

SUSTAINING RAPID GROWTH IN KOREA THROUGH INNOVATION

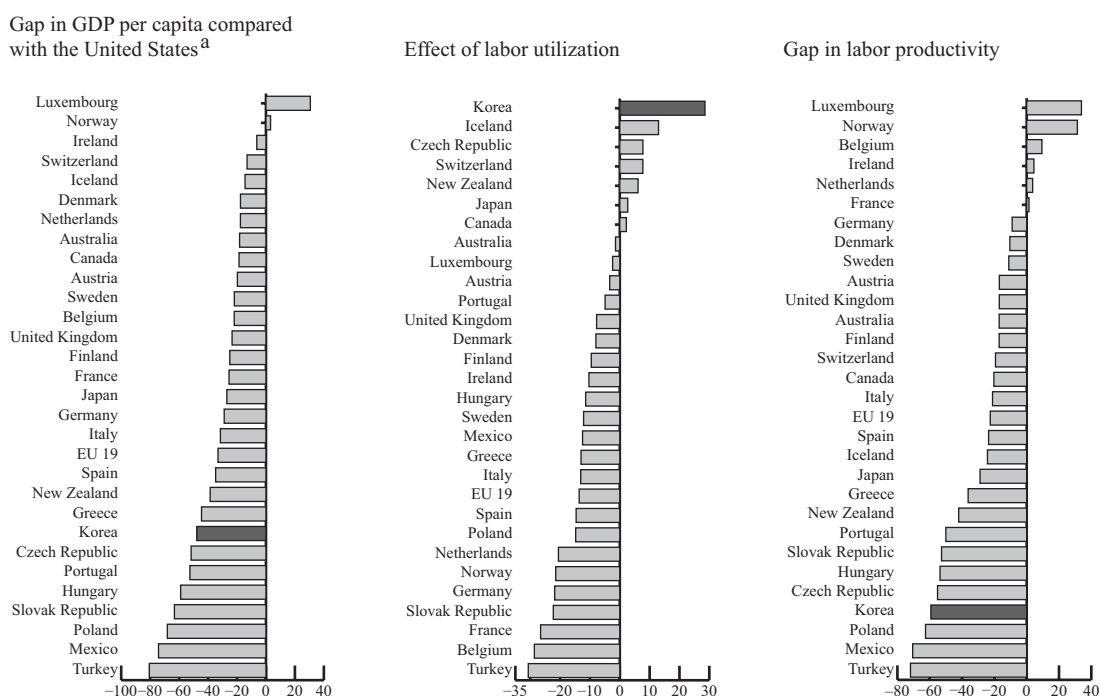
By Randall Jones

Rapid economic development lifted Korea's per capita income from 15 percent of the U.S. level in 1970 to approximately half by 2005 (*Figure 1*). Growth has been based primarily on inputs of capital and labor, driven by the highest rate of business investment in the Organization for Economic Cooperation and Development (OECD) area, a growing working-age population, long working hours, and rising participation in the labor force. In addition, investment in education and research and development (R&D) has facilitated a catch-up model of innovation. However, the growth of the working-age population is decelerating and is projected to begin falling beginning in 2016, while fixed investment has dropped from an

average of 37 percent of gross domestic product (GDP) during the 1990s prior to the Asian crisis to less than 30 percent during the past few years.

Given the slowdown in inputs of labor and capital, sustaining high growth depends increasingly on innovation to drive productivity gains. There is large scope to increase labor productivity, which at present is only 40 percent of the U.S. level (see *Figure 1*, right-hand column). Productivity gains are closely linked to innovation—the successful development and application of knowledge—which includes the invention of new technologies and the development of new products and processes based on the existing stock of

Figure 1: Explaining Differences in Income: Percentage Point Differences in Per Capita Income Relative to the United States, 2005



Source: *Economic Policy Reforms: Going for Growth* (Paris: OECD, 2007).

a The gap in GDP per capita is equal to the sum of the two components shown. The effect of labor utilization is based on total hours worked per capita. Productivity is measured on a per-hour basis.

knowledge. This is particularly important to Korean exporters, some of whom have reached the technology frontier in their fields. Innovation also includes the diffusion of existing technology to lagging sectors. The potential benefits of technology diffusion are important, given the large gap in labor productivity relative to the United States noted above. Indeed, it is as important to expand the capacity to utilize existing knowledge as it is to create new technology.

