

- **Enabling greater role for private sector in the economy.** The planned second 5-year State Program for Accelerated Industrial and Innovation Development , scheduled to start from 2015, calls for active private sector participation, including foreign investors. However, there is need to set concrete targets to realize this. Currently, the government prefers to rely on state-owned companies to start technology-intensive and higher value-added production. The dominant roles of state-owned enterprises with quasi-monopoly power need to be reduced through greater privatization *and* market liberalization. The country's competition policy body needs to be strengthened with substantive power to prevent monopolistic behavior by the large state-owned enterprises in new industries. Without a more level playing field, new firms will be hesitant to challenge the incumbents or enter new industries, nor invest in new innovation.
- **Tackling the problem of wide perception of corruption.** Given the poor ranking on corruption perception, there is need to address this in the public sector. Given the wide-ranging prevalence of corruption, the perception is that rent seeking through political connections is an effective way to get ahead in society (ICG 2013). In a natural resource-dependent economy with a high degree of state control, preferential access to resources can naturally lead to perceptions of corruption; however, the government needs to do more to improve the country's image and demonstrate concrete actions in fighting corruption.
- **Strengthening entrepreneurship.** There is very limited prevalence of entrepreneurship, including among youth, who are typically expected to be more prone to entrepreneurship. This is particularly the case for "innovative entrepreneurship," or the creation and growth of new ventures to commercialize new knowledge. The teaching of entrepreneurship is important in the universities, which is currently not being emphasized. There is need to promote innovative entrepreneurship education among the faculty and students in tertiary education institutions as well as young researchers and professionals in public research institutions and large technology-intensive enterprises. The effort by the National University of Singapore, the leading university in Singapore, to inculcate entrepreneurship among its undergraduates may be of relevant interest to Kazakhstan.

Education and Skills

The relatively high score of Kazakhstan for the education pillar reflects the high average number of years of education of the population (10.4 compared to 8.2 in the PRC and 5.5 in India) and the high enrollment rate in tertiary education (39% compared to 26% in the PRC and 18% in India). Indeed, Kazakhstan has achieved a steady increase in mean years of schooling over the last 20 years, achieving a level that exceeded not only the PRC, India, and Indonesia, but even Singapore. In terms of primary and secondary education coverage, Kazakhstan's policy of compulsory education through the secondary level has enabled the country to achieve an adult literacy rate of 99.5%.

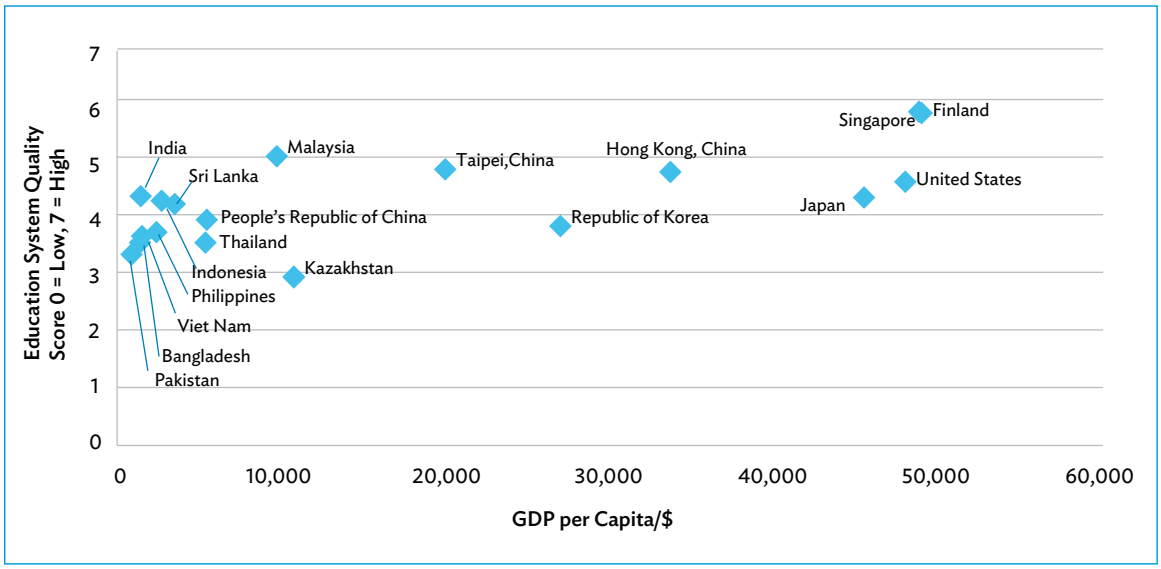
However, such impressive achievements mask a number of major weaknesses in the educational system of Kazakhstan. The country has performed poorly in terms of quality of education. Kazakhstan has performed rather poorly, and it ranked below the PRC, India, and Indonesia. Indeed, relative to its level of GDP per capita, Kazakhstan has significantly underperformed (see Figure 17), with its quality below even countries such as Pakistan and Bangladesh that have

much lower income levels. As per time series data from the World Economic Forum's Global Competitiveness Report, the perceived quality of education in the country has been deteriorating over the past 6 years.

