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SUSTAINING HIGH GROWTH THROUGH INNOVATION: REFORMING THE R&D AND EDUCATION SYSTEMS IN KOREA

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ABSTRACT/RESUMÉ

Sustaining High Growth through Innovation: Reforming the R&D and Education Systems in Korea

With inputs of labour and capital slowing, sustaining high growth rates in Korea will increasingly depend on total factor productivity gains, which are in turn driven to a large extent by innovation. While a number of Korean firms are at the world technology frontier in areas such as ICT, the diffusion of technology to lagging sectors is a priority to sustain growth. This paper recommends policies to improve the science and technology system by upgrading the R&D framework, in part through closer linkages between firms, universities and the government, and enhanced intellectual property right protection. Strengthened competition, particularly in the service sector, is needed to promote the diffusion of new technologies. Innovation also requires policies to ensure the supply of high-quality human capital through reforms of tertiary education. This requires a restructuring of the university system through increased competition and deregulation, as well as additional financial resources to improve quality. This Working Paper relates to the 2005 OECD *Economic Survey of Korea* (www.oecd.org/eco/surveys/korea).

JEL classification: I2, O39, O31, O33, O34, O38, O53.

Keywords: Innovation, R&D system, science and technology, technological change, ICT sector, patents, intellectual property rights, product market competition, entry barriers, service sector, regulatory reform, venture business, tertiary education, Korea.

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Maintenir une forte croissance grâce à l'innovation : réforme des système de R-D et d'éducation

Les apports de main-d'oeuvre et de capital se ralentissant, le maintien de taux de croissance élevés en Corée dépendra de plus en plus des gains de productivité totale des facteurs, lesquels sont induits dans une large mesure par l'innovation. Tandis qu'un certain nombre d'entreprises coréennes se situent à la pointe de la technologie mondiale dans des domaines tels que les TIC, la diffusion de la technologie dans les secteurs retardataires est une priorité pour le maintien de la croissance. Ce papier préconise des politiques pour améliorer le système scientifique et technologique en modernisant le cadre de la R-D, notamment par une extension des liens entre les entreprises, les universités et l'État, mais aussi par un renforcement de la protection des droits de propriété intellectuelle. Une intensification de la concurrence, en particulier dans le secteur des services, est indispensable pour promouvoir la diffusion des nouvelles technologies.
L'innovation requiert aussi des mesures visant à assurer une offre de capital humain de qualité par des réformes de l'enseignement supérieur. Cela exige une restructuration du système universitaire grâce au développement de la concurrence et de la déréglementation, ainsi qu'un accroissement des ressources financières pour améliorer la qualité.
Ce Document de travail se rapporte à l'Étude économique de l'OCDE de la Corée, 2005 (www.oecd.org/eco/etudes/coree).
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Mots clés: Innovation, système de R-D, activités scientifiques et technologiques, secteur TIC, brevets, droits de propriété intellectuelle, concurrence sur les marchés, obstacles à l'entrée, les services, réforme réglementaire, entreprises à risqué, enseignement supérieur, Corée.

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SUSTAINING HIGH GROWTH THROUGH INNOVATION: REFORMING THE R&D AND EDUCATION SYSTEMS IN KOREA

Yongchun Baek and Randall S. Jones[1]

1. Korea's rapid growth has been based primarily on inputs of capital and labour, driven by the highest rate of business investment in the OECD area, a growing working-age population and rising participation in the labour force. Total factor productivity (TFP) gains - including human capital accumulation - have played a secondary role. Nevertheless, a high level of investment in education and R&D has supported TFP gains, in part by facilitating a "catch-up" model of innovation. Rapid growth has helped to promote the convergence of per capita income to two-thirds of the OECD average and make Korea a leader in certain manufacturing industries, such as ICT. Despite this impressive performance, Korea remains in the bottom quarter of OECD countries in terms of per capita income.

2. Sustaining high growth will increasingly depend on TFP gains through innovation as the growth of inputs of labour and capital are expected to decelerate over the medium term. Innovation - the successful development and application of new knowledge - spans a wide range of activities ranging from invention of new technologies to their diffusion and related organisational changes. It also includes the development of new products and processes based on the existing stock of knowledge. Indeed, it is as important to expand the capacity to utilise existing knowledge, as it is to create new technology. The scope for benefiting from existing knowledge is large in Korea, given that labour productivity per hour worked is 40% of the US level (see the 2005 *OECD Economic Survey of Korea*). In particular, productivity in Korea's service sector is only about half of that in manufacturing, which implies that increasing productivity in services is a priority to raise overall economic performance.[2] To spur economic growth, an upgrading of the national innovation system was announced in a 2004 programme that includes ambitious targets to raise total R&D spending and basic research outlays by the government, with the aim of developing key technologies as future growth engines.