This article considers how both aspects of innovation—facilitating the development of new technology and the diffusion of existing knowledge—can be used to sustain Korea’s growth potential. The first section discusses how the R&D framework can be improved to facilitate innovation. Innovation depends, however, on a broad range of factors that extend beyond R&D. The following two sections look at policies to improve the education system and encourage the diffusion of technology to lagging sectors, notably services.

Upgrading the R&D System in Korea

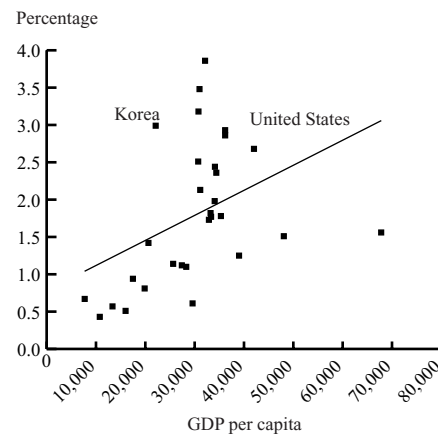
Total R&D spending in Korea increased from 2.6 percent of GDP in 2003 to 3 percent in 2005, surpassing the 2.7 percent ratio in the United States (*Figure 2*). The high R&D intensity in Korea is due primarily to the business sector, which accounts for three-quarters of R&D spending. Moreover, the number of researchers, at 0.7 percent of the workforce, ranks close to the OECD average.

Weaknesses in Korea’s R&D Framework

The return on Korea’s investment in R&D is limited by a number of problems:¹

- Korea is still in the midst of the transition from a catch-up model of innovation, which has emphasized imports of technology and reverse engineering, to a more creative approach. In a survey of 6,000 manufacturing firms, the overall level of technology is estimated to be 80 percent of the world technology frontier, while 13 percent of firms re-

Figure 2: Spending for Research and Development in OECD countries, as a Percentage of GDP, 2005 or latest year



Source: Main Science and Technology Indicators, OECD, Paris, 2006.

Note: U.S. dollars PPP exchange rates.

plied that they have already reached the frontier. Thus, foreign sources can no longer provide the needed expertise in a growing number of fields. Moreover, there is a perception that foreign firms have become more reluctant to release their technology.

- R&D activities are concentrated in a relatively small number of industries and firms in the manufacturing sector. The information and communication technology (ICT) sector and automobiles accounted for 60 percent of business R&D in 2003, with the top five companies alone in these two industries responsible for 37 percent of total business R&D. The heavy concentration in two industries contributes to the dualism in the Korean economy and may not provide a broad enough base to promote the convergence of per capita income to the levels in the most advanced OECD countries.
- R&D in services is small. Although the service sector produces 57 percent of value-added in Korea, it accounts for less than 10 percent of business R&D, well below the OECD average of 25 per-

1. The statistics on R&D spending in this section are reported in the annex of Randall S. Jones and Tadashi Yokoyama, “Upgrading Japan’s Innovation System to Sustain Economic Growth,” Economics Department Working Paper no. 527, OECD, Paris, 29 November 2006.

cent and the 40 percent share in the United States. The low level of R&D in services makes it difficult to narrow the large productivity gap between the manufacturing and service sectors in Korea.

- The universities are not well integrated in the R&D system. While they employed 72 percent of researchers with Ph.D. degrees in 2003, they accounted for only about 10 percent of the total R&D performed in Korea, about half of the OECD average, indicating that the human resources of universities are underutilized in research. More generally, there is lack of interaction among business, government, and academic R&D activities. For example, only 2 percent of R&D financed by the business sector is performed in universities and only 1 percent in government research institutes.
- Korea's R&D system is relatively isolated internationally. Foreign sources financed only 0.4 percent of R&D activities in Korea in 2003, the lowest share among OECD countries. Korea also ranks last in terms of the share of foreign ownership of domestic inventions, partly reflecting the low level of FDI in Korea. International isolation may limit the scope for technological progress, as foreign sources of knowledge are increasingly important for innovation.
- Despite its relatively high level of R&D intensity, Korea's output of knowledge, as measured by patents and publications, is relatively small, reflecting the legacy of focusing on catching up rather than the creation of new knowledge.