The poor quality of Kazakhstan's education system has already been highlighted in a number of earlier studies (see, e.g., OECD 2007; UNECE 2012). The OECD report on Kazakhstan's higher education system highlighted a number of Soviet legacy problems that persisted: university education course content and allocation of places by field of studies have been dictated in great detail by the education ministry, with little inputs from employers; the quality assurance system emphasizes enforcing control and compliance and discourages innovations to improve; and classroom teaching is emphasized over development of skills and competencies. The report also raised concerns that university teachers, while respected, are not well compensated—they are overworked, underpaid, and given little support for professional development—and it also highlighted pervasive corruption in the system for selecting, evaluating, and graduating students. It further concluded that, except in a few favored universities, facilities, equipment, and information infrastructure is poor by international standards, both for teaching and for research, and that the overall culture within the education system favors conservatism and discourages innovation, creativity, and enterprise. The report by the United Nations Economic Commission for Europe echoed most of these concerns, but also highlighted similar problems at the primary and secondary school level, including the poor state of technical and/or vocational education.

The government has partially overcome the shortage of good-quality graduates by establishing a generous scholarship program (Bolashak) in 1993, which has since sent over 9,000 Kazakhs to study at leading universities in North America, Europe, and Asia. The program requires the scholarship holders to return to work in Kazakhstan for a minimum of 5 years. The program was initially for overseas studies at the undergraduate level, with minimum control over the fields of study, but in response to changing human resource needs, the program has since 2010 shifted to funding overseas studies in the science and engineering fields at the master's and doctorate levels only.

Figure 17: Education System Quality over Gross Domestic Product per Capita



Source: World Economic Forum, Global Competitiveness Index 2012–2013.

The government has also sought to improve the quality of local tertiary education by setting up Nazarbayev University in 2009 with the aim of making it a "world-class" research-intensive university. The university has established partnerships with leading universities in the world for each of its faculties/schools to assure quality. The government has also made efforts to boost the quality of science and technology (S&T) education in several existing public universities in recent years, including the Kazakh-British Technical University.

Among recent trends are the introduction of information technology solutions in education and teaching processes (e.g., e-learning, distance learning) as well as demand-based offerings of courses (e.g., introducing more technical and industry-specific subjects and fields).

Kazakhstan also faces a significant mismatch between the needs of industry and what the education system provides. In particular, the system for polytechnic education is underdeveloped, with a recent Ernst &Young (2012) survey of executives suggesting that there is a severe mismatch between industry demand for technicians and current supply, whereby the aging technicians trained in the old Soviet system are not being replenished by those educated in a modern system. The proliferation of higher education institutions produces too many non-S&T graduates and not enough of S&T graduates of acceptable quality to industry. Data from the Global Competitiveness Report also suggest that Kazakhstan scores poorly in the provision of on-the-job training.

Key Guidelines for the Education and Skills Pillar

- **Addressing quality of education.** Despite a high enrollment rate in higher education, Kazakhstan has a tertiary education system that is plagued with uneven quality problems, with many of its 139 tertiary education institutions producing graduates of low quality. The system also produces university graduates that lack employable skills. Modernization of the curriculum, renewal of pedagogy, and the development of performance standards for different levels of education are needed. Further quality improvements need to be targeted in a timebound fashion with appropriate monitoring mechanisms—the standards could relate to benchmarking curriculum with well performing education systems, setting standards for teacher professional development, and assigning goals to improve student learning. Kazakhstan's performance in the OECD Programme for International Student Assessment (PISA), which is an internationally comparable test of 15-year-olds in math, science, and reading, has been quite low—it ranked 49th of 65 countries in math, 52nd in science, and 63rd in reading. It is crucial to strengthen the quality of secondary education, put in place more rigorous student learning assessments, and introduce development of soft skills.
- **Enhancing focus on science.** There are 10 other universities in Kazakhstan focusing on innovations which are being supported by the government for development of science and innovation. There are 20 science laboratories for common use belonging to the universities. Seven universities and two research institutes have nine pilot commercialization offices. There is also Nazarbayev University, which was recently set up as a flagship institution in the country. However, these are overwhelmingly under the control of the government. What is required is more involvement and direct partnerships with industry to focus on those areas that are of most relevance to the market.
- **Improving technical and vocational education and training.** Technical and industry-specific professional education is provided via the college system, which represents an intermediary step between high school education and the university degree. There are currently 888 colleges (out of which 499 are state owned). These institutions are even

more disadvantaged than the universities, as quality and relevance of training are lacking in meeting the needs of industry. There is an acute shortage of well-trained technicians at the polytechnic level. This mismatch is exacerbated by a cultural norm that values white-collar work and university degrees over blue-collar work and technical and/or vocational skills. The low prestige associated with such training and the lack of labor market relevance compound the challenge, and there is an urgent need to transform the sector with courses for a modern economy with renewed curricula, pedagogy, and a new set of credentials that are suited to occupations in a new economy.

- **Increasing opportunities for on-the-job training.** There are thousands of agreements between enterprises and universities as well as agreements for job placements and internships for students. Thousands of scholarships are also provided to employees by their employers. As of December 2012, more than 100 enterprises in agriculture, transport, metallurgy, machinery, oil and gas, chemicals, and other industries were included in the list of organizations for introduction of dual education, which combines on-the-job training with academic education. In order to reinforce technical education development, the joint stock company Holding Kasipkor was established by the government several years ago to take on the role of the system operator to create world-class level colleges and introduce modern methods of managing technical and professional education. While these are all important initiatives, the problem is one of implementation. A more result-oriented approach to enterprise training will help improve the problem of skills mismatch.
- **Establishing world-class tertiary institutions with international partnerships.** The country established Nazarbayev University with the aim of making it a world-class institution. It has adopted good approaches to setting up standards by collaborating with a number of leading universities of the world. However, a more explicit focus to develop national faculty in a timebound fashion linked to clearly articulated professional and performance standards would help the country make the leap forward in the quality of education imparted. Moreover, the creation of a critical mass of high-quality academics who are committed to the development of the university community over a sufficiently long period is needed. Moreover, excellence cannot be confined to just one big institution. There is need for providing a broad base of education across the country of a basic standard of quality. Application of state-of-the art technology in just one institution will be limiting. Rather, transformational approaches such as blended and e-learning need to become extensively available, given the relatively high ICT score for the country.
- **Accelerating the upgrading of vocational and polytechnic education system.** A good model for vocational and polytechnic education which Kazakhstan may consider adapting is the Singaporean system (see Box 1).
- **Deploying ICT in education for innovative teaching and learning at all levels of education.** On the one hand, ICT in education can particularly serve those located in geographically remote areas; on the other, it can help to develop transformational pedagogical tools to make education more interesting, more interactive, and student-centered. Kazakhstan has started an e-learning project in secondary and technical schools which is to be welcomed; however, such projects need to be more driven by private providers with the requisite knowledge to implement them rather than be under too much government control. Moreover, the potential cannot be realized if the focus is solely on online accessibility without interventions for quality and interaction with students.

