A fundamental question facing East Asia, especially its low- and middle-income economies, is how to sustain or even accelerate the growth of recent decades. From 1950 to 2005, for example, the region’s real income per head rose sevenfold. With aging populations, these economies will need to derive an increasing share of growth from productivity improvements rather than from physical factor accumulation to drive growth.1

The recent global economic and financial crisis has served only to lend urgency to East Asia’s search for avenues to higher productivity and competitiveness in an increasingly global market, ultimately leading to growth. Investment in human capital, physical investment in research and development (R&D), technological progress, and the increase in total factor productivity arising from scale economies and agglomeration effects are all elements of the search. These investments will help East Asia reap the rewards of globalization and rapid technological development, promote within-sector productivity growth, and provide the necessary incentives for further labor reallocation toward high-productivity sectors.

Investing in education—particularly higher education—is a crucial part of East Asia’s drive toward greater productivity, growth, and technological development. This book introduces a conceptual framework for the analysis of higher education in lower- and middle-income countries in East Asia (the target country group).2 The book takes a broad definition of higher education to include all public and private formal institutions of learning beyond the upper-secondary level. These institutions award formal academic degrees, diplomas, or professional certification and include, but are not limited to, universities, two- and four-year colleges, institutes of technology, religious-based educational institutions, online and distance learning, foreign branch campuses, and other collegiate-level institutions (such as vocational, trade, or career) (see appendix A for a detailed list of higher education institutions in East Asia).

At the very core of the conceptual framework is the idea that higher education in low- and middle-income East Asia has the potential to lift productivity and competitiveness by providing the high-level skills demanded by the labor market and by launching or expanding robust research needed for innovation and growth. As important is the need to consider higher education as a system composed of the higher education institutions...
themselves; the other skill and research users and providers that interact with them; the underlying policies that support higher education institutions; and the interactions among higher education institutions, users, and providers. While it is important to note that higher education provides several non-economic benefits such as nation building and socialization, this book focuses on the economic benefits of higher education as they relate to skills and research.

The book argues that higher education is failing to deliver skills for growth and research for innovation because of widespread disconnects between higher education institutions and other skill and research users and providers. These disconnects undermine the very functioning of the higher education system. The main assumption of the report is that to deliver labor market skills to higher education graduates, these institutions (a) must have characteristics that are aligned with what employers and employees need and (b) must be well connected among themselves and other skills providers. Similarly, to deliver research that can enhance innovation and productivity, higher education institutions need to have a strong role in research provision and have strong links with firms and other research providers.

Getting the system to work well requires adequate information, capacity, and incentives that are closely related to financial resources, public higher education management, and stewardship for higher education systems. Government and households have a critical role to play at the policy stage, including holding institutions accountable for results and providing public and private resources. The disconnects are ultimately illustrative of weaknesses and failures in the way financial resources and institutions are managed. Prompt public intervention is required because no country in East Asia has reached high-income status without a strong higher education system.

Figure 1.1 illustrates this conceptual framework as presented throughout the chapters of this report. This first chapter presents the economic landscape in East Asia, showing the vast differences of productivity and growth across countries in the region. To show how low- and middle-income countries can advance, this chapter then introduces the role of higher education in equipping individuals with skills and producing research that can lead to greater productivity and growth. Chapter 2 continues with a diagnostic of higher education in skills and research in low-, middle-, and upper-income economies in East Asia. Chapter 3 shows how failures to deliver on skills and research in lower- and middle-income countries are related to critical disconnects between (a) higher education and (b) users and providers of skills and research. It demonstrates how these disconnects are related to problems with poor information, low capacity, and weak incentives. Given these challenges, chapters 4–6 provide policy recommendations to address these problems and mitigate the disconnects through better financing of higher education (chapter 4), better management of public higher education institutions (chapter 5), and better stewardship for the higher education system (chapter 6).

**East Asia’s economic landscape**

The economies of East Asia can be divided into three income groups, which beyond a certain income per capita tend to share some common characteristics in terms of economic structure, human development, and business climate. The first income group is made up of Hong Kong SAR, China; Japan; the Republic of Korea; Singapore; and Taiwan, China. These economies also have a sophisticated economic structure and advanced human development indicators. China, Indonesia, Malaysia, Mongolia, the Philippines, and Thailand represent the second middle-income group of East Asia. These economies also have a sophisticated economic structure and advanced human development indicators. China, Indonesia, Malaysia, Mongolia, the Philippines, and Thailand represent the second middle-income group of East Asia. More precisely, according to the income classification adopted by the *World Development Report*, five of these countries are lower-middle-income economies, and Malaysia is an upper-middle-income economy. This group is fairly heterogeneous, but countries in it generally share more developed
economic structures, human development indicators, and business climate than the lower-income economies have. Finally, the lower-income group comprises Cambodia, the Lao People’s Democratic Republic, and Vietnam. These countries are late starters, as is apparent from their per capita gross domestic products (GDPs) and development levels.

In addition to the three income groups, the East Asian economies can be divided into three technology clusters on the basis of the skill and high-tech intensity of their products and exports. Together, these metrics serve as a proxy for measuring an economy’s level of innovation in supporting productivity and its development of science and technology. As a result, this proxy provides an assessment of an economy’s productivity and ability to move up the value chain within the service, manufacturing, non-manufacturing industry, and agricultural
sectors. Although the relationship between income and technology is similar, there is not a one-to-one match between the groups, with economies within income groups performing at slightly different levels of technological capacity (figure 1.2).7

The first group’s economies grew rapidly from the mid-1960s to the mid-1990s and have achieved high income levels (table 1.1). They coincide therefore now with the group of high-income East Asian economies. Each of them, with the exception of Hong Kong SAR, China, focused on manufacturing, which accounts for around a quarter of GDP (table 1.2). Growth was sourced mainly from capital accumulation, supplemented by gains in factor productivity, with investment largely financed by domestic savings.

Overall, these economies are East Asia’s technological leaders in a wide range of medium- and high-tech manufacturing industries, including electronics and electrical products, automobiles and parts, shipbuilding, and machinery (table B.4 in appendix B), but they also have service sectors with high levels of innovation and productivity and thus form part of the top technology cluster. While less manufacturing oriented, Hong Kong SAR, China’s level of innovation in the service sector also positions it in that cluster, but at the bottom. Throughout the past two decades, exports as a share of GDP have grown significantly (table B.3 in appendix B).

The share of services is also significant and has been increasing, reaching at least 60 percent of GDP in 2007 (figure 1.3).

China, Indonesia, Malaysia, Mongolia, the Philippines, and Thailand compose the middle-income country group. They are all in the under-US$7,000 per capita range (table 1.3) in constant nominal GDP. Indonesia, the Philippines, and especially Mongolia trail in manufacturing value added (table 1.4) and investment. Electronics and electrical products are the leading export subsectors in China, Malaysia, the Philippines, and Thailand, while Indonesia and Mongolia still export mainly primary and agro-based products (table B.8 in appendix B).

FIGURE 1.2  A schematic of income groups and technology clusters

Source: Authors’ elaboration.

Note: Income level is given by GDP per capita in 2009. Economies’ position in the figure reflects their ranking by income and technology.
in appendix B). Unlike those economies in the upper-income group, when they produce or export electronics, this group’s countries are mainly assemblers and processors of electronic products, operating at a far lower level of technological competency and at lower points in the value chain. Services account for about 35–55 percent of GDP, and their share has been increasing in most of these countries. This sector (as well as agriculture) is also working at lower levels of productivity. From that perspective, and because they cannot yet be classified as innovative, although China, Malaysia, and to a lesser degree Thailand began encouraging investment in R&D in the 1990s, they are part of another technology cluster.

Within this lower cluster there are, however, substantial differences between countries and countries’ subgroups. China, Indonesia, Malaysia, the Philippines, and Thailand started climbing the technological ladder in the 1970s and have facilitated technology assimilation by becoming increasingly open and following the example of the East Asian frontrunners by promoting industrialization and infrastructure development through high levels of investment (table B.7 in appendix B), they are part of another technology cluster.

Within this lower cluster there are, however, substantial differences between countries and countries’ subgroups. China, Indonesia, Malaysia, the Philippines, and Thailand started climbing the technological ladder in the 1970s and have facilitated technology assimilation by becoming increasingly open and following the example of the East Asian frontrunners by promoting industrialization and infrastructure development through high levels of investment (table B.7 in appendix B). In contrast, Mongolia is a late starter and, as such, part of an even lower cluster together with lower-income countries. As will be further illustrated below, even within the five countries with some developing innovative capacity, there are significant differences between China, clearly ahead, and countries such as Indonesia and the Philippines, trailing behind.