How to Improve the R&D System in Korea

The government announced a plan in 2004 to restructure the national innovation system, in part by shift-

ing from a catch-up model to a more creative approach.² The plan also calls for the development of certain technologies to act as growth engines for the Korean economy.³ At the same time, Korea is trying to promote "innovation cities" as part of its objective of regional development to reduce concentration in the capital region. This initiative aims at strengthening the link among public organizations, industry, and universities through the relocation of public organizations, thereby creating a favorable environment for innovation.⁴ While the recent reforms in the innovation system include many improvements, there remain a number of concerns.

First, choosing certain industries as engines of future growth could lead to government failure and distortions. Given the rapid pace of technological change, it is difficult for the government to accurately anticipate what areas will be most important in the future. Rather than trying to pick winners, the government should strengthen its focus on developing generic technologies and human capital in order to avoid crowding out private investment. In addition, the growth engine program focuses on a number of key manufacturing industries, such as cars, semiconductors, computer displays, and mobile telecommunication equipment. Such an approach tends to maintain the emphasis on manufacturing at the expense of the service sector. Another risk of focusing on key high-technology products, such as semiconductors and mobile telecommunications, is a further deterioration in the terms of trade as other countries also increase production in these areas. Terms-of-trade losses have reduced Korea's national income by 13 percent since 1998, the largest such loss in the OECD area.⁵

Second, there is a risk that mixing regional development programs with measures to upgrade the inno-

2. For details of this plan, see *OECD Economic Surveys: Korea* (Paris: OECD, 2005).

3. The ten strategic industries identified as future growth engines include bio-medical products, next-generation computer displays, next-generation semiconductors, next-generation batteries, future automobiles, intelligent robots, digital TV and broadcasting, next-generation mobile communications, intelligent home networks, and digital content and software solutions.

4. The innovation cities will benefit from the transfer of 175 public institutions from the capital region, thus reducing the share of public organizations located in the capital region from 85 percent to 35 percent.

5. Other countries where ICT is important—Finland, Sweden, and Japan—also recorded large terms-of-trade losses. Of course, the rise in oil prices has also contributed to the terms-of-trade loss.

vation system will reduce the effectiveness of both initiatives. Granting more autonomy to local governments and establishing a well-designed block grant system to transfer central-government revenue to them are essential for more balanced regional development.⁶

Third, a key challenge in making the innovation system more efficient is to strengthen linkages among the institutions active in R&D, including foreign players. In particular, joint research and manpower exchanges among research institutes in universities, the government, and the business sector would promote such cooperation. Achieving greater international linkages depends largely on increasing the stock of foreign direct investment (FDI) in Korea, which at 11.5 percent of GDP in 2002 was the fifth lowest among OECD countries. A more attractive environment for FDI could be created by: (1) countering antiforeign investment sentiment in the market and thereby encouraging more cross-border mergers and acquisitions; (2) further relaxing FDI restrictions, notably foreign ownership ceilings in key sectors; (3) reducing product market regulation, particularly in the service sector; and (4) improving the business environment by increasing the transparency of tax and financial supervisory policies and addressing the problem of contentious industrial relations.

Fourth, an appropriate system of intellectual property rights (IPRs) strengthens incentives for innovation. The challenge is to design an IPR system that encourages the creation of knowledge by raising the returns as well as promotes the diffusion of innovation. In Korea, empirical studies find a positive relationship between patent protection and technological innovation. Korea has strengthened the legal framework for IPR protection, bringing it in line with global standards such as the World Trade Organization Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS). This should encourage patenting and thus boost growth although enforcement of the framework needs to be improved further to

encourage companies to invest in R&D and to file patents. Based on opinion surveys of business executives, the Institute for Management Development (IMD) ranked Korea's patent and copyright protection at 37th out of 60 economies in 2004, and the World Economic Forum (WEF) ranked IPR protection at 23rd out of 104 countries.