Box 1: The Polytechnic and Vocational Educational System of Singapore

Singapore has developed one of the most highly regarded polytechnic and vocational education systems. While many developing economies overemphasized the academic stream of secondary school education and university education, Singapore invested early and heavily in vocational and technical education (VTE) infrastructures and resources, even when the country was relatively poor in the 1960s. Such a heavy VTE investment has been instrumental in Singapore's rapid industrial development between the 1970s and the 1990s, and it laid the foundation for the island economy to become a major hub in the world for offshore manufacturing by global multinational corporations.

The VTE system of Singapore comprises two components: (i) a 2-year vocation-based training program for students with weaker General Certificate of Education (GCE) "O" level or GCE "N" level results, leading to a locally recognized "National ITE Certificate"; and (ii) a 3-year polytechnic educational program for students with better GCE results, leading to the award of a diploma. Unlike many other countries, polytechnics in Singapore do not award university degrees. However, polytechnic diploma holders can subsequently enroll in university (often after some work experience), which take in students with A-level (or International Baccalaureate) postsecondary education.

The foundation for the vocational education system was laid in the late 1960s with the establishment of nine vocational secondary schools. The new Vocational and Industrial Training Board formed in 1992 later evolved into the Institute of Technical Education (ITE) in 1992. Five polytechnics were established, which were initially supplemented by a number of technical training institutes run by French and German industry associations. In the early 1990s, the German and French institutes were integrated into a new polytechnic, and another new one was established. A fifth polytechnic was set up in 2003 to promote action-based learning.

The steady expansion of ITE and the polytechnics provided the crucial supply of well-trained technologists and technicians needed to fulfill the export-oriented, foreign direct investment-driven industrialization drive of the economy in the late 1970s and 1980s. It is only from the late 1980s that demand for university graduates in manufacturing became significant. But even as the economy began to shift toward more technology-intensive manufacturing and services in the 1990s and 2000s, ITE and polytechnic graduates continued to play important roles, and the VTE system has constantly evolved to stay relevant with new courses continuously being developed to meet emerging industry needs.

In 2007, ITE was conferred the international IBM Innovations Award in Transforming Government (organized by the Ash Center for Democratic Governance and Innovation of Harvard University), in recognition of its transformation of VTE in Singapore. ITE was cited as "the world's most transformative government programme," which has a "profound impact on citizens' lives" and a "model programme" with potential for global replication.

Students from the polytechnics of Singapore have been frequent winners of many world skills competitions. For example, at WorldSkills Leipzig 2013, Singapore achieved seventh place, outshining even larger countries such as Canada, Australia, and the United Kingdom.

Sources: APEC 2010 and Author.

Innovation and Technological Adoption

The low ranking of Kazakhstan in innovation on the KEI is consistent with similar findings from several other global rankings of innovation. The World Competitiveness Report 2012 ranks Kazakhstan 102nd out of 144 countries in terms of innovation, substantially below the PRC at 34th and India at 43rd. The INSEAD Global Innovation Index 2013 likewise ranks Kazakhstan substantially below the PRC and India (83rd versus 35th and 66th, respectively). Relative to its level of GDP per capita, Kazakhstan is substantially underperforming in terms of innovation.

After a new law on Government Support for Industrial and Innovation Activities came into force in 2012, the National Agency for Technological Development (NATD) supports and promotes innovations in Kazakhstan through innovative grants, venture capital financing, support for technological business incubation, and concept design offices to assist with the production of new or improved products. It has also supported the creation of international technology transfer centers—four centers have been jointly created with partners from France, Norway, the United States (US), and the Republic of Korea. As part of innovations infrastructure development, 9 regional technoparks, 15 commercialization offices, and 4 commercialization centers have been established. Despite all this, growth of new industries through innovation activities remain limited.

Kazakhstan performs rather poorly in virtually all dimensions of its national innovation system. Based on the three component indices (market sophistication, knowledge/technological outputs, and creative outputs) of the INSEAD Global Innovation Index, Kazakhstan ranks uniformly lower than the PRC, India, and Indonesia, and shows no improvement or even a decline over the last 6 years. In particular, Kazakhstan scores poorly in terms of R&D spending by both companies and the public sector, with an aggregate GDP on R&D to GDP ratio of only 0.16% in 2011 (down from 0.28% in 2005), substantially below the PRC's 1.8% (up from 1.3% in 2005) (UNESCO, various years). In 2010, the number of employees engaged in R&D in Kazakhstan was 1,036 per million people, which is significantly less not only than advanced countries like Finland (7,832) and the US (4,605), but also than developing economies that are Organisation of Islamic Cooperation members such as Tunisia (3,240), Jordan (1,934 in 2008), and Turkey (1,715) (Cengel, Alpay, and Sultangazin 2013).