**TABLE 1.1** Per capita GDP averages, upper-income economies

<table>
<thead>
<tr>
<th>Economy</th>
<th>Nominal (constant 2000 US$)</th>
<th>PPP (constant 2005 international $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>35,310</td>
<td>38,368</td>
</tr>
<tr>
<td>Singapore</td>
<td>18,269</td>
<td>26,500</td>
</tr>
<tr>
<td>Hong Kong SAR, China</td>
<td>23,115</td>
<td>29,188</td>
</tr>
<tr>
<td>Taiwan, China</td>
<td>11,102.2</td>
<td>16,044</td>
</tr>
<tr>
<td>Korea, Rep.</td>
<td>8,974</td>
<td>13,593</td>
</tr>
</tbody>
</table>

Source: World Development Indicators (WDI) database.
Note: PPP = purchasing power parity.
a. Hong Kong SAR, China, and Taiwan, China, average for 2000–08.

**TABLE 1.2** Manufacturing value added, upper-income economies

<table>
<thead>
<tr>
<th>Economy</th>
<th>1990–99</th>
<th>2000–09</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Korea, Rep.</td>
<td>27.1</td>
<td>27.2</td>
<td>0</td>
</tr>
<tr>
<td>Singapore</td>
<td>26.0</td>
<td>24.4</td>
<td>−6</td>
</tr>
<tr>
<td>Taiwan, China</td>
<td>27.1</td>
<td>23.3</td>
<td>−14</td>
</tr>
<tr>
<td>Japan</td>
<td>24.0</td>
<td>21.1</td>
<td>−12</td>
</tr>
<tr>
<td>Hong Kong SAR, China</td>
<td>9.4</td>
<td>3.9</td>
<td>−59</td>
</tr>
</tbody>
</table>

Source: WDI database.
a. Japan and Taiwan, China, average for 2000–08.
b. Hong Kong SAR, China, average for 2000–07.

Cambodia, Lao PDR, and Vietnam are the lower-income East Asian countries, but they have moved onto a rapid-growth trajectory (table 1.5). Although Lao PDR’s and Cambodia’s investment rates remain below 20 percent (table B.11 in appendix B), Vietnam’s are similar to those of its neighbors at earlier stages of development. Vietnam and Cambodia are building manufacturing capacity (table 1.6) but have yet to rise beyond the low-tech, labor-intensive stage of manufacturing, as clearly reflected in their exports (table B.12 in appendix B). Lao PDR is further behind in terms of manufacturing capacity. Services represent about 40 percent of GDP in all countries, and they are still working at low productivity levels. These three countries, together with Mongolia, are part of the lower technology cluster, with Vietnam sitting in front, but with generally smaller differences in technological capability across countries.
This picture conveys the main challenges facing East Asian low- and middle-income economies. The members of the East Asian technology clusters are competing in export markets—often fiercely with each other—to enlarge the gains from industrialization and trade, seeking to move up the value chain in manufacturing while increasing the productivity of their growing service sectors.

Japan leads the top technology cluster (and upper-income group), followed by Hong Kong SAR, China; Korea; Singapore; and Taiwan,
China. These last four have some way to go before they achieve per capita income parity with Japan. Korea most closely approximates Japan in manufacturing breadth, while Hong Kong SAR, China, and Singapore are the furthest removed. All have one thing in common: they are at the technological frontiers in their respective industries. Moreover, Japan, Korea, and Taiwan, China, are among the most innovative industrial economies, pushing the technological frontiers in electronics, petrochemical, metallurgical, automotive, and other fields, such as services and agriculture. Singapore is attempting to join the other members of the cluster through research in biotechnology and electronics, with some success. Its innovations are more conspicuous in services (such as managing hotels and industrial parks, and urban planning), water purification, logistics, and use of information and communication technology. All five economies are exemplars for the rest of East Asia.

Middle-income countries of the middle technology cluster range in size from China with more than 1.3 billion people to Malaysia with 28 million. With China comfortably in the forefront of the technology cluster, all these nations have acquired significant manufacturing capabilities. China is the world’s second-ranked industrial nation and the largest exporter. In less than two decades it has emerged as the leading producer of products ranging from steel, glass, and cement to electronics, photovoltaic cells, and household appliances. China’s export competitiveness speaks to its rapidly maturing manufacturing capabilities and strengthening grasp of production technologies across several sectors.

Malaysia, Thailand, the Philippines, and Indonesia, in that order, have also built up competitive manufacturing industries, with electronics, textiles, automotive, and resource-based industries the most important. Electronics and electrical engineering are the most important for the first three countries, whereas light manufacturing and processing activities are of greater significance to Indonesia. All these countries have relied extensively on foreign direct investment to build manufacturing capacity and to master production technology. Multinational corporations and their joint ventures account for a sizable share of production for export (the most advanced and competitive segment of industry), though production skills are now widely diffused, with domestic manufacturers often able to compete with multinationals.

Nevertheless, members of the middle technology cluster are still some years and, in the case of Indonesia and the Philippines, decades away from acquiring the technological capabilities of the leading industrial nations. Except China (which is more diversified and has greater industrial depth), the other countries are largely focused on assembly, processing, testing, and relatively low-value-adding operations, and their indigenous technological

**TABLE 1.5** Per capita GDP averages, lower-income economies

<table>
<thead>
<tr>
<th>Economy</th>
<th>Nominal (constant 2000 US$)</th>
<th>PPP (constant 2005 international $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>299</td>
<td>530</td>
</tr>
<tr>
<td>Cambodia</td>
<td>239a</td>
<td>407</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>263</td>
<td>399</td>
</tr>
</tbody>
</table>

Source: WDI database.

Note: PPP = purchasing power parity.

**TABLE 1.6** Manufacturing value added, lower-income economies

<table>
<thead>
<tr>
<th>Economy</th>
<th>1990–99 (average % of GDP)</th>
<th>2000–09 (average % of GDP)</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>15.2</td>
<td>20.3</td>
<td>34</td>
</tr>
<tr>
<td>Cambodia</td>
<td>11.1a</td>
<td>18.0</td>
<td>62</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>14.2</td>
<td>14.6b</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: WDI database.
b. Lao PDR average for 2000–08.
Capabilities are limited to simpler downstream activities. Their service sectors are also still low productivity. And although they are achieving high levels of efficiency in production, their indigenous technological capabilities are limited to simpler downstream activities. Even China, whose exports overlap with those of countries in the Organisation for Economic Co-operation and Development (OECD), still operates in the lower-quality and value-adding ends of manufacturing. While China is closing the technology gap in virtually all fields of manufacturing—and in some areas is approaching the point where it can become an innovator—its domestic capability still lags behind that of leading industrial nations, leaving substantial room for catch-up in some areas.

Some countries in Southeast Asia (four are in the middle cluster) began taking a serious interest in innovation as a new growth driver after the crisis of 1997–98, because of lost growth momentum and declining private investment. Innovation captured the imagination of policy makers in Malaysia, and to a lesser degree in Thailand and even China (which did not experience a comparable growth slowdown). Countries clearly show differences, though, because while firms in China are beginning to experiment with real innovation, firms in Indonesia and the Philippines see it as a more distant prospect.

Most middle-income countries’ biggest gains at this stage are from applying, assimilating, and adapting new technology. Businesses have rationally shown little interest in developing new technologies when there is so much low-hanging fruit to be picked. For most companies, the demand for innovation is the same as learning technologies already developed (in country or outside) and adding to production and technological capabilities.

The lower-income and low technology cluster includes the latecomers, countries that began industrializing in the 1990s and that have not progressed much beyond light manufacturing and simple assembly operations. They are likely to remain in the learning mode for some time. The primary challenge for these economies is to increase productivity in all sectors and break into manufacturing. Climbing the technology ladder is another immediate objective.

Given this economic context, how can low- and middle-income East Asia develop higher levels of productivity in the short run? And how can economies develop the technological capacity they need to increase productivity in the medium run, which has shown to be so important in determining the higher productivity levels of upper-income East Asia? Skills, which enhance capacity to apply, adapt, and create new technology, and research, which enhances capacity to develop new technology, will be two key drivers. And higher education can supply both.

**Role and impact of higher education**

Skills are positively related to innovation and productivity (and so growth), as discussed below. This is one reason why in low- and middle-income East Asia—whether playing technological catch-up or moving from catch-up to creation (both parts of a broad definition of innovation in this report)—the importance of higher education as a source of scientific, technical, and analytical skills is increasing. A well-trained and highly educated workforce underpins growth: skilled labor can deploy flexibly, achieve high levels of productivity, apply existing technologies, and engage in innovation as a means to increase a nation’s competitiveness and growth. At the same time, East Asian markets are absorbing a larger share of exports from the region itself; thus, adapting technologies while customizing products, processes, and design will be of greater significance and will call for the kind of support higher education can provide.