Securing the Supply of Highly Qualified Human Capital

The supply of well-qualified labor is a key ingredient in the generation and diffusion of innovation and economic growth. The OECD growth study estimates that the long-run effect on GDP per capita of one additional year of education ranges from 4 percent to 7 percent.⁷ Korea has a remarkable record of expanding student enrollments at all levels of schooling. By 2002, the proportion of the population between 25 and 34 years old with an upper secondary school education was the highest in the OECD area and the third highest for university education. Moreover, rising educational enrollment has been accompanied by exceptionally good student achievement on international standardized tests. The OECD's PISA study shows that Korean fifteen-year-olds have some of the highest scores in mathematics, reading, science, and problem solving, placing them second overall.⁸

However, there is widespread dissatisfaction with the education system. The WEF ranked the quality of Korea's education system 60th out of 104 countries, while it was ranked 44th out of 60 countries by the IMD. Moreover, the IMD ranked the usefulness of Korea's university education at 59th. Low quality may limit the ability of the education system to enhance the country's competitiveness in a global economy driven by knowledge. Moreover, the education system is expensive. Korea spent 7.5 percent of GDP for educational institutions at all levels in 2003, the second highest among OECD countries, along with the United States. While public-sector expenditure for

6. For a discussion of these issues, see Randall S. Jones and Tadashi Yokoyama, "Getting the Most Out of Public-Sector Decentralisation in Korea," Economics Department Working Paper no. 468, OECD, Paris, 2005.

7. *Sources of Economic Growth in OECD Countries* (Paris: OECD, 2003).

8. For details, see *Learning for Tomorrow's World: First Results from PISA, 2003* (Paris: OECD, 2005).

education, at 4.6 percent of GDP, was below the OECD average of 5.2 percent, private outlays were the highest in the OECD area at 2.9 percent. This does not include spending for students' out-of-school activities, especially private tutoring provided at institutes known as *hakwon*. This section discusses problems in primary, secondary, and post-secondary education and lifelong learning.

Improving Primary and Secondary Education

Approximately three-quarters of Korean primary and secondary students receive private tutoring after school hours, with total expenditure estimated at around 2.5 percent of GDP.⁹ Private tutoring competes and overlaps with public education, thus raising total expenditures on education unnecessarily. In a 2005 government survey of married women between the ages of 20 and 44 with at least one child, more than half cited education as the largest item in the household budget, absorbing 18 percent of household income on average.¹⁰ One-third of the women surveyed did not plan to have more children because of the high cost of education, thus helping to depress the fertility rate, which is the lowest in the OECD area at 1.08. The high and rising reliance on private tutoring also has a number of negative effects on primary and secondary education. First, the high burden of private tutoring hinders equal access to educational opportunities, raising equity issues. Second, it makes it difficult for the public education system to cope with students of widely differing educational levels. Third, the highly competitive nature of the education system risks hampering the full development of children. Combined with

the already high in-school learning time at 37 hours per week (the OECD average is 26 hours), additional out-of-school learning boosts total learning time to 50 hours, well above the OECD average of 35 hours. Government measures to reduce private tutoring—even by laws banning *hakwon*—have proved unsuccessful.

The fundamental cause of the high reliance on private tutoring is that the current public education system does not satisfy the expectations of students and their parents.¹¹ A recent study found a significantly positive relationship between the level of private tutoring and dissatisfaction with schools. Another study reported a strong link with school quality: private tutoring expenses are higher for students attending lower-quality schools, ranked in terms of both teachers and students.¹² Improving quality requires structural reform. Perhaps most important is decentralization to bring decision-making power and accountability closer to those who teach and manage schools, thus enhancing quality and responsiveness. In this context, the scope to create independent private schools and to diversify curricula should be expanded to increase flexibility in education and enlarge the choices of students and schools. At present, there are only six independent private schools in Korea.