The World Economic Forum's Global Competitiveness Report, 2013 likewise scores Kazakhstan very low on the technology infrastructure and quality of scientists and engineers subindices. The number of US patents granted to inventors in Kazakhstan is also very low: between 1994 and 2011, only 32 US patents were granted to Kazakhstan-based inventors. While the number of domestic patents granted by the Kazakhstan Intellectual Property Office is much larger (598 in 2010 alone), many of these are actually held by foreign firms seeking protection in Kazakhstan.

A number of recent studies on Kazakhstan's national innovation system likewise point to the many similar weaknesses highlighted above (Abazov 2011; UNECE 2012; Cengel, Alpay, and Sultangazin 2013). The World Bank Enterprise Survey 2009 found manufacturing firms in Kazakhstan to have lower propensity to import foreign technology and obtain certification from the International Organization for Standardization (ISO) than the average of Eastern Europe/ Central Asia (World Bank 2009a).

The rich oil and gas and mineral resource base of Kazakhstan is both a blessing and a curse. While it endows the state with a strong revenue base to finance investment in new knowledge-based capability development, it also causes severe distortions in the economy. These include sucking in

talents through its high pay structure, causing overvaluation of the domestic currency that makes its other tradable sectors uncompetitive (the so-called "Dutch disease"). These distortions in turn stunt the development of local enterprises in tradable sectors, and cause income inequality to rise. For the industrial diversification strategy to work in the long term, the government must invest significantly to develop the innovation system that provides the long-term basis for the diversification process.

Outside the oil and gas and mineral extraction industries, most enterprises are small and medium-sized enterprises (SMEs) with small resources and technical human resources bases to adapt advanced technologies to improve productivity, let alone invest in R&D to innovate new products and processes. The World Bank Enterprise Survey 2009 found that only one out of ten Kazakhstan enterprises engaged in any R&D activities, and these tend to be the large state-owned enterprises or foreign firms.

There is weak development of innovation intermediaries in transferring technologies from public research institutes and universities to existing local enterprises. Such intermediaries and/or infrastructure services include applied research institutes, consulting firms, proof-of-concept labs and design houses, standards certification and testing facilities, technology and market intelligence services, and intellectual property (IP) services.

In the past, as part of its regional development policy, the government has established a two-tier system of technology parks: national S&T parks and regional technology parks. The national industrial parks were meant to create new industries in Kazakhstan, while the regional parks were created to develop the innovative capacity of existing industries of the region, particularly small and medium-sized tech businesses. To date, about 10 national technology parks and regional parks have been established (Cengel , Alpay, and Sultangazin 2013). However, the impact of these parks has so far been quite limited. Besides the challenge of finding enough innovative entrepreneurs, a key problem facing many of these parks is that they tend to be stand-alone facility that lack other supporting ecosystem elements such as colocation with a high-quality technical university, strong links to large companies that are potential customers and R&D collaborators with the tenant companies, easy access to venture investors and technology transfer intermediaries, and close proximity to a vibrant social community. Even the largest of these parks, the Special Economic Zone "Park of Innovative Technologies" (SEZ PIT) in the outskirts of Almaty, has yet to develop into a fully integrated high-tech cluster since its construction began in 2003, although there is momentum toward it with the construction of the new International University of Information Technologies campus and an Oil and Gas Institute by the Kazakh-British Technical University.

Key Guidelines for the Innovation Pillar

- **Increasing public funding for innovation.** While it is hard to delineate what would be an appropriate level of investment in innovation capability building, it is clear from a comparative benchmarking of Kazakhstan with other middle-income economies that have successfully moved up the technological development ladder that the country has significantly under-invested in innovation in the past. When Taipei,China, the Republic of Korea, and Japan were at the level of the current per capita income of Kazakhstan, they had all invested more than 1.5% of their GDP on R&D, versus less than 0.3% for Kazakhstan. Factoring in other expenditure in innovation activities beyond R&D spending, the gap between Kazakhstan

and the more successful Asian economies at comparable stages of income per capita is even wider.

- **Supporting local SMEs to tap into the innovation ecosystem.** SMEs are not in a position to directly tap knowledge created by universities and public research institutes and therefore need intermediaries that can facilitate the process of tapping into knowledge. In addition, various technology adoption and/or innovation subsidy schemes like advanced technology adoption subsidies, proof-of-concept grants, innovation voucher, double tax deduction, and subsidized secondment of researchers implemented by more advanced Asian economies, such as Singapore, the Republic of Korea, and Taipei,China, could be adapted in Kazakhstan. The public sector often needs to invest in such intermediary services ahead of market demand, either directly or by offering investment incentives and/or subsidies to attract private service providers (including foreign ones) to enter the market.
- **Encouraging investment in local innovation capability.** Large oligopolistic or monopolistic SOEs and foreign multinational corporations prefer to import technologies from overseas. While these enterprises do have the technical talent and resources to absorb technologies from overseas, they lack incentives to invest in developing innovation capability locally. The recently proposed compulsory contribution of 1% of revenue by foreign firms in the oil and gas and mineral extraction sector to fund innovation activities is a good policy to induce these firms to increase their investment in innovation
- **Inducing national firms to increase capacity for innovation.** Such capability is critical to reduce the country's dependence on foreign expertise as well as to enable national firms to diversify into higher value-adding services beyond pure extraction activities; for example, processing equipment fabrication, control systems engineering, downstream processing, and oil field technical and training services. A good example of a state-owned oil and gas company in an emerging economy that has made good progress in diversifying beyond basic extraction activities is Malaysia's Petronas.
- **Developing the venture financing industry for knowledge-based start-ups.** The financial system of Kazakhstan is primarily bank-based and emphasizes physical collaterals to secure loans. As the primary assets of knowledge-based start-ups are intangible, they require equity financing by angel investors and venture capital funds. Both are underdeveloped in Kazakhstan. However, the problem goes beyond the lack of funding. Venture investing expertise is needed along with public proof-of-concept grants and an angel investment community to seed start-ups. In this regard, the experience of Singapore in nurturing the development of an angel investment community may be of relevant interest to Kazakhstan (Box 2).
- **Strengthening innovation policy implementation.** As the government expands its public funding of innovation activities, it needs to strengthen its innovation policy implementation and assessment capability. The Ministry of Industry and New Technologies and its implementation agency (NATD) over the last 2 years have announced a slew of policies aiming to improve the nation's innovation system. While most of these policies drawn from various advanced countries are well-intended, the key is in ensuring that they are effectively implemented. This requires not only the capacity of the implementing agencies to adapt the policies to the local context, but also the development of capacity at the right level of government to independently evaluate the outcome and impact of policies, and to fine-tune the policies based on such assessment. Such independent policy assessment will ensure far greater accountability and transparency, which are important given the context of widespread public perception of public policies being subject to capture by rent-seeking individuals.