As economies move up the technology ladder and the gap between some of them and the leading industrial economies narrows, their need for education and skills at all levels grows, particularly at the tertiary level. Thus a range of tertiary institutions take on larger responsibilities—and they can help
accelerate industrial change—because they are the source of an increasing share of entrepreneurs, managers, and skilled workers. Additionally, a few research universities begin contributing to innovation through basic research that generates ideas or upstream applied research and technology transfer (or both) that initiates the process of transmuting knowledge and ideas into applications with potential commercial relevance.

Higher education provides several non-economic benefits, such as nation building and socialization (box 1.1). But this report focuses on the contribution of higher education to the productivity that allows economies to remain competitive in a global market.

Whether tertiary education is a more significant predictor of growth than primary education in developing countries continues to be debated. There is, however, some consensus that tertiary education is positively associated with economic growth and GDP regardless of a country’s development level. Very crudely, this relationship is apparent from figure 1.4, which shows a positive correlation between GDP and enrollments in higher education. While causality cannot be established (given the many other factors that matter, including the composition and quality of higher education itself), no country or region has achieved, in the long term, high-income status without first crossing

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**BOX 1.1 Private and public benefits of higher education**

As a proponent of liberal education, the Oxford scholar Cardinal Newman advocated for higher education as a place for cultivating universal knowledge rather than developing vocational training and research. He believed students should study the classics and philosophy because these courses had the ability to “strengthen, refine, and enrich the intellectual powers.” With this “habit of mind,” individuals would be equipped to think clearly and articulate their thoughts in any profession. While Cardinal Newman’s view is an important mission of higher education, the benefits of higher education extend from individuals to society and from economic to social benefits.

There is much evidence of the economic benefits of investing in higher education. Individuals who attend higher education have higher average earnings, are more likely to be employed, and are less likely to experience poverty than individuals without higher education. Data on lifetime earnings of U.S. workers by education level show that relative to high school graduates, individuals with some college education have on average 17 percent higher earnings, and those with a professional degree have more than three times the earnings. Thus, individuals who invest in higher education can expect their future economic returns to exceed the costs of tuition, fees, and forgone earnings from not working.

Higher education also generates economic benefits to society. Countries with a large labor force of individuals with higher education have higher productivity and higher tax payments. This also lowers dependence on public welfare programs. The United States spends US$800–2,700 less per year on social programs for graduates of higher education than for high school graduates. All these factors contribute to a country’s economic growth.

In addition to economic benefits, higher education provides several social benefits. Higher education institutions are good settings for individuals to socialize with peers. Individuals with higher education tend to have higher standards of living and better well-being. They also tend to be in better health, are less likely to smoke, and are less likely to engage in criminal activities. The benefits of higher education also extend across generations: children of parents with higher education are more exposed to reading, have higher cognitive skills, and are better able to concentrate. Finally, higher education promotes nation building, because citizens with higher education are more likely to vote, to donate blood, and to participate in community service. These benefits show how higher education can enhance the quality of life for individuals and countries.

Source: Baum and Payea 2005.
a Newman 1976.
a “respectable” higher education threshold. And figure 1.5 reports a positive relation between labor productivity and higher education.

The relation between higher education and skills is well documented. Results of seven participating countries of the Adult Literacy and Life Skills Survey undertaken by the OECD show a strong positive correlation between cognitive skills (generally considered a combination of academic and thinking skills—see box 1.2) and educational attainment, with individuals having more years of higher education consistently scoring at higher skill levels than individuals having fewer or no years of higher education (figure 1.6). This finding is consistent with those of past studies that educational attainment is a leading contributor of cognitive skills such as literacy and numeracy.\textsuperscript{13}
In turn, skills are positively related to productivity, labor market outcomes, and growth. Earlier research on the contribution of human capital to economic growth using regression analysis yielded equivocal results on the relation between education and growth. More recent analysis that factors in the quality of education and moves beyond the criticized measures of educational achievement (which largely relied on years of schooling) has been, however, more successful in establishing a relationship running from the level of education to the level of output and from the quality of education to growth of GDP.\textsuperscript{16} Along these lines, recent evidence confirms that there is a direct relation between cognitive skills, on the one hand, and productivity and growth, on the other.\textsuperscript{17} An emerging literature has also demonstrated the link between cognitive ability and labor market outcomes.\textsuperscript{18} Beyond cognitive skills, noncognitive skills (intended mostly as behavioral skills) are increasingly shown to have a positive impact on labor market outcomes.\textsuperscript{19} Beyond supporting the application of current technology, higher education can foster innovation (in this report defined broadly as the ability of economies to both create and adapt new knowledge) through the skills that it provides. Those individuals with more education of better quality have a higher probability of starting a technology-intensive business, hiring skilled workers, and engaging in innovation.\textsuperscript{20} This is also illustrated by the positive relation at the firm level between technological innovation, defined in a broad sense,\textsuperscript{21} and ratio of workers with higher education found in a sample of firm surveys of the region (figure 1.7).\textsuperscript{22} The correlation would be stronger if one were able to control for the quality of higher education graduates, considering their skill sets. Unfortunately, that cannot be done. Nevertheless, it is known that there is a positive relation between professionals with management skills, innovation, and productivity,\textsuperscript{23} or that a higher share of graduates with science, technology, engineering, and math (STEM) skills is generally correlated with higher

**BOX 1.2 Defining skills**

At least three main categories of skills can be identified: academic skills, generic (or life) skills, and technical skills. Academic skills are directly measured and are generally associated with subject areas (math, literacy, English). They are typically taught in schools and measured through standardized tests. Generic (or life) skills refer to a broader set of skills transferable across jobs and from education to employment. They generally include thinking (critical and creative thinking, and problem solving), behavioral (communication, organization, teamwork, time management, ability to negotiate conflict and manage risks, and leadership), and computing skills. Technical skills are those associated with one’s profession. They are generally considered a mix of specific knowledge and skills to perform specific jobs. Cognitive skills are often used as a further categorization and typically include a combination of academic and thinking skills.

These three skill categories can also be divided internally: there are both threshold-level academic, generic, and technical skills, and higher-order academic, generic, and technical skills. The level and combination of required skills vary by firm and job function. The nature of the skill acquisition process implies that a comprehensive approach to skill development is needed. Formal education is one critical actor. High-quality and relevant school-based formal education has a strong role in providing all three types of skills discussed. Primary education systems can provide basic academic and generic skills. Secondary education systems can provide more advanced academic and generic skills, as well as some technical skills. And tertiary education systems can provide all three types, of a higher order.
innovation outcomes (figure 1.8). Firm innovation surveys undertaken for this report in Indonesia, the Philippines, and Thailand showed that the active innovators are those with higher levels of R&D expenditures, more highly qualified staff, and located in more R&D-intensive industries.24

The top technology cluster in East Asia can also readily illustrate the relation between higher education, innovation, and growth through both skills and research. High-income economies in East Asia are among the world’s most innovative. No member of this group has attained high innovation and income status without making considerable strategic investments in higher education. Korea, for example, has invested aggressively in government research institutes and university-affiliated science parks, as well as pursued policies leading to high enrollment in higher education (particularly in science and engineering) since the 1970s.25 Similarly, Singapore has devoted much capital to developing world-class scientific and technological capabilities through higher education.26 Hong Kong SAR, China, has pursued an agenda to develop itself as a hub for higher education, pouring resources into improving quality, developing staff, fostering greater links between academia and industry, and incentivizing research. And Taiwan, China, has attributed investment in science, engineering, and higher education as a key driver of its economic growth.27 Long-term trends in R&D undertaken by higher education compared with long-term trends in some innovation outcome indicators, while not perfectly aligned, point to a positive correlation between higher education and innovation outcomes in upper-income East Asia (and other advanced economies) (figures 1.9–1.12).

The relation between higher education and innovation is also widely illustrated in several studies that show the positive relationship between economic growth and higher levels of education as measured by variables such as tertiary gross enrollment ratio (GER), science test scores, R&D, and number of scientists and engineers per capita.28 This evidence suggests that low- and middle-income economies will need to start prioritizing higher education if they want to grow. As a matter of example, while coverage of higher education has been rising fairly steadily since the 1970s in most economies (figure 1.13), the GER still remains below par in developing East Asia (figure 1.14). Korea possesses one of the highest tertiary GERs in the world: almost 100 percent of the adult school-age population is enrolled. Japan’s tertiary GER has reached 60 percent. The tertiary GERs of Hong Kong SAR, China;
Japan; and Korea are on par with (or even higher than) those of several high-income countries in Europe and North America. But the relatively poor performance of most low- and middle-income East Asian economies has kept the developing-Asia region’s average tertiary GER significantly below the OECD average, at a paltry 20 percent.