The importance attached to gaining admission to elite universities dictates not only the secondary school curricula, but also increases the burden of private tutoring on families. According to one survey, 61 percent answered that support from former classmates is the most important factor determining success in life for individuals of similar ability, followed by the

9. This section draws on Baek Yong-chun and Randall S. Jones, "Sustaining High Growth through Innovation: Reforming the R&D and Education Systems in Korea," Economics Department Working Paper no. 470, OECD, Paris, 2005.

10. Education costs amounted to 12 percent of spending in households with one child, 22 percent in those with two children, and 26 percent in those with three or more. See *2005 National Survey of Marriage and Childbirth Trends* (in Korean) (Seoul: KIHASA [Korean Institute for Health and Social Affairs]; Seoul: Ministry of Health and Welfare; and Seoul: Presidential Committee on Aging Society and Population Policy, 2005).

11. This is reflected in the growing number of students going abroad for education.

12. See Kim Hyun-jin, "Analysing the Effects of the High School Equalisation Policy and the College Entrance System on Private Tutoring Expenditure in Korea," *Journal of Educational Policy* (Korean Educational Development Institute, Seoul) 1, no. 1 (2004); and Kim Tae-jong, "Shadow Education: School Quality and Demand for Private Tutoring in Korea," working paper, KDI School of Public Policy and Management, Seoul, 2004.

level of educational achievement and regional background at 16 percent and 9 percent, respectively.¹³ The value of education at an elite university puts pressure on students to get high scores on the university entrance exam. Such an approach encourages homogeneity rather than preparing students for a world in which creativity to develop new ideas is essential. Admission to universities will be based more on overall performance in secondary school and less on the entrance exam beginning in 2008. Successfully implementing this reform would help shift the education system away from learning by rote and toward more creativity; it could also reduce the emphasis on private tutoring.

Higher Education Should Be Reformed

The rapid expansion of higher education, reflected in the rise in the advancement rate from secondary to post-secondary education from 33 percent of the age cohort in 1990 to 81 percent in 2004, was accompanied by a decline in quality. In particular, the ratio of students to teaching staff has risen significantly to a level well above the OECD average. In addition to the surveys cited above, international flows of students also suggest quality deficiencies. Although Korea accounts for almost 5 percent of foreign-student flows to the OECD area, making it the second-largest source after China, Korea's role as a destination is among the lowest in the OECD. Only 0.1 percent of all students at the post-secondary level in Korea are from abroad. Korea needs to achieve a better balance between quantitative expansion and quality promotion in higher education through a number of reforms.

The first priority is to expand financial resources. Public expenditure on post-secondary education per student amounted to less than \$1,000 (at purchasing power parity exchange rates), compared with an OECD average of around \$8,000. User charges, at 84 percent of total post-secondary-education costs, are thus the highest in the OECD.¹⁴ The heavy reli-

ance on user charges creates equity concerns about the access of low-income households to higher education, given that scholarships and student loans in Korea are relatively low. However, reform requires consideration of a number of complex issues: (1) the already high level of overall educational spending, including private tutoring; (2) the balance between public and private financing; and (3) the allocation of funds among different levels of education. Public spending on the post-secondary level was 0.3 percent of GDP in 2002, much lower than the 3.3 percent spent on primary and secondary schools. In contrast, outlays in the OECD area are divided more evenly at 1.0 percent and 3.5 percent, respectively.¹⁵ The projected 29 percent decline in the number of children between the ages of 5 and 15 over the next decade should facilitate shifting expenditures to the post-secondary level.

Second, restructuring and consolidation of universities are required. The expected decline in university-age population provides a good opportunity to achieve cost savings that can be used to boost the quality of higher education. Because of the declining fertility rate, overcapacity in university education is already apparent among provincial universities, and by 2017 the population in the 15 to 25 age group is projected to decline by 5 percent. It is important to follow through on the government's 2004 plan to encourage the restructuring of the higher education sector through mergers and the exit of nonviable universities.