3. However, Korea faces a number of obstacles in using innovation to enhance its growth potential:

- R&D spending is concentrated in a small number of firms and industries, while linkages between business, university and government research institutes are weak. Universities play a minor role in R&D and interaction with foreign researchers is limited.

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1. Yongchun Baek was an economist on the Japan/Korea Desk in the Economics Department of the OECD when this paper was written and has since returned to the Ministry of Finance and Economy in Korea. Randall Jones is the head of the Japan/Korea Desk in the Economics Department. This paper draws on material originally produced for the OECD Economic Survey of Korea published in October 2005 under the responsibility of the Economic and Development Review Committee. The authors are indebted to Andrew Dean, Jorgen Elmeskov, Michael Feiner, Byung-Seon Jeong, Val Koromzay, Willi Leibfritz, Daniel Malkin and Jerry Sheehan for comments. Special thanks go to Brooke Malkin for technical assistance and Nadine Dufour for secretarial help.

2. Productivity per worker in Korea's manufacturing sector is 90% of the OECD average compared to only 54% in the service sector.

- Entry barriers and regulations restrict competition, particularly in the service sector, thus weakening incentives for the diffusion of technology. Despite government support, the development of the venture business sector has been weak.
- The sharp expansion in the number of students going to university has been accompanied by a decline in the quality of tertiary education, which is relatively poor by international standards.

4. This paper highlights a number of policy issues affecting innovation - including the generation of new knowledge and the effective use of existing knowledge - and recommends policies to help sustain Korea's growth potential. It begins by presenting an overview of the major challenges facing the R&D framework and recent government initiatives in this area, including policies to encourage private-sector innovation. The following sections examine important aspects of the product, capital and labour markets that impact on innovation and the challenge of securing adequate human capital, which requires the reform of the education system. The paper concludes with a set of policy recommendations shown in Box 5.

Upgrading the R&D system in Korea[3]

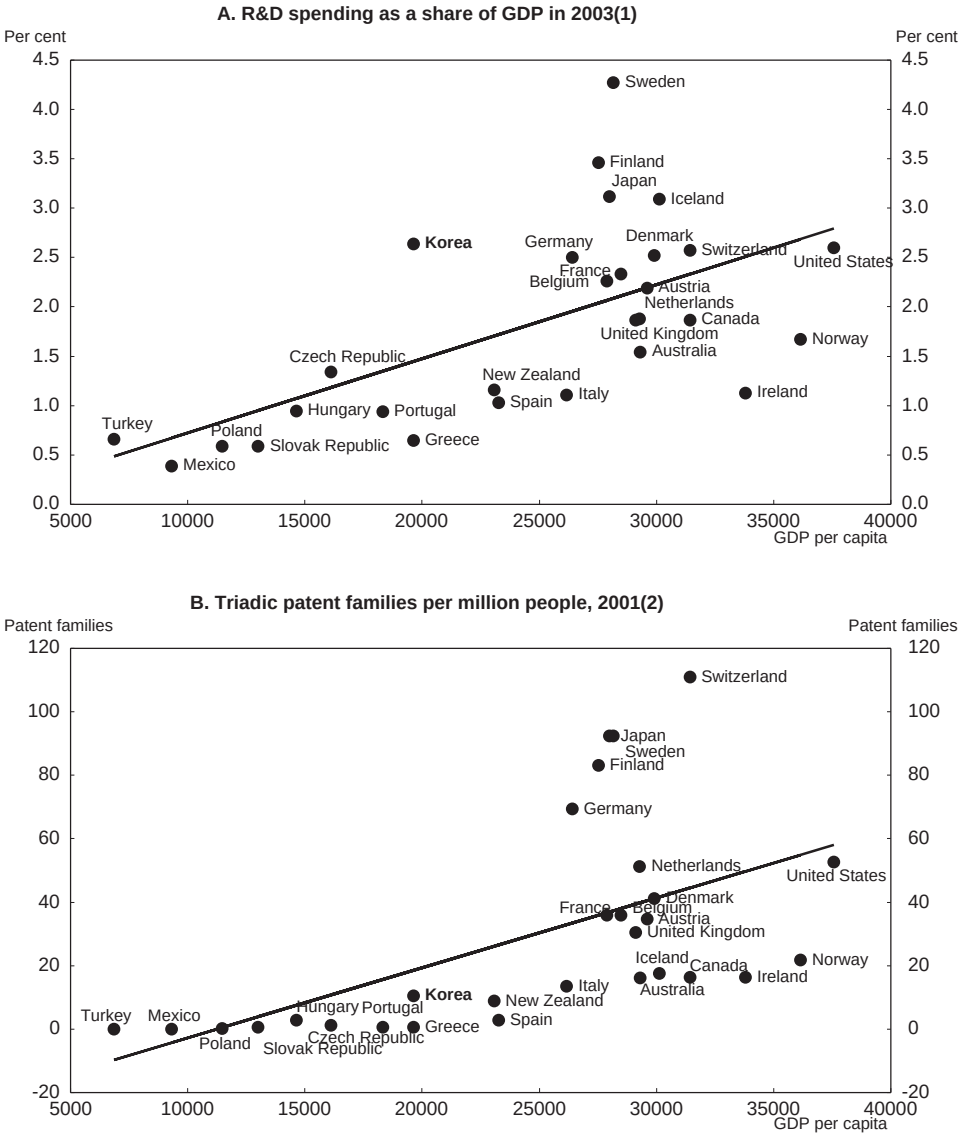
5. The OECD *Growth Study* found a positive link between private-sector R&D intensity and the level of per capita GDP. At 2.6% of GDP, total R&D spending matches that in the United States and Germany despite Korea's lower level of development (Figure 1). The high R&D intensity in Korea is due primarily to the business sector, which accounts for three-quarters of R&D spending (Table 1). The number of researchers, at 0.7% of the workforce ranks close to the OECD average. However, according to an OECD study, Korea's overall innovation performance was ranked below the average of member countries (Freudenberg, 2003).[4] The key challenges facing Korea's R&D system include:

- The transition from a catch-up model of technological progress to a more creative approach.
- Reducing the concentration of R&D activities in a relatively small number of firms and industries in the manufacturing sector, while boosting the share of the service sector.
- Increasing interaction between business, government and academic R&D activities.
- Expanding international R&D linkages, which are relatively limited at present.
- Increasing the output of codified knowledge in the form of patents and publications.
- Strengthening the diffusion of knowledge throughout the economy.

3. R&D and patents are used here as proxy variables of innovation input and output, supplemented by surveys based on self-assessment, *i.e.*, the Korean Innovation Survey. For more discussion of the concept of innovation and relevant data, see a paper on innovation in Germany by Fuentes *et al*., 2004.

4. Indeed, it was ranked 18th out of 29 OECD countries in "generation of new knowledge", 22nd out of 23 in "industry-science linkage/technology diffusion" and 16th out of 30 countries in "industrial innovation".

Figure 1. R&D spending and patents



1. US$ PPP exchange rates.
2. Patents filed in the patent offices in Europe, Japan and the United States to protect the same invention.

Source: OECD, *Main Science and Technology Indicators* (2004).

Table 1. Performance of science and technology activities

	Indicators of scientific and technological activities[1]							
	GDP per capita (using PPP, OECD = 100 In 2003)	R&D[2] intensity (% of GDP in 2003)	Business financed R&D (% of R&D[2] in 2003)	BERD[3] intensity (% of value added in 2003)	Basic research expenditure (% of R&D[2] in 2002)	Researchers (per 1 000 employed in 2003)	Triadic[4] patent families (per million pop in 2001)	Science & engineering articles (per million pop in 2001)
Australia	110	1.54	46.3	1.06	26.0	7.2	16.2	758
Austria	114	2.19	42.6	1.62	15.2	4.7	34.7	564
Belgium	109	2.33	64.3	2.59	-	8.4	35.9	582
Canada	119	1.87	44.3	1.35	-	7.1	16.3	727
Czech Republic	64	1.34	51.4	1.09	37.7	3.2	1.3	256
Denmark	115	2.52	61.5	2.82	18.3	9.3	41.1	931
Finland	105	3.46	69.5	3.57	-	16.4	83.1	983
France	107	2.26	52.1	2.02	23.3	7.5	36.0	514
Germany	101	2.50	65.4	2.48	18.7	6.9	69.4	530
Greece	75	0.65	33.1	0.29	-	3.7	0.5	304
Hungary	56	0.95	30.7	0.55	24.5	3.8	2.8	243
Iceland	115	3.09	46.2	2.85	15.9	-	17.5	610
Ireland	128	1.13	67.2	1.04	12.2	5.1	16.3	432
Italy	100	1.11	43.0	0.77	22.0	2.8	13.6	385
Japan	108	3.12	73.9	3.10	12.5	9.9	92.3	451
Korea	**78**	**2.64**	**74.0**	**2.77**	**13.7**	**6.8**	**10.6**	**233**
Luxembourg	196	1.71	90.7	2.15	-	6.2	45.2	-
Mexico	36	0.39	29.8	0.18	30.8	0.6	0.1	32
Netherlands	112	1.88	51.8	1.54	9.5	5.5	51.2	786
New Zealand	88	1.16	37.1	0.56	44.9	7.0	8.9	742
Norway	139	1.67	51.6	1.41	15.0	8.7	21.9	721
Poland	44	0.59	31.0	0.18	32.2	3.9	0.2	147
Portugal	71	0.94	31.5	0.52	22.4	3.5	0.6	208
Slovak Republic	50	0.59	45.1	0.44	25.9	4.7	0.7	177
Spain	89	1.03	48.9	0.79	15.5	5.1	2.8	387
Sweden	108	4.27	71.9	5.18	18.4	10.6	92.3	1 159
Switzerland	117	2.57	69.1	3.11	28.0	6.3	110.9	1 117
Turkey	26	0.66	41.3	0.23	-	1.1	0.1	60
United Kingdom	112	1.87	46.7	1.84	-	5.5	30.5	807
United States	145	2.60	63.1	2.47	19.1	8.6	52.6	705