Quantity, however, is not necessarily a goal in itself. Indeed, as seen above, similar GDP and innovation outcomes are related to very different quantity levels. And as shown in figure 1.6, the variation in skills and attainment indicates that other factors may influence skill proficiency (besides attainment). What matters is the capacity of higher education to provide labor market skills and research for productivity and innovation. On both counts, lower- and middle-income countries have a long way to go, as will be seen.

**From higher education to growth: Skills and research**

As a provider of high-quality skills relevant to current and future labor market needs, effective higher education systems improve human capital formation and allow entrepreneurs, managers, and skilled workers to perform well, thus supporting technological mastery, productivity, and competitiveness. These systems also help develop countries’ technological capability by undertaking research, supporting technology transfer, and providing workers with (and upgrading) the skills for innovation.

Skills and research support longer-run productivity and competitiveness by reorienting, upgrading, and diversifying national economic structures. Cross-country regressions have shown that a college degree is associated with higher individual earnings, higher productivity, and higher wages. One commentator has written, “Tertiary education helps countries build globally competitive economies by developing a skilled, productive, and flexible labor force and by creating, applying and spreading new ideas and technologies.”

In pursuing these twin tracks, countries need to consider opportunities of access to and inclusiveness of higher education. Whatever higher education coverage targets they choose, they must be able to draw from the widest talent pool possible, ensuring that the most able students are not excluded.
FIGURE 1.9  Trends in higher education R&D, 1996–2007

Sources: UNESCO Institute for Statistics (UIS) Data Centre, WDI database.

FIGURE 1.10  Trends in patents, 1996–2007

Source: U.S. Patent and Trademark Office data.
FIGURE 1.11  Trends in journal articles, 1995–2007

Source: WDI database.

FIGURE 1.12  Trends in technology licensing, 1975–2007

Source: WDI database.
FIGURE 1.13  Tertiary GERs in East Asia and some comparator economies, 1970–2010

Source: EdStats database.
from higher education because of inequities of access or long-term disadvantage. This is not only an ethical choice but also an economic one.

Countries will not find a one-size-fits-all target for access. For example, to support a more focused innovation agenda, they may assume a strong focus on developing centers of excellence and very highly skilled graduates, a strategy that may contrast with the idea of more widely available higher education. Others looking to improve their higher education system’s labor market relevance may make investments and assign priorities in ways that are more compatible with broader access. Still, the critical economic criteria guiding the system’s expansion are the current and future labor market absorption capacity, the need for a critical mass to support innovation, and budget constraints. The next two sections delve deeper into the roles of skills and research.

Higher education as a provider of skills

As suggested by the definitions of skill categories (box 1.2), skills are produced in many different ways, dynamically, and through multiple actors. Preemployment education and training, on-the-job training, work and life experience, and peer learning all contribute to skill development that could be useful on the job.32 Whereas academic skills are normally acquired through formal and nonformal educational institutions, generic or life skills are acquired in various ways. Early-childhood parental education, specifically targeted curricular and pedagogical approaches, on-the-job training, and work experience all develop and enrich these types of skills. Technical skills are generally provided through targeted upper-secondary and tertiary training programs, on-the-job training, and learning-by-doing.

Skill acquisition is thus a cumulative and dynamic process that occurs throughout the life cycle. It starts at birth with parental education and continues through the course of school education, training, and experience. And just as these skills can grow over time, they can deteriorate if the possibilities for lifelong learning are not well developed.

Actors outside the formal education system also have a large role. Quality nonformal education and training can provide academic, generic, and technical skills to out-of-school populations and can complement formal education with additional generic or technical skill instruction. It can also provide opportunities to update academic and technical skills over time, particularly for the non-school-age population. Firm and on-the-job training can complement both formal and nonformal education and training by providing additional job-relevant technical and generic skills. This type of training can also provide opportunities to maintain the existing generic and technical skills of workers.

Within this broad skill framework, higher education plays a crucial role—perhaps no more clearly than in skill provision. Higher education institutions provide the basis for the range of skills needed for both mature and developing economies. Tertiary graduates enter the workforce with cognitive, technical, social, and behavioral skills honed at university that allow them to
bring advanced knowledge to bear on complex problems, use that knowledge to work toward their solution, perform research, and develop ideas of more productive ways of performing. It is during higher education that more mature students have the capacity, ability, and time to learn sophisticated client orientation, communication, problem solving, and creativity skills, not only through close links with particular careers (for example, business and communication), but also across careers through the use of well-crafted teaching-learning methodologies. While many practical skills will be acquired on the job, higher education also offers a critical opportunity to its students to apply academic skills to more concrete and practical cases through case studies and other methodologies, with wider breadth than more specific on-the-job training would provide. Other research indicates that higher education instructors can teach students relevant technical and behavioral skills that they will need to know and use as industrial actors, without actually doing industrial research themselves.33

These points reflect in some part a changing concept of the role of higher education. As technological structures and the nature of industry evolve, academic qualifications are increasingly taken as indicators of a particular level of academic competence and of the skills to deal with the demands of a fast-changing work environment. Employers expect tertiary graduates to possess the academic, generic, and technical skills to increase their productivity and growth.34 Increasingly, employers also expect a smaller group of workers to possess the ability to think, to be creative, and to have the capacity to spur innovation. This is consistent with emerging research on academic knowledge transfer, which has found that skilled graduates bring to industry attitudes and abilities for acquiring knowledge and using it in novel ways.35

Keen to bolster their productivity, East Asian economies are giving new consideration to the knowledge and skills of their workers, and consequently the education and training systems that shape them. Policy makers in East Asia are reexamining how higher education systems should prepare graduates to take their places in the labor force. They are also asking how graduates should be equipped to deal with changing labor force structures and demands from employers in ways that can meet both the current and future needs of the economy.

A better perspective of higher education’s potential for delivering skills requires knowing the skills—particularly tertiary—that low- and middle-income East Asian labor markets need, as seen in demand both for tertiary graduates and for specific functional skills.

**Trends in demand for tertiary graduates**

In the long term, demand for tertiary graduates has been generally on the rise in the region, as seen in the steep increase in wage premiums for completing a tertiary education in Cambodia, China, Mongolia, and Vietnam, as well as gradually increasing ratios of tertiary education workers in Cambodia, China, and Vietnam (figure 1.15). In Mongolia, the decreasing trend of a tertiary-educated workforce clearly indicates quantity gaps. Alongside sharper increases in the number of workers with a tertiary education, the slightly increasing or flat premiums in the Philippines, Indonesia, and Thailand indicate sustained demand for such graduates.37

Demand is particularly dynamic in the service sector. Trends in tertiary education premiums and the tertiary-educated workforce by sector reported in appendixes C and D show that demand for tertiary graduates has been generally stronger in services, though often sluggish in manufacturing (but with differences across countries). The evolution of tertiary education premiums has been rather sector specific in Indonesia, the Philippines, and Thailand, with generally decreasing returns in agriculture, mixed performance in manufacturing (decreasing in Indonesia and the Philippines, flat in Thailand), and increasing in services (at least in Indonesia and the Philippines). The evolution of education premiums has been broad-based in Cambodia,
FIGURE 1.15  Trends in wage education premiums and educated workforce in selected East Asian economies

Source: di Gropello and Sakellariou 2010, on the basis of labor and household surveys (various years).
Note: For Cambodia, skilled 1 = workforce with at least lower-secondary education; skilled 2 = workforce with at least upper-secondary education; skilled 3 = workforce with tertiary education and above; skill premium 1 = wage premium for workforce with at least lower-secondary education compared to workforce with less education; skill premium 2 = wage premium for workforce with at least upper-secondary education compared to workforce with less education; skill premium 3 = wage premium for workforce with at least tertiary education compared with workforce with less education. For other countries, skilled 1 = workforce with at least upper-secondary education (secondary education for the Philippines); skilled 2 = workforce with at least tertiary education; and skill premium 1 = wage premium for workforce with at least upper-secondary education (secondary education for the Philippines) compared to workforce with less education; skill premium 2 = wage premium for workforce with at least tertiary education compared to workforce with less education.


One needs to interpret the trends carefully in the Chinese case, given the much shorter time covered by the data and the less updated information.
China, Mongolia, and Vietnam (with services showing an edge, particularly if compared with the upward trends in educated workers in this sector). Apart from Mongolia, the share of tertiary-educated workers has increased in all sectors across countries, with a generally faster increase in services. Tertiary education premiums have generally increased the most in subsectors such as business, finance, and information technology (IT) services, transport and telecommunication, and trade (appendix D).

Given services’ significant employment and GDP share, these trends indicate that tertiary graduates need to possess the skills demanded by the sector. To the extent that services’ GDP and employment shares grow—aligning more with the East Asian high-income (see figure 1.2) and OECD economic structure—and the trend continues toward more skill-intensive subsectors, services will increasingly drive demand for graduates with a tertiary education. It will be important to ensure the delivery of service-related careers in business, finance, transport and telecommunications, or even only some generic social science careers (at the university and college levels) that support workers’ mobility and flexibility among service-related jobs.