Third, greater deregulation is needed to help stimulate competition among universities and encourage them to better respond to the preferences of students and the corporate sector. The rigid hierarchy of universities in Seoul and the information asymmetry between education service providers and consumers discourage competition among universities, which is needed to improve their performance as well as to guide the restructuring process. It is important to provide more information about universities' performance to pro-

13. Jung Tae-hwa and Lee Byung-wook, "Study on Academic Cliques [in Korean]," Research Report no. 03-45 (Seoul: Korea Research Institute for Vocational Education and Training, 2003).

14. This reflects the fact that private institutions account for more than 80 percent of university-level students.

15. These numbers are taken from *Education at a Glance* (Paris: OECD, 2006).

mote competition. The decision to disclose the success of the graduates of each university in finding jobs is significant and should be expanded to cover more information. It is also important to develop a transparent mechanism with which to assess the quality of teaching. An independent national body with clearly defined criteria and standards should be established to undertake these tasks. Greater competition would result in more diversity among universities as they develop their comparative advantages.

Opening the university education market to accredited foreign providers would be an effective way to stimulate competition and upgrade the competitiveness of Korean universities. At present, no foreign post-secondary-level institutions with a majority share of investment are operating in Korea. Some restrictions aimed at ensuring the quality of education, such as standards for setting up campuses, act as entry barriers. In addition, the repatriation of earnings from schools is banned, effectively discouraging foreign schools from entering Korea.

Fourth, industry-university relationships should be strengthened to reduce mismatches in the labor market. According to a 2004 survey by the Federation of Korean Industries, 78 percent of companies replied that higher education has serious problems in supplying skilled workers, and it takes between 23 and 30 months to train new employees. The degree of mismatch and concerns about the quality of education are reflected in the high unemployment rate for youth (15 to 24 age group) of 10.2 percent in 2005. This was 3 times higher than the unemployment rate for the 25 to 54 age group, compared with an OECD average of 2.3 times. In addition, half of workers are employed in a field different from the one they studied in school.

Lifelong Learning

The changing demand for skills in the labor force in the context of the shift to a knowledge-based economy suggests a rationale for a public role in lifelong learning. Government expenditures on lifelong learning, including vocational training, amounted to only 0.8 trillion *won* (0.1 percent of GDP) in 2004. The participation rate of adults in lifelong education is 23 percent, which is in the lower group of OECD countries, and the rate is less than 10 percent for those

who failed to complete secondary school. More emphasis on lifelong learning and training would likely improve the employment prospects of older workers. A coherent strategy, including a well-functioning system of recognition and certification of learning, shared financing between public and private sources, quality control, and better policy coordination within government and between social partners, is required.

Strengthening Competition to Promote the Diffusion of Innovation

Competition in the product market strengthens incentives to innovate, thereby promoting productivity growth. In contrast, regulations that inhibit competition have been found to reduce R&D spending. The key priority in Korea is to strengthen competition in the service sector, where labor productivity is low. Indeed, in 2003, it was only 65 percent of that in manufacturing, considerably below the 97 percent level in the OECD area as a whole (*Table 1*). Entry barriers and regulations that restrict competition are higher in services than in manufacturing in Korea. This helps explain why services account for only 27

Table 1. Employment, Value-Added, and Productivity, by Sector in Korea, 2003

	Korea	OECD
Share of total employment (%) ^a		
Manufacturing(15–37)	19.0	16.6
Services (50–99)	63.5	69.2
Share of total value-added (%) ^b		
Manufacturing(15–37)	26.4	17.9
Services (50–99)	57.2	68.9
Value-added per worker, manufacturing = 100 ^a		
Services (50–99)	64.8	97.1
Wholesale & retail trade, hotels, and restaurants(50–52, 55)	28.1	70.5

Source: “STAN Database for Industrial Analysis,” Organization for Economic Cooperation and Development, Paris, 2006.

a. The OECD total is the simple average of 28 countries in which both employment and value-added data are available for 2003 or the most recent year.

b. The OECD total is based on 30 countries, using data for the latest year available.

Note: Numbers in parentheses show the International Standard Industrial Classification (ISIC, Rev.3) codes

percent of the stock of FDI in Korea, the lowest in the OECD area and well below the 62 percent share in the United States. In addition to weaker competition, productivity in the service sector has been negatively affected by industrial and tax policies that have favored the manufacturing sector and exports.