Box 2: Promoting an Angel Investment Community in Singapore

The development of a critical mass of angel investors has been an essential part of Silicon Valley (Lee et al. 2000) and other vibrant start-up entrepreneurial ecosystems. Unlike venture capitalists (VCs) who invest other people's money (limited partners who contribute to the VC fund) and typically do so at later stages of a start-up, angel investors invest their own money and usually do so at the founding seed stage. Typically ex-entrepreneurs who made money from their ventures or experienced executives with deep industry knowledge or connections, angel investors often play a hands-on role in helping the start-ups.

In early 2000, a group of angel investors in Singapore came together to establish an angel investor network called Business Angel Network Southeast Asia (BANSEA). Modeled after similar angel investment networks like the Band of Angels in Silicon Valley or Tech Coast Angels in San Diego, the network organized monthly pitching events for start-ups and conducted training to induct new angel investors. Arising from consultation with BANSEA, the government introduced a one-to-one matching scheme (SEEDS) in 2001 to provide co-investment capital in early stage start-ups by angel investors (up to S$300,000 per deal in the first instance and S$1 million cumulative). In addition, the government also provided seed funding to BANSEA to expand its professional development activities, including organizing the first Asian Business Angel Forum to promote cross-border angel investment and to attract more foreign angel investors to be based in Singapore. These support schemes have accelerated the growth of the angel investment community in Singapore and significantly increased the number of early stage high-tech start-ups in the 2000s. As the angel investment community grew, the government shifted its emphasis in the late 2000s to promoting more organized angel groups who can invest a greater amount of capital and provide more professional services, such as incubation facilities, with new schemes like the Business Angel Scheme that co-invest larger amounts, and the Technology Incubation Scheme (modeled after the Israeli incubation support program) that encourages angel investors to group together to run incubators. The latter program has attracted a significant number of overseas angel investors to locate in Singapore.

Source: Wong Poh Kam (2013).

Information and Communication Technology

For the ICT pillar, the relatively high ranking of Kazakhstan in the KEI is consistent with its relatively high overall score on the ICT Readiness Index of the *World Economic Forum's Global Information Technology Report 2013*, which ranks it 43rd in the world and above all the other Asian developing economies except Malaysia. However, a more detailed analysis of the subindices of the ICT Readiness Index reveals a number of weaknesses in Kazakhstan's ICT pillar. First, while Kazakhstan scores well in terms of government and individual usage of ICT, the country performs considerably less well in terms of business usage relative to its level of income, suggesting low readiness of Kazakhstan's businesses, especially the many local SMEs, in exploiting ICT. The World Bank Enterprise Survey 2009 similarly found lower usage of internet among firms in Kazakhstan than the average for Eastern Europe/Central Asia.

Second, while the ICT Readiness Index ranks Kazakhstan relatively higher in terms of affordability and government usage, the country's scores are low on political and regulatory environment. Third, due to its large landmass, much of it sparsely populated, inequality of ICT access (or the "digital divide") among its population is very high. Thus, while broadband internet access and mobile penetration rates are relatively high in the large cities, they remain low for many remote rural villages. Kazakhstan also scored less well on the ICT skills component index of the Global Information Technology Report, behind Asian economies such as the PRC or Eastern European economies such as Ukraine.

The State Program "Informational Kazakhstan – 2020" is aimed to address current challenges related to the lack of availability of ICT infrastructure in the regions and rural areas. The action points set up by the government include the following:

- modernization and development of telecommunications network in the rural areas with the usage of CDMA technologies;
- introduction of 3G networks in the locations with a population exceeding 10,000 people;
- introduction of 4G network sin all regional capitals, locations with a population exceeding 50,000 people, and all district centers in Kazakhstan; and
- decrease in tariffs on internet access and traffic services annually by 10%.

Kazakhstan is experiencing a growing telecom market with mobile penetration at 175% and more than 50 internet users per 100 people. The mobile network covers 95% of the territory of Kazakhstan, and 3G and 4G services were introduced in 2010 and 2013, respectively. By early 2013, mobile broadband services comprised around a quarter of the total mobile market as this service platform continued on a rapid growth path.[56]

The cloud technology services market is a relatively young market in Kazakhstan with a limited number of companies offering such services. The government has demonstrated interest in developing these services in Kazakhstan and has considered using them in the public sector. Use of cloud technologies as a solution for optimizing operational expenses of government agencies is included in the government's action plan for implementing the State Program "Informational Kazakhstan – 2020." In particular, the government has given consideration to the creation of the state's cloud platform "G-Cloud," migration of the information systems of the state to the cloud infrastructure, introduction of a service of a single mailing system of the state agencies on the basis of cloud technologies, and introduction of the register of state agencies' data on the basis of G-Cloud (Kazakhstan National Information Technologies JSC 2013).