Tertiary graduates also need to meet the needs of technologically intensive and open manufacturing: within the sector, foreign-owned enterprises, more technologically intensive firms, and to some extent, more export-oriented firms employ a greater number of tertiary graduates. Beyond sector composition effects, firm surveys offer evidence of a robust positive correlation among foreign direct investment, measures of technological adaptation and innovation, and share of tertiary-educated workers at the firm level, confirming the presence of skill-biased technical change; the role of exports in driving demand for tertiary-educated workers is less clear-cut (figure 1.16).

More sophisticated cross-section regression analysis (appendix E) confirms these results. Although this type of analysis can imply only association, it suggests two initial points: (a) that foreign investors bring to their overseas subsidiaries various managerial, organizational, and technical innovations that would not otherwise be diffused to the host country, and (b) that highly skilled labor is needed to adapt and further diffuse these innovations. This second point is particularly the case in Vietnam (table 1.7), where foreign firms employ more highly skilled graduates and play a larger role in technology development.

The results also underscore the broad and well-documented positive relationship between technological development, also including technological assimilation and adaptation, and tertiary education (this relation goes both ways, from the tertiary-educated workforce to technological innovation, and vice versa), which is clearer in middle-income countries (likely explained by their somewhat more developed innovation systems). By contrast, the net effect of exports on the employment of tertiary graduates heavily depends on the relative importance of the pressures of international competition and the drive to specialize and within specialization on the importance of low-skill-intensity products relative to high-skill-intensity ones. In China and Vietnam, the net effect is negative (fewer tertiary graduates employed in export sectors), but in Cambodia, Indonesia, and Thailand, the effect is clearly positive (more tertiary graduates employed in export sectors). The pressure exerted by Chinese exports largely accounts for the negative overall outcomes in low- and middle-income countries in table 1.7.

Manufacturing demand for tertiary graduates depends on trends in openness indicators, among other factors. To the extent that globalization continues and stimulates higher foreign direct investment and import penetration—in turn related to higher access to technology and new working practices—demand for tertiary graduates in manufacturing may increase (despite the sector’s slower value-added upgrading in most of the region).

The association among foreign direct investment, technology, and tertiary education in East Asian manufacturing is also
important when looking forward, particularly because it has the potential to shape future growth and development patterns.\textsuperscript{47} In a context in which low-income countries need to break into manufacturing and engender a technological capability, and middle-income countries need to move further up the manufacturing value chain (while continuing to develop their technological capability), governments must achieve an alignment of foreign direct investment, technology, and higher-level skills.

Doctoral graduates may therefore be important, because they are key contributors in conducting research, fostering innovation, and sharing knowledge. Furthermore, the experience of the leading East Asian economies suggests that developing indigenous technological capabilities requires a steady increase in the stock of scientists and engineers who help in assimilating and adapting foreign technology. The experience of Japan, Korea, and Taiwan, China, suggests that if an economy is to rapidly assimilate technology, one-third or more of its university graduates must have studied science and engineering. The positive relation between STEM skills and innovation has been illustrated above.

**Trends in demand for functional skills**

Recent employer and employee surveys provide a benchmark of the generic and technical skills the region needs (box 1.2). To the extent that these apply to professionals and managers (expected to be educated at

**TABLE 1.7** Regression coefficients of technological and openness variables in a sample of East Asian economies

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cambodia</th>
<th>Vietnam***</th>
<th>Philippines</th>
<th>Indonesia</th>
<th>China</th>
<th>Thailand</th>
<th>Malaysia</th>
<th>Korea, Rep.</th>
<th>Low income</th>
<th>Middle income\textsuperscript{a}</th>
<th>Middle income\textsuperscript{b}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign ownership</td>
<td>0.628</td>
<td>0.400***</td>
<td>−0.231</td>
<td>−0.118</td>
<td>0.191***</td>
<td>0.0121</td>
<td>0.131</td>
<td>0.419***</td>
<td>0.459***</td>
<td>0.0721</td>
<td>0.0785</td>
</tr>
<tr>
<td>Technology innovation</td>
<td>−0.161</td>
<td>0.0549</td>
<td>0.497***</td>
<td>0.247*</td>
<td>0.342***</td>
<td>0.314*</td>
<td>0.00724</td>
<td>0.0509</td>
<td>0.015</td>
<td>0.297***</td>
<td>0.280***</td>
</tr>
<tr>
<td>Exports</td>
<td>1.531***</td>
<td>−0.0503</td>
<td>−0.0276</td>
<td>0.388**</td>
<td>−0.406***</td>
<td>0.142**</td>
<td>0.336</td>
<td>0.015</td>
<td>0.002</td>
<td>−0.115**</td>
<td>−0.0958**</td>
</tr>
</tbody>
</table>

Source: Appendix E.

Note: Dependent variable is the share of workers with more than 12 years of schooling.

\textsuperscript{a} All East Asian economies except low-income countries, Malaysia, and Republic of Korea.

\textsuperscript{b} All East Asian economies except low-income countries and Republic of Korea.

Significance level: * = 10 percent, ** = 5 percent, *** = 1 percent.
the tertiary level), these surveys reveal the skills expected from tertiary graduates.48 A share of skilled production and nonproduction workers is also educated at the tertiary education level (particularly college education and technical and vocational education and training), making these other categories of workers also relevant. (Charts by country derived from employer and employee surveys—Investment Climate Surveys, and firm skill surveys—are included in appendix F.) A short summary is provided in table 1.8, which ranks (from 0 to 7) the relative importance of each skill within each country, largely for professionals. Differences between professionals and other relevant workers’ categories are alluded to in a couple of countries.

According to the surveys and as illustrated in table 1.8, employers and employees in East Asia are giving particular emphasis to some job-specific skills and several thinking and behavioral skills, reflecting a change in skill demand. Job-specific technical skills—both theoretical and practical—are important in most countries, with an edge for experience and practical job-related knowledge. Thinking and behavioral skills, and to a lesser extent IT skills, are also important. Problem solving and creativity receive significant emphasis in most countries, as do communication and leadership skills. English skills are subject to significant fluctuations in importance across countries but are becoming a priority in countries such as Cambodia, Mongolia, Thailand, and Vietnam. While there are no obvious differences across countries, creativity and IT skills tend to have a higher relative importance within upper-middle-income countries. A further analysis of data for Indonesia and the Philippines shows that skill demands are lower overall for skilled production and nonproduction workers—and that most of the relative priorities in terms of skills are maintained for the Philippines, while changing more substantially in Indonesia. Overall, basic academic skills, practical knowledge of the job, IT, teamwork, and ability to work independently become particularly relevant, whereas English, leadership, and creativity decrease in importance.

The relative importance of generic skills varies by sector, trade orientation, and foreign ownership. Behavioral skills appear to be more important in services. (Further disaggregation of skill demand in other studies shows that behavioral skills, such as ability to work independently, initiative and leadership skills, communication skills, and teamwork skills, tend to have higher importance in services than in manufacturing in Indonesia, Malaysia, the Philippines, and Vietnam, particularly communication skills.) Several generic skills are, however, also critical in manufacturing. Problem-solving skills and creativity (at least for a few workers in the

<table>
<thead>
<tr>
<th>Skill</th>
<th>Vietnam</th>
<th>Cambodia</th>
<th>Indonesia</th>
<th>Malaysia</th>
<th>Philippines</th>
<th>Thailand</th>
<th>Mongolia</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>5.7</td>
</tr>
<tr>
<td>Communication</td>
<td>6</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5.1</td>
</tr>
<tr>
<td>English</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>4.9</td>
</tr>
<tr>
<td>Problem solving</td>
<td>—</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>4.8</td>
</tr>
<tr>
<td>Leadership</td>
<td>—</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>4.7</td>
</tr>
<tr>
<td>Information technology</td>
<td>—</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>4.7</td>
</tr>
<tr>
<td>Creativity</td>
<td>—</td>
<td>—</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4.6</td>
</tr>
<tr>
<td>Work attitude</td>
<td>7</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Source: Appendix F.
Note: Ranking from 0 to 7 of the relative importance of each skill for employers.
a. Relates to college graduates.
b. Relates to professionals and other skilled workers.
— = not available.
case of creativity) appear to be much more important in the exporting than nonexporting sector in Indonesia (figure 1.17) and the Philippines, as well as negotiation and leadership skills for professionals and managers in both countries, highlighting the pressure of international competition. Foreign-language and communication skills are also particularly important in Vietnamese foreign-owned enterprises.

Leading firms that attach importance to innovation look for several attributes in their new hires. They value industry experience and a “big picture mindset,” and, in a small but important group of workers, creativity and the ability to “think outside the box.” Similar opinions were reflected in the firm surveys undertaken in Indonesia, the Philippines, and Thailand (box 1.3).