Nevertheless, services have accounted for a growing share of the Korean economy, rising from 47 to 57 percent between 1980 and 2003 in terms of value-added, reflecting the high income elasticity of demand for some services and population aging (see Table 1). The share of employment in services has increased even faster, climbing from 37 to 64 percent over the same period. The service sector remains relatively small in Korea compared with the OECD averages of almost 70 percent in terms of both value-added and employment, but it is likely to expand toward the average share. Consequently, persistently low productivity in the service sector would impose a considerable drag on Korea's overall productivity performance, in part by penalizing the manufacturing sector, which incorporates a wide range of services in its production activities. In addition, the wide gap between manufacturing and services is contributing to increasing income inequality and relative poverty in Korea.

Restructuring of the service sector is thus a priority in Korea to boost productivity and promote the convergence in per capita income to the U.S. level. A priority should be to promote a pro-competitive regulatory environment by lowering entry barriers, focusing on three areas. First, although regulations on retail trade at the central-government level have been almost phased out (except those related to traffic and environmental considerations), there remain obstacles at the local level to opening large-scale stores. Empirical evidence in many countries shows large productivity gains from the liberalization of entry in retail trade over the past two to three decades. Second, in professional services, such as law and accounting, regulations on entry and business activity should be lowered further. Third, in social services, several studies have documented positive effects from expanding user choice and competition on performance in health care, child care and long-term care. In addition, remaining policies that discriminate in favor of manufacturing should be abolished. For example, electricity tariffs for manufacturing firms should not be kept below other sectors.

Productivity gains are driven by “creative destruction” through new entry and exit of firms as well as by productivity growth in existing firms and changes in market share. New firms make an important contribution to innovation because they can begin their operations with the most productive combinations of inputs. The entry of new firms is highest in business environments with high-quality regulation, low start-up costs, and a low level of corruption. Despite Korea's regulatory reform efforts following the 1997 financial crisis, barriers to entry remain an important concern. While the start-up time for a new business is not high compared with other OECD countries, the number of procedures, the total cost, and minimum capital requirement (50 million *won* or 3.3 times annual per capita income), are relatively onerous (Table 2). Multiple contact points and administrative procedures should therefore be simplified. However, the most significant entry barrier is the extensive regulatory framework governing land use, which includes 112 different laws administered by a number of different ministries. Moreover, there is a lack of transparency given that there is no comprehensive database on these regulations.

Table 2: Comparison of Time and Cost in Starting a Business, 2004

Factors	Korea	OECD ^a
Number of procedures	12	6
Time (days)	22	25
Cost (percentage of income per capita)	17.7	8.0
Minimum capital (percentage of annual income per capita)	332.0	44.1

Source: *Doing Business in 2005: Removing Obstacles to Growth* (Washington, D.C.: World Bank, 2005).

a. Includes 22 high-income OECD countries.

Conclusion

With inputs of labor and capital slowing, sustaining high growth rates will increasingly depend on productivity gains. Korea is well positioned to achieve high productivity growth and to continue catching up to the leading OECD countries, given its large investment in R&D and education. However, Korea's development strategy, while promoting rapid growth, has resulted in a dualistic economy divided between a

highly competitive, export-oriented manufacturing sector and a much less dynamic, domestic demand-oriented sector. Large companies in the ICT and automobile industries are the leading innovators, while smaller companies, particularly in the service sector, lag behind. The challenge for Korea is to maintain an innovation framework that enables the leading firms to remain at the world technology frontier as it encourages greater innovation efforts and the diffusion of technology to the lagging sectors. This requires expanding the stock of knowledge and ensuring that optimal use is being made of the existing stock of knowledge to enhance economic growth. To accomplish these objectives, it is important to improve the R&D framework; ensure adequate human capital, notably through reform of the education system; and reform product market regulations so as to encourage innovation.

Dr. Jones is Head of the Japan/Korea Desk in the Economics Department of the Organization for Economic Cooperation and Development. The views expressed in this article are those of the author and not necessarily those of the OECD or its member countries.