EU-25	-	1.86	55.5	1.72	-	5.8	-	-
OECD	100	2.26	62.2	2.14	-	6.5	37.5	468

1. As of the year indicated or latest available year.
2. Gross domestic expenditure on R&D.
3. Business enterprise expenditure on R&D.
4. Patents filed at the patent offices in Europe, Japan and the United States to protect the same invention.

Source: *OECD in Figures* (2004), OECD *Science, Technology and Industry Outlook* (2004) and OECD *Main Science and Technology Indicators* (2004).

An overview of the major challenges facing the R&D system

The transition from a catch-up model of innovation

6. Korea's relatively low performance in the generation of new knowledge reflects the fact that its innovation system has remained largely based on a "catch-up" model, which favours the acquisition of advanced technologies from abroad in selected sectors rather than a broader strengthening of its knowledge base (see Box 1). A recent study found that the contribution to TFP from foreign technologies has been a little larger than that from independent R&D activities (Ha, 2004).

Box 1 The catch-up model of innovation

As a late industrialising country, Korea has relied heavily on foreign technology. Technological development was achieved through the interplay of imports of technology from abroad and indigenous R&D efforts. At the initial stage, Korea relied heavily on packaged technology, such as turnkey plants that largely produced "Original Equipment Manufactures" for sale under foreign brand names. As late as 1978, business-sector R&D expenditures were only 0.25% of GDP, while payments for technology imports amounted to 0.15%. The strategy began to evolve as Korea's cost advantage in terms of cheap labour began to wane at the end of the 1970s. This prompted the creation, in 1982, of the National R&D Programme, which aimed at localising technology by helping local firms adapt foreign technology through their own R&D efforts. In general, the assimilated technologies and the resulting products were in mature and standardised industries (Suh, 2000). It should be noted that, as in other East Asian countries, catch-up through reverse engineering and duplicative imitation was facilitated by relatively weak intellectual property rights (see Box 3). The shift to locally-developed technology is reflected in the eight-fold increase in business R&D spending to 2% of GDP between 1978 and the early 1990s, while payments for technology imports only doubled to around 0.4% of GDP over the same period.

The reliance on foreign technology, combined with past export-oriented policies focusing on products with economies of scale, has resulted in heavy dependence on foreign sources of materials, parts and components. This limits the beneficial "linkage effects" and amplifies vulnerability to external shocks. For example, the dependency ratio on foreign materials and components is about 70% for DVD players, 50% for mobile phones and 91% for liquid crystal displays. Using the 2000 input-output table, Korea's "import inducement coefficient" (the amount of imports generated by one unit of exports) was estimated to be 0.29 (0.46 in the ICT sector), much higher than Japan's 0.10 (BOK, 2004).