Across sectors, practical knowledge also appears crucial, particularly so for low- and lower-middle-income countries. This comes out clearly from firm surveys in Indonesia, the Philippines, and Vietnam (appendix F), which emphasized the practical knowledge of the job (even more than theory) and general experience in the field.

As a further illustration of the importance of practical orientation, labor force surveys suggest that firms often prefer workers with technical and vocational education and training (TVET) skills. High shares of such graduates are, for instance, employed as professionals in Indonesia and Mongolia (the share is even higher than for university graduates in Indonesia). Managers and professionals with TVET command, relative to unskilled workers, similar or even higher salary premiums (especially in Mongolia, because of its lower technology demands) than managers and professionals with a university education (figure 1.18). In Mongolia skilled workers with TVET are also paid much more than skilled workers with university degrees. The situation is different in Thailand where the much higher share of university graduates in professional occupations may indicate a combination of better university education, poor primary and secondary education, and

The data in figure 1.18 also show that a significant share of tertiary education graduates, particularly those educated at TVET and college level, find employment as skilled production and nonproduction workers—and that therefore demand for skills at these levels is also one of the benchmarks.

In sum, employers expect professionals and other skilled workers to have some key technical and generic skills, and
BOX 1.3  A snapshot of skills for innovation in Indonesia, the Philippines, and Thailand

To understand how much Indonesia’s higher education system is contributing to innovation at the firm level, the World Bank interviewed 12 Jakarta-based firms in October 2009. The firms were drawn from services and manufacturing. Service firms included providers of mining services, education, financial services, research, and logistics; manufacturing firms included pharmaceutical, wireless technology, and palm oil-processing companies. Respondents were asked questions on the education levels of the top manager and employees, R&D expenditure, staff training, relationships with universities, and innovation activities (which included details of the innovation, the person who introduced it, the requisite education and skill levels, and the constraints encountered). Respondents were also asked to provide any general recommendations on innovation policy as it relates to Indonesia’s higher education system.

Responses varied about the importance of education levels in the innovation process. Two respondents regarded PhDs as required: unsurprisingly, the wireless technology manufacturer and one of the pharmaceutical firms. The majority of the remaining respondents thought that a master’s degree was sufficient. Two of the firms reported that the requisite skills were obtained through outsourcing. On-the-job experience was mentioned and was presumably relevant in most cases.

As to the skill levels required, all firms (except one nonrespondent) emphasized the importance of relevant industry-specific technical knowledge and a broad understanding of the company’s general operations. Several referred to the importance of understanding international best practice. Some respondents stressed the importance of generic skills such as “curiosity,” “proactivity,” and “creativity”; significantly, these remarks originated from firms with a general commitment to R&D and education.

Similar surveys were carried out in the Philippines and Thailand. Philippine respondents emphasized the importance of a strong base of core skills in all new employees, and firms in IT and manufacturing underscored the importance of job-specific technical skills as well. In Thailand, surveyed managers, particularly for exporting firms, complained of weak language skills (English), lack of creativity (workers seemed to do only what they were told by their managers), and lack of teamwork skills. As a result, most new employees of surveyed firms underwent some form of in-house training.


requirements for some of these skills are even higher in services and open sectors. This clearly has implications for higher education, which, beyond providing the training needed for some careers, will also need to inculcate the functional skills for workplace requirements.51

The dynamism of demand for tertiary graduates in services emphasizes the importance of tailoring curriculum design and pedagogical approaches of tertiary education to labor-market needs. Service-related careers in business, finance, transport, and telecommunications will remain important, as well as some broader social science tracks, gained at both university and college levels. Skills more typically applicable to services include higher-order behavioral skills such as client orientation, communication, and initiative skills, as well as knowing a foreign language. At the same time, technology and engineering careers, as well as problem solving, some command of foreign language, and IT skills, among other things, will help manufacturing firms respond to the requirements of foreign direct investment and competitive export markets and therefore need to be possessed by tertiary educated workers. And there is evidence that critical and creative thinking and management skills are already requested by employers from a group of employees to move their technology frontier forward. Finally, possessing practical knowledge is a plus in all countries, particularly in low- and lower-middle-income countries that need to develop higher technological capability.
The demand for skills will continue changing in East Asia. As countries move up the value-added chain, the types of skills needed will continue evolving to a greater focus on more sophisticated technical skills and on the high-level generic skills that are increasingly driving labor productivity (such as analysis, problem solving, and communication). The experience in the United States shows that as countries’ demand for interactive and analytical skills increases, demand for manual and routine cognitive skills falls. The European Union (EU) is tackling this problem (box 1.4) in its own way. As in industrial countries, greater client orientation and teamwork, new ways of working, and greater computer use are likely to accelerate demand for new skills in East Asia. Moving forward, higher education sectors will need to provide the skills relevant to the labor markets of today with a vision of tomorrow—they cannot stand still. Skills for the service sector, high-order generic skills, and skills for innovation not only are needed now but also will be in increasing demand moving forward.
Higher education as a producer of research

The most critical growth-oriented objective of higher education is producing enough proficient and innovative graduates for the labor market, but the importance of higher education in directly supporting technological development and innovation is also growing. The presence of a few research universities also becomes a key priority for growth.

There is a close positive relation between R&D and innovation. Expenditure on R&D (usually as a share of GDP) is a common metric that provides a reading on a country’s acquisition of technological capacity, and it is much higher in the East Asia upper-income innovative economies. By this yardstick, Japan was the largest spender in East Asia in 2006 (3.4 percent of GDP), followed closely by Korea with 3.2 percent (table 1.9). The position of these two countries switched in 2007. Singapore had been increasing its spending on R&D, at 2.6 percent that year. By comparison, R&D in Southeast Asia amounted to less than 1 percent of GDP. The fastest rate of growth was in China, rising from 0.6 percent in 1996 to 1.5 percent in 2007 (and 1.7 percent in 2009). Given its rapid economic growth during this period, the increase in the volume of resources committed was huge.

The low R&D spending rate by low- and middle-income countries (lower and middle technology cluster) is also much lower than the OECD average (figure 1.19), which only Japan, Korea, and Singapore exceed.

Mirroring the overall pattern in OECD countries, firms account for two-thirds or more of R&D spending in a majority of East Asian economies (table 1.10).

Private and public funding have a complementary role in R&D. As the technological gap narrows, increasing attention to process

BOX 1.4 Skills for the future

The European Union has formally recognized that lifelong learning—and the skills to enable it—will be a major determinant of the bloc’s future innovation, productivity, and competitiveness. In the context of increasing internationalization and regional integration, and continuous technological upgrading, it is taking steps to ensure that its education and training systems develop a workforce that will not only be able to keep its job-specific skills up to date and relevant but also possess certain generic skills that will allow workers to better adapt to change. The EU in 2006 adopted the European Framework for Key Competences for Lifelong Learning, the aim of which is to inform curricular development at all levels of education. It identifies the key competences that European citizens will require for “personal fulfillment, social inclusion, active citizenship, and employability in [the] knowledge-based economy.”

The framework defines eight competences that young people should possess by the end of their formal education to equip them for their working life, further learning, and skill development. These are communication in the mother tongue, communication in foreign languages, competence in math and basic competence in science and technology, digital competence, learning to learn, social and civic competence, a sense of initiative and entrepreneurship, and cultural awareness and expression.

The framework emphasizes competence in the basic skills of language, literacy, numeracy, and information and communication technology as the foundation of learning, while stressing the importance of critical thinking, creativity, initiative, problem solving, risk assessment, and decision making. With the framework, the EU aims to develop a workforce better able to adapt to changing circumstances and technologies, innovate, create jobs, and make its education and training systems more relevant to productivity and growth.

innovation by firms prepares the ground for competition strategies alive to the need for continuous innovation, because improved processes can be integrated more readily into the operations of a firm and because the returns accrue quickly. Once process innovation, which is generally incremental, gathers momentum and its utility is widely perceived, R&D gains stronger adherence (most importantly from management) both inside the firm and outside. It also becomes better integrated into the operations of an entire industry. Firms can and should then start to play a larger role and support university research. Thus, encouraging firms to improve existing processes and products through systematic research must be a major strand of government policy aimed at stoking interest in innovation. Such encouragement can complement efforts to augment research in universities and public research institutions with the help of public financing. In particular, in lower- and middle-income countries the public sector can have an important role in financing basic early-stage applied research and technology transfer through universities and research institutions, when private initiative is still limited, but positive externalities are clear. R&D spending during the beginning stage of development can be thought of as part of the effort to assimilate and internalize foreign technology as well as to build the foundations of a national innovation system. It supplements the technological upgrading achieved through technological change embodied in equipment and through interaction with overseas buyers and suppliers. During the rapid-growth phase of Japan, more than 30 percent of R&D was devoted to learning. The role of public financing continues even later with the continuous contribution of universities and research centers to basic research and their potential role in