While the various new policy initiatives announced by the government in recent years are clearly the right direction, more needs to be done to effectively address several key KBE development challenges facing Kazakhstan. In addition, even with the right policy, implementation capacity could be a bottleneck that needs to be addressed. The following key KBE challenges have been identified for priority attention by policy makers, and specific recommendations for addressing them are highlighted:

Kazakhstan faces the daunting challenge of improving communication access to its rural population sparsely distributed across a vast landmass. While the government has rightly emphasized the importance of developing physical transport and ICT infrastructures to promote regional economic integration and bring economic development to the less developed regions, it must be recognized that this can become extremely costly. Indeed, geography is probably one main factor for the relatively low penetration of broadband communication among Kazakhstan's population versus other economies at a similar level of per capita income.

Recognizing this, the government has recently proposed a regional agglomeration strategy, whereby communication and transport infrastructure development will be concentrated around

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[56] See http://www.budde.com.au/Research/Kazakhstan-Telecoms-Mobile-Broadband-and-Forecasts.html?r=51#sthash.7eXk9UYg.dpuf.

several major regional hubs and the network of satellite towns around each hub. Rural inhabitants in very isolated villages are encouraged to relocate into one of these regional hubs-and-satellites networks (see Nazarbayev 2012).

Our comparative analysis between Kazakhstan and various former Soviet Union republics suggests that Kazakhstan has lagged behind its potential in terms of software and/or business process outsourcing (BPO) and digital content services. Indeed, even neighboring Uzbekistan, with a lower per capita income and less economic integration with the Russian Federation and Belarus, has developed a stronger reputation for such ICT-enabled services. Aside from the relatively low access to broadband ICT, another factor could be the relatively low priority accorded by the Government of Kazakhstan to the promotion of high-quality ICT education and the ICT and/or digital media services industry.

As part of the state policy to promote the development of the ICT sector in Kazakhstan, the ICT Development Fund was created in 2012 by the Ministry of Transport and Communications, National ICT Holding Zerde, and mobile operators (Kazakhtelecom, Kcell, and Beeline) with the goal of providing funding and support to early-stage IT start-ups.

Another initiative backed by the government (Zerde and ICT Development Fund) is the establishment of the national ICT cluster based on the International IT University in Almaty, Nazarbayev University in Astana, and SEZ PIT in Almaty. The cluster will be operating as a resident of SEZ PIT but will allow companies to enjoy the supportive taxation environment without requiring them to move to SEZ PIT. In addition, the ICT cluster will include funding tools for early-stage IT projects that will be administered by the ICT Development Fund (pre-seed, seed, and venture funding).

Key Guidelines for the Information and Communication Technology Pillar

- **Implementing agglomeration strategy to optimize ICT deployment.** Agglomeration is a cost-effective infrastructure development strategy for Kazakhstan's geography. Well executed, this will also help spread the growth of urbanization away from over-concentration in the current three largest cities (Almaty, Astana, and Shymkent). The deployment of ICT infrastructure needs to be accelerated as part of the new regional agglomeration strategy. To ensure that this happens, the government may need to look into greater liberalization of competition in the telecommunications sector. Also, the development of high-quality educational programs in ICT and digital media in selected local universities, preferably one in each of the regional hubs, is also of high priority. However, for this strategy to work, the government must ensure the development of new sources of urban employment opportunities around these regional hubs-and-satellites systems. Otherwise, Kazakhstan could face the problem of rising urban youth unemployment.
- **Assimilating IT into manufacturing.** While there is scope for expanding existing mining and agricultural activities into more downstream complex processing activities, as well as developing more footloose new manufacturing industries in the regional parks around each of these regional hubs, the high transport costs for manufactured goods export (and corresponding import of parts and components) arising from the country's land-locked geography may limit the scale economy for many manufacturing industries. In many parts of the world, there is increasing application of IT and micro-processing technologies in manufacturing. Kazakhstan will benefit from encouraging the deployment of ICT in

manufacturing, which may help add value to the extractive industries where more processing value creation could be undertaken within the country itself.