7. In some sectors, Korea is now reaching the limits of the catch-up model as it approaches the technology frontier. According to a recent survey of 6 000 manufacturing firms, the overall technology level is estimated to be 80% of the world technology frontier, while 13% of firms replied that they have already reached the frontier (Du-Yong Kang *et al*., 2004). 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, reducing the scope for such imports. Korean firms are thus under increasing pressure to develop their own technological capabilities. According to the survey cited above, 89% of firms engaged in R&D possess in-house research facilities, and 59% of them implemented R&D without outside assistance. As for firms undertaking joint R&D activities, 46% co-operated with other firms and 43% with universities or GRIs, but only 11% with foreign institutions.

The concentration of R&D in large enterprises and in the manufacturing sector

8. Korea's R&D resources and outputs tend to be concentrated in a small number of industries. Overall, about three-quarters of business-sector R&D is in high and medium-high technology manufacturing industries (Figure 2). In 2003, 80% of this R&D was concentrated in two sectors: ICT and automobiles (MOST, 2004).[5] The heavy concentration in two sectors contributes to the dualism in the

5. This amounts to about 60% of total business R&D. Moreover, one-half of Korean patents at the European Patent Office (EPO) are in the ICT area (OECD, 2004a).

Korean economy and may not provide a broad enough base to promote the convergence to income levels in the most advanced OECD countries. In addition, a small number of firms play an important role: the top five companies[6] accounted for 37% of business R&D expenditures and 28% of researchers employed in industry, while the top twenty companies accounted for 52% and 48%, respectively. The concentration of innovation activities is also reflected in patents. The top five ICT companies hold 57% of all Korean patents in the United States, led by Samsung Electronics (35%).

9. Although innovation activities are concentrated in certain large companies, the share of small and medium-sized enterprises (SMEs) in business R&D has risen from less than 10% before the 1997 crisis to 24% in 2003, with venture businesses accounting for about half (MOST, 2004). Consequently, the proportion of business R&D conducted in large enterprises, at 76% in Korea, is somewhat less than the more than 80% share in the United States, Japan and Germany (OECD, 2004m). The proportion of enterprises engaged in innovation activity during 2000-01 in Korea was 40% for small enterprises, 57% for medium-sized, and 82% for large enterprises.[7] This is similar to Europe: the proportions were 40%, 63% and 80%, respectively, between 1998 and 2000.[8] In domestic patenting, the share of applications from SMEs and individuals in Korea doubled from 23% of applications between 1990-93 to 46% between 1998-2001 (KIPO and KIPRIS, 2005). Innovation networking between chaebol-affiliated companies and SMEs has been increasing, notably in the form of spin-offs or strategic alliances that has accompanied the restructuring of chaebol companies (Suh, 2005). Despite their rising share of R&D and patents, improvements in both labour productivity and TFP in SMEs have been relatively slow, resulting in a widening gap with large companies since the 1990s (KDI, 2003).

10. Korea's service sector, which is dominated by small establishments, accounted for 13% of business R&D in 2001, well below the OECD average of 21% (OECD, 2004m). In some "knowledge-intensive services", innovation activities are vigorous, supported by Korea's advanced ICT infrastructure (Lee *et al.*, 2003). Nevertheless, Korea has a large trade deficit in knowledge-intensive services, such as computer software system services**.** Excluding some ICT-related services, such as software consultancy, computer services and telecommunications, R&D expenditures in the service sector are almost negligible at 3% of total business R&D. In 2001 and 2002, the proportion of service-sector enterprises engaged in innovation activity was 25% (Um *et al*., 2004), well below the EU average of 40% (Eurostat, 2004). The weak R&D performance in the service sector is reflected in a relatively low level of productivity (see below).

Weak interaction among R&D activities in business, government and the universities

11. A high rate of complementarity between public and private-sector R&D improves innovation performance. Ensuring such linkages requires the government to be responsive to the rapid evolution of the innovation process and to business needs and strategies (OECD, 2001b and Park, 2003). While collaboration among R&D players has gained in significance across OECD countries (OECD, 2002a), the industry-academia-government interface in Korea has remained weak because of inherent structural problems.[9] The innovation system is characterised by only limited reliance of industry on scientific

6. The five