**TABLE 1.9** R&D expenditure, 1996–2007

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>—</td>
<td>0.1</td>
<td>0.2</td>
<td>—</td>
<td>0.3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Philippines</td>
<td>—</td>
<td>—</td>
<td>0.2</td>
<td>—</td>
<td>0.1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Indonesia</td>
<td>—</td>
<td>0.1</td>
<td>—</td>
<td>0.1</td>
<td>0.1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>China</td>
<td>0.6</td>
<td>0.9</td>
<td>1.1</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Thailand</td>
<td>0.1</td>
<td>0.3</td>
<td>0.2</td>
<td>0.3</td>
<td>—</td>
<td>0.2</td>
<td>—</td>
</tr>
<tr>
<td>Malaysia</td>
<td>0.2</td>
<td>0.5</td>
<td>0.7</td>
<td>0.6</td>
<td>—</td>
<td>0.6</td>
<td>—</td>
</tr>
<tr>
<td>Korea, Rep.</td>
<td>2.4</td>
<td>2.4</td>
<td>2.5</td>
<td>2.9</td>
<td>3</td>
<td>3.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Singapore</td>
<td>1.4</td>
<td>1.9</td>
<td>2.2</td>
<td>2.2</td>
<td>2.4</td>
<td>2.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Japan</td>
<td>2.8</td>
<td>3</td>
<td>3.2</td>
<td>3.2</td>
<td>3.3</td>
<td>3.4</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Source: WDI database.

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**FIGURE 1.19** R&D expenditure, East Asia and OECD

![Graph showing R&D expenditure for various countries](source)

high-tech R&D, often too costly to be undertaken by firms. Indeed, government and higher education research maintain a significant share of overall R&D in the economies of the top technology cluster (table 1.10), even more so in Hong Kong SAR, China, and Singapore. And in Singapore, the role of higher education was even larger 15 years ago, illustrating its importance in leading R&D effort and economic development.55

Firms and universities have a complementary role. Research universities not only add to the fund of knowledge, but universities and other tertiary institutions can also help countries of the lower technology cluster raise their technological capabilities and countries of the middle technology cluster go beyond technology assimilation to innovation by assisting firms in assimilating and upgrading technology through providing consulting services, hosting incubation facilities, and customizing foreign technologies for local requirements, among other approaches. Because most small and medium enterprises in the lower and middle technology cluster carry out very little R&D (and even large firms only do a modest amount of applied research), universities can step in to help narrow the technology gaps between technology clusters by enhancing technological capabilities.

Among the region’s high-income countries, several research universities are sources of ideas and engage in applied research (see, among other indicators, the higher-ranked universities in table 2.7, chapter 2). But universities cannot substitute for firms, and several challenges exist in setting up effective university-industry links (reviewed in the rest of this report). Research by universities and even the R&D by firms themselves will yield meager returns if businesses have limited faith in the usefulness of innovating and are not persuaded of the value of making innovation into a routine. The type of university-industry link will also change across country groups.

Economies of scope and scale provide further justification for research universities. An important assumption of this study is that there are economies of scope between teaching and research, and economies of scale in research, making support to research in at least a few higher education teaching institutions an effective option (and more effective than using only research centers). Although the link between teaching and research has been hotly debated, results from three meta-analyses find a positive correlation suggesting that teaching and research are not mutually exclusive goals in education.57 A comparison of the world’s highest-ranked universities reveals several similar characteristics, such as conducting research, teaching innovative curricula, and integrating research into undergraduate teaching.58

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**TABLE 1.10 Composition of R&D expenditure**

<table>
<thead>
<tr>
<th>Economy</th>
<th>Business enterprises</th>
<th>Government</th>
<th>Higher education</th>
<th>Private nonprofit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>14.5</td>
<td>66.4</td>
<td>17.9</td>
<td>1.1</td>
</tr>
<tr>
<td>Philippines</td>
<td>68.0</td>
<td>19.1</td>
<td>11.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Indonesia</td>
<td>14.3</td>
<td>81.1</td>
<td>4.6</td>
<td>0.0</td>
</tr>
<tr>
<td>China</td>
<td>71.1</td>
<td>19.7</td>
<td>9.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Thailand</td>
<td>43.9</td>
<td>22.5</td>
<td>31.0</td>
<td>2.6</td>
</tr>
<tr>
<td>Malaysia</td>
<td>71.5</td>
<td>10.4</td>
<td>18.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Korea, Rep.</td>
<td>77.3</td>
<td>11.6</td>
<td>10.0</td>
<td>1.2</td>
</tr>
<tr>
<td>Hong Kong SAR, China</td>
<td>48.3</td>
<td>2.2</td>
<td>49.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Singapore</td>
<td>65.7</td>
<td>10.4</td>
<td>23.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Japan</td>
<td>77.2</td>
<td>8.3</td>
<td>12.7</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Source: UIS Data Centre.
Note: Hong Kong SAR, China, and Malaysia (2004); the Philippines and Thailand (2003); Vietnam (2002); Indonesia (2001); other countries (2005–08).
There are certainly several arguments that research facilitates teaching, with benefits to both students and professors. Students who are actively engaged in research acquire knowledge and experience in their fields. They gain exposure to research methodology, data analysis, critical analyses, and presentation of the findings. All these are greatly needed skills (as seen above). Research also provides students with credibility and concrete evidence of what their professors teach. In developing countries, professors can often relay more current research to students than textbooks.59

Indeed, other findings suggest that teaching receives larger beneficial effects from research than research does from teaching and that these benefits are greater at the graduate than the undergraduate level.60 There is, however, also evidence of the benefits that research receives from teaching, and studies suggest three factors are important: (a) teaching provides young researchers with opportunities to present their ideas; (b) teaching and students can stimulate ideas for new research; and (c) classrooms can act as a forum for academics to clarify and close gaps in their research.61 In addition, a U.S. study found that teaching has a positive effect on research up to eight hours of teaching per week, indicating that previous inconclusive results could be because teaching and research have a curvilinear relationship, rather than the previously accepted linear relationship.62

Institutions that provide teaching and research gain several benefits. Research increases an institution’s image and reputation, and thus attracts high-quality students and faculty. Teaching and research share similar skills such as creativity, critical thinking, and diligence. Students exposed to research are more likely to conduct research, including in areas that have few researchers. Students and faculty engaged in research can foster collaboration and learning of research. Finally, presenting research results not only reinforces the research but also generates ideas for further investigation.63

Results of several empirical studies of the costs of conducting research in universities in the United States and Japan provide further evidence of product-specific economies of scale. A study of more than 300 comprehensive universities in the United States finds product-specific economies of scale for conducting research in undergraduate and graduate public and private universities. Similarly, the study also finds product-specific economies of scope in these institutions.64 Another study of nearly 1,900 U.S. higher education institutions further illustrates that institutions that combine undergraduate teaching, graduate teaching, and research are more efficient than single-output institutions. In this study, product-specific economies of scale for research are most apparent in public graduate institutions.65 Finally, a study of 94 private universities in Japan finds product-specific economies of scale for conducting research in large universities.66

Innovation is clearly not fully captured by patents, journals, or even technology licensing since mere technological upgrading may be an even more important objective. But a simple relation between science and technology journals and R&D undertaken at the university level on the one side, and patents and R&D undertaken at the university on the other, indicates that there is a positive correlation between university research and innovation (figures 1.20 and 1.21), pointing to (at least potential) beneficial effects of R&D carried out at the university level.

Conclusion

Higher education has the potential to deliver skills and research for productivity and innovation. While the final goals of higher education are the same across countries, the different conditions faced by income and technology cluster groups dictate slightly different immediate broad priorities. Low-income and low-technology-cluster countries striving toward middle-income status must focus their immediate attention on higher education as skill producers and develop their human capital
To further enhance innovation, as a second goal they must start building some research capacity in higher education. Middle-income countries aspiring toward high-income status must focus urgently on both further developing the skills of their labor force and fostering research through higher education as a research provider. How much they should aim to do in relation to technology and innovation will very much depend on their position within the technology cluster. For instance, developing the technological and engineering capacity of workers and building some limited research capacity for technology upgrading may be sufficient for countries such as Indonesia and the Philippines at their stage of technological development but would not be sufficient for China. The bottom line is that all countries need to start moving up within their income and cluster group and beyond, and higher education can help them to do so. But does it?