- **Incubating digital enterprises and software services sector development.** There is significant scope for leveraging good ICT infrastructure, especially broadband internet access, to enable digital content and software-related service sector development. Some former Soviet Union republics with similarly high levels of education as Kazakhstan (e.g., Ukraine) have done well as software programming offshoring and BPO hubs for multinational corporations, while others like Estonia have become hotbeds for software start-ups (e.g., Skype). Such ICT-enabled export services are not constrained by the high physical transport costs for manufactured products, and as such can be located in any regional hub that has good ICT infrastructure. They could thus become a potential source of new employment for the regional hubs and their satellites. In addition, with the rapid growth of consumption of digital media contents, especially mobile applications among the young, Kazakhstan can leverage on its Russian language capability to produce digital contents for export to the Russian-speaking population at large in addition to producing digital contents for domestic consumption. The promotion of ICT-enabled software and BPO services represents a key area for future growth of Kazakhstan's knowledge economy. The country may need to seriously look to the knowledge-based services sector as an additional means to diversify its economy.
- **Applying ICT in education to increase quality and relevance.** The extensive application of ICT solutions in education has a considerable potential in transforming the older pedagogical model that is not equipping students with the requisite market-oriented skills. ICT-based solutions can generate state-of-the-art curricula and make learning more interactive. Learning modules, particularly in identified gap areas such as entrepreneurial education, can be used to upgrade and update the existing curriculum and course offerings in the universities. Nazarbayev University can become a hub for possible massive open online courses (MOOCs) in identified disciplines, particularly in the IT field, for developing the skills needed for digital enterprises. IT platforms for entrepreneurial education and business start-up mentoring would be valuable as they can target the on-the-job community as well.
- **Promoting ICT-led innovation in agriculture.** Kazakhstan is endowed with extensive arable land resources, and the country is already among the ten largest wheat producers and five largest wheat exporters in the world (OECD 2010). However, Kazakhstan's agriculture sector in general and the grain production sector in particular suffer from low yield due to poor farming knowledge and outdated technology as well as a poor supply chain system due to poor transport infrastructure and logistics management (OECD 2010). A greater focus on innovative deployment of ICT will help address these impediments to the growth of Kazakhstan's agriculture sector. Indeed, the rapid pace of ICT innovation in recent years, especially in mobile communications technology, has created significant opportunities to improve agricultural productivity and supply chain efficiency worldwide (Donovan 2011; Halewood and Surya 2012). In particular, many innovative, low-cost applications of internet and mobile technologies have emerged in less developed countries that are helping rural farmers to reduce their cost of production as well as increase their market access through better information. An increasing number of studies have shown that the introduction of such ICT applications have raised the income of farmers (Halewood and Surya 2012). Kazakhstan should significantly increase its effort to promote the innovative application of ICT in its agriculture sector by increasing the allocation of funding for ICT innovation projects in agriculture, increasing the teaching of agricultural ICT in universities, and strengthening its agricultural extension services to include innovative ICT deployment. See Box 3.

Box 3: Innovative Applications of Information and Communication Technology in Rural and Agriculture Sector

Information and communication technology (ICT) has been found to contribute significantly toward improving the entire agricultural value chain from crop planning to production and marketing, including the following:

Agricultural research. ICT has significantly reduced the cost of collection and analysis of agricultural research data, making the research data and information accessible to farmers and extension service workers to facilitate the adoption of better seedlings or farming techniques. ICT can also be used to disseminate meteorological and pest outbreak information to enable a more timely response to weather conditions. For example, a project in Turkey to provide daily localized weather information to farmers via short messaging services (SMS) enabled them to apply pesticides when needed and in appropriate amounts, resulting in a 50% reduction in pesticide cost; the same timely weather information service also enabled them to reduce crop damage from frost (Donovan 2011).

Agricultural planning and production. Through the use of geographic information systems (GIS), the size and soil conditions of agricultural land can be used to guide planning of crops and nutrient application. For example, the Seeing Is Believing – West Africa (SIBWA) project, funded by the Bill & Melinda Gates Foundation, used satellite imaging technology to provide an assessment of soil conditions to optimize crop planning by small farmers in several West African countries. Through the use of remote real-time monitoring technologies like GPS and wireless sensor networks, "precision" farming methods can be introduced that significantly improve yield, optimize water and fertilizer usage, monitor and reduce wastage through leakage, and detect crop diseases and damages for early remedial actions, among others. In addition, by reducing the use of crop nutrients, precision farming will reduce environmental impacts. Precision farming has been most widely practiced in advanced countries such as the United States and Australia where farm sizes are large, although a number of developing economies such as Brazil and Argentina have also been actively promoting it. For example, Brazil has established the Brazil Precision Agriculture Research Network to advance agricultural productivity and reduce environmental impact (Embrapa 2013).

Agricultural transport and logistics. ICT can be used to improve transport logistics management of agricultural produce, reduce spoilage, and enhance traceability and tracking to ensure food quality and security. For example, the National Coffee Growers Association in Colombia, representing half a million coffee farmers, has leveraged RFID technology to improve traceability and record-keeping on coffee quality standards (Halewood and Surya 2012).

Access to market. ICT can be used to significantly reduce the transaction cost of matching farm supply to demand by providing an online trading, tendering, and bartering platform that makes access to market information like price and demand volume more timely and transparent (particularly important for perishable produce) as well as reducing dependence and control by intermediaries, thereby lowering the market transaction cost for the farm producers. Many examples of such applications, particularly via the use of mobile phones, are found among the less developed economies where marketing channels have been less well developed (see, e.g., Syngenta Foundation 2011).

The Way Forward

The following is a summary of the key points under the different pillars:

- **Economic Incentive and Institutional Regime:** Although the country has achieved good progress on Ease of Doing Business indicators, it performs poorly on corruption perception. Active support to new business formation is required, particularly for industrial diversification. Streamlining tariffs in the context of WTO accession and proactive policies to encourage FDI-linked partnerships for industrial and trade diversification will support the objective of reducing the preponderant dependence on natural resource-intensive growth. At the same time, assimilation of technology, particularly through locally generated technological capability, will help enhance the value addition from oil and gas industries and make them more knowledge-intensive.
- **Innovation:** There is need to increase R&D expenditure as a percentage of GDP as well as the number of R&D personnel. Although venture capital funds have been launched, investments in innovation intermediaries are needed—proof-of-concept labs, design houses, standards certification, and technology and market intelligence services.
- **Education and Skills:** The country enjoys high mean years of schooling, but education is of poor quality. Education systems are not supportive of the growth objectives of the country. While a state-of-the-art university, Nazarbayev University, has been set up, national capacity is largely missing in this institution, which is mainly run with international expertise. There is a severe lack of relevant and high-quality technical and vocational education and training and higher-order skills for industrial diversification. Technical education is still cast in the old Soviet-style education mode and needs to be modernized and made flexible. Tertiary education needs to have links with innovation parks and innovation support instruments that have been put in place by the government, such as technology and entrepreneurship development.
- **Information and Communication Technology:** Although Kazakhstan has achieved a good position in network readiness, business usage of ICT is low, particularly for SMEs. There is a great digital divide between rural and urban populations as well as need for liberalization of the telecom sector and increased competition to enable higher penetration. Agglomeration strategies proposed by the government to provide clustered ICT services to the rural population in selected hubs is a good initiative for the short term. Universal broadband access would be needed in the long run.