**Notes**

1. The earlier performance was driven primarily by rapid accumulation of physical capital, gains in labor and total factor productivity, and generally favorable institutional and policy environments (IMF 2006).
2. The terms higher education and tertiary education are used interchangeably in this book.
3. Thailand very recently transited to upper-middle-income status but was still a middle-income economy according to the gross national income per capita Atlas method applied to 2009 data. Hence, it is considered a middle-middle-income economy in this book. This classification is also justifiable from the fact that all available higher education indicators are for 2009 or earlier.
5. Vietnam very recently transited to lower-middle-income status but was still a lower-income economy according to the gross national income per capita Atlas method applied to 2009 data. Hence, it is considered a lower-income economy in this book. This classification is also justifiable from the fact that all available higher education indicators are for 2009 or earlier.
6. See Castellacci and Archibugi (2008) for an adaptation of the concept from the convergence club literature and an attempt at grouping countries.
7. While the income group is the main classification followed in the book, reference is often made to technology clusters when technological capacity is a critical variable for the understanding of some issue or when technological
clusters are more closely aligned to economy performance.
8. China’s technological prowess in biotechnology and nanotechnology might enable it to cross this threshold in the next decade.
9. Because of this technical advancement, exporting firms and multinational corporations tend to hire more educated workers than nonexporting or domestic firms (Yilmaz 2009).
11. China still lacks core technologies in most advanced areas of electronics and transport equipment, for example.
13. Vandenbussche, Aghion, and Meghir (2006) draw attention to the greater returns from investment in skills and research as a country approaches the technological frontier.
18. In Canada, for instance, higher reading scores at age 15 lead to higher future wages (OECD 2010b). Improving the quality of education improves test scores in the short term (Jakubowski and others 2010) and labor market success in the medium term (Bertschy, Cattaneo, and Wolter 2009).
20. Entrepreneurial performance is associated with the quality of formal schooling (Berry and Glaeser 2005; Glaeser 2007; van der Sluis, van Praag, and Vijverberg 2008).
21. The technology variable refers to firms having “introduced a new technology that substantially changed the way the main product was produced in the three years prior to the survey” (definition adopted in the World Bank’s Investment Climate Surveys). This definition, which is related to process innovation, leaves room for both adaptation of an existing technology (developed domestically or imported from abroad) and innovation within the firm.
22. Almeida (2009b) gives details on methodolo-ogy and sample. The different samples are not directly comparable, however. The Indonesia sample, for instance, covers a greater number of large and foreign-owned firms than some other samples. It is the comparisons between technologically and nontechnologically innovative firms within countries that are relevant. By the same token, the firm sample of Indonesia distorts somewhat the results by including more firms close to the technology frontier.
24. These surveys, undertaken in 2009–10, sought to understand the extent to which higher education systems in these countries contribute to innovation at the firm level. The firms, which were in services and manufacturing, included providers of mining services, financial services, research and logistics, pharmaceuticals, and wireless technology as well as rubber processors and palm oil processors. Respondents were asked questions on the education levels of the top manager and employees, R&D expenditure and staff training, relationships with universities, and innovation activities. The last included details of the innovation, the person who introduced it, requisite education and skill levels, and the constraints encountered when introducing the innovation. Respondents were also asked for general recommendations on innovation policy as it related to their national higher education system.
32. Indeed, school is considered only the fourth source of skills for college-level workers in Vietnam, after on-the-job experience, training, and previous experience (World Bank 2008); whereas in Indonesia, school is still considered the most important source of skills for managers and professionals, but it comes after on-the-job exposure and previous experience for nonproduction and skilled production workers (di Gropello, Kruse, and Tandon 2010).
34. Computerization has increased the demand for college preparation to undertake non-routine cognitive tasks as machines take over routine tasks (Autor, Levy, and Murnane 2001). The scarcity of skilled and technical workers and of R&D facilities is a major reason for the slow pace of industrial upgrading in Southeast Asia (Tan 2010).
36. One needs to interpret the trends carefully in the Chinese case, however, given the much shorter time covered by the data and the less updated status of the information.

37. They also indicate some emerging constraints in the overall absorption capacity for new tertiary-educated graduates.

38. The regression framework for estimating education (and industry) wage premiums follows the approach used by Goldberg and Pavcnik (2005) and other researchers. Specifically, for each year the log of worker $i$’s wage ($\ln(w_{ijt})$) is regressed on worker $i$’s characteristics ($H_{ijt}$) such as gender and age; on whether, based on his or her education, the worker is skilled or unskilled ($S_{ijt}$); and on a set of industry $j$ indicators ($I_{ijt}$) reflecting worker $i$’s industry affiliation:

$$\ln(w_{ijt}) = H_{ijt}\beta_1 + S_{ijt}\delta + I_{ijt}\lambda + w_{ijt}\rho + \epsilon_{ijt}$$

where $sp_{ij}$ represents the sectoral return to education (or education premium) of sector $j$ at time $t$, and $wp_{ij}$ represents the industry premium.

39. In Indonesia about 65 percent of service firms confirm to having seen skill requirements increase over these past 10 years (compared with about 50 percent of manufacturing firms), and 95 percent of firms (in both manufacturing and services) think skill requirements will continue to rise over the next 10 years (di Gropello, Kruse, and Tandon 2010).

40. Increases in value added within services, though only gradual, are visible in Cambodia, Indonesia, the Philippines, and Vietnam and where the public administration and other services subsector has been generally decreasing, with corresponding increases in the more skill-intensive finance and business, transport and communication, and trade and tourism subsectors. In these cases the public administration and other services subsector includes a mix of services with both higher-educated workers (health, education) and lower-educated workers (private household services, lower public administration levels, nonformal). Further, despite the recent global economic downturn, finance and banking subsectors in Singapore; trade and tourism subsectors in Cambodia, Lao PDR, and Vietnam; and the communication subsector in the Philippines are seen as emerging or quickly recovering, implying that these sectors will need increasingly skilled workers (Asia Business Council 2009).

41. The main data set used here is a large firm-level database collected by the World Bank, Investment Climate Surveys, covering eight developing countries in East Asia. The surveys were conducted in 2002–05, and the samples were designed to be representative of the population of firms according to their industry and location within each country. The final sample has 9,776 firms distributed across a wide range of sectors (manufacturing 77 percent, construction 1.37 percent, services 20 percent, and agro-industry 0.8 percent). Manufacturing covers a range of industries, such as auto and auto components, beverages, chemicals, electronics, food, garments, leather, metals and machinery, nonmetallic and plastic materials, paper, textiles, and wood and furniture.

42. The relationship with technological innovation was shown in figure 1.4.

43. The model, fully detailed in Almeida (2009b), is related to a vast literature linking foreign investment, trade, and technology with skills. See, among others, Berman, Bound, and Machin (1998); Fajnzylber and Fernandes (2004); Feenstra and Hanson (1997); and Tybout (2000).

44. This limitation is despite the effort to control for as many observable and unobservable variables as possible.

45. Such investment would continue the upward trend experienced in some countries. In Thailand, for example, foreign direct investment as a share of GDP increased from only 1 percent in 1990 to 5 percent in 2008. Concurrently in Indonesia, foreign ownership in manufacturing rose from 22 percent to 37 percent (WDI database various years).

46. The evidence suggests that the generally low-value-added food, textile, timber, and furniture subsectors employ most workers in Indonesia and Vietnam, while other subsectors that add higher value are developing only slowly (mainly chemicals in Indonesia and machinery and equipment in Vietnam). The Philippines focused more on other, high-value-added, manufacturing subsectors, but the direction of change is not clear, with an increase in the employment share of other manufacturing but a decrease of the machinery and transport subsector.

47. As mentioned previously, one can look at the relation both ways: from technology and foreign direct investment to demand for tertiary education, or from tertiary education to
technological innovation and attraction of foreign capital.

48. This book uses Investment Climate Surveys, related skill modules, and two employer and employee skill surveys carried out in Indonesia and the Philippines. This book analyzes how employers (and employees where possible) rate the importance of generic (thinking, behavioral, IT), technical (job-specific), and in a few cases subject-based (academic) skills for doing their jobs. The analysis is carried out for Cambodia, Indonesia, Malaysia, Mongolia, the Philippines, Thailand, and Vietnam. Some results are not strictly comparable across countries because of different samples’ compositions and sizes, occasionally different skill definitions (which have been kept as comparable as possible), and in some cases slightly different units of measure. Even so, it is possible to derive some main findings.


50. Wadhwa and others 2007.

51. Learning such skills will be coordinated with other education and training levels and types, since, as illustrated previously, skill acquisition is cumulative and diverse.

52. And they are likely to create demand for new skills related to higher education workers, as illustrated by the results of alternative specifications checking robustness of the tertiary education determinants to different technological variables (see appendix E), which show a positive association among R&D, use of computers, use of the Internet, and share of workers with more than 12 years of schooling.

53. Although without the existence of at least some proactively innovating firms (or firms demanding innovation), increasing the supply of ideas alone will rarely bear any fruit.

54. Mok 2010.


60. Smeby 1998.