Developing a National Action Plan for Knowledge-Based Economic Development

KBE development is integral to Kazakhstan's drive to diversify its economy beyond natural resource extraction and to raise its competitiveness. Compared to many other developing economies, Kazakhstan enjoys the advantage of political vision at the top and relative resource abundance to invest more aggressively in KBE development. What it needs is an integrated approach combining all four KBE pillars to enhance the efficiency of resource investment into KBE development.

In this chapter, key strategies to be pursued are presented in each of the four KBE pillars of Kazakhstan. The successful implementation of each of these pillar strategies depends crucially on each other. As such, it is recommended that a high-level, interministerial council be established to oversee the coordination of implementation of the four KBE pillars. In particular, the policies of the Ministry of Industry and New Technologies and the Ministry of Education and Science need to be better coordinated through such a high-level council. Currently, according to provisions of new law "On Government Support for Industrial-Innovation Activities," a Council for Technological Development headed by the prime minister has been established under the government. However, it still does not really assume this very important coordination function.

A useful model for Kazakhstan to consider is that of Finland, which has established a national research and innovation council, led by the prime minister. The Research and Innovation Council defines the main outline of the national strategy and presents a development program for the next several years with the aim of strengthening its position among the world's leading knowledge- and skills-based countries. In December 2010, the council adopted an integrated policy report on education, research, and innovation policy for implementation over the subsequent 5 years (see Research and Innovation Council of Finland 2010).

To support the high-level council in Kazakhstan, a secretariat should be established that will also function as a monitoring agency with the capability to independently assess the implementation, performance, and impact of various KBE policies and programs being implemented by the various ministries. A useful model that Kazakhstan can consider is that of the Korea Institute of Science and Technology Evaluation and Planning (KISTEP), which has played a significant role in providing independent analysis and assessment of innovation policies in the Republic of Korea.

The existing National Analytical Center under Nazarbayev University, which was established as a think tank/consultancy for the government in 2007, has the potential to be developed into such an independent policy assessment agency for innovation policy, provided its capability in innovation policy analysis and assessment is built up. Other options could be that the NATD under the Ministry of Industry and New Technologies should be used as the basis for its formation. Administration of innovation-supporting schemes in this case, obviously, should be moved from NATD to another government agency.

In addition to streamlining public policies, Kazakhstan needs to nurture and unleash the entrepreneurial energies and creative imagination of its people to spur innovation. There is currently too much of a top–down public push for innovation, and not enough bottom–up, market-driven entrepreneurial drive. A concerted program by the Ministry of Education and Science to increase learning about entrepreneurship and innovation at all levels—from primary to higher education—is recommended to change the mind-set of the young. At the same time, market liberalization and reduction of the monopolistic roles of SOEs need to be pursued, while the fight against corruption need to be stepped up so as to create the market space for value-creating (instead of rent-seeking) entrepreneurs to operate.

As highlighted throughout this chapter, many of the KBE challenges faced by Kazakhstan today have previously been encountered by some of the more advanced Asian and European economies. As such, Kazakhstan can profitably draw on the lessons learned from these economies and tap their experience in developing each of the four KBE pillars. In particular, Kazakhstan can benefit from adapting some of the more successful policies and programs of more advanced East Asian economies, such as the Republic of Korea, Singapore, and Taipei,China, in innovation and human capital development. In the past, Kazakhstan has tended to look to the Russian

Federation, Europe, and the US for policy advice on education and innovation (e.g., the two major reviews of Kazakhstan's innovation system commissioned in recent years were to UNECE and Columbia University, respectively, while the 2007 higher education policy review was conducted by OECD headquarters in Paris). In the future, Kazakhstan could broaden its tapping of policy advisory sources to cover the advanced economies of Asia as well. In the case of the Republic of Korea, besides KISTEP, Kazakhstan can also consider developing collaboration with the Korea Development Institute, particularly in the area of industrial development and diversification. With Singapore, the already established collaboration between Nazarbayev University School of Public Policy and the Lee Kuan Yew School of Public Policy at the National University of Singapore could be expanded to include learning exchange in the area of entrepreneurship education and university spin-off incubation as well. In addition, because of their similarities with Malaysia in terms of dependence on oil and gas as well as a common interest in using KBE development to overcome the middle-income trap, Kazakhstan could also benefit from closer knowledge exchange with Malaysia, especially in the area of petrochemical technological deepening and related industry diversification.

Besides initiating and deepening bilateral knowledge transfer and learning exchange programs with these individual Asian economies, Kazakhstan should also explore participating more actively in various existing multilateral platforms, as well as launching new ones focusing on knowledge-based economic development.

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Innovative Asia: Advancing The Knowledge-Based Economy
Country Case Studies for the People's Republic of China, India, Indonesia, and Kazakhstan

This report presents the case studies of the People's Republic of China, India, Indonesia and Kazakhstan in their knowledge-based economy approaches. It identifies a range of policies and initiatives that these economies need to consider to strengthen innovation led growth and make a transition from middle income to high income levels.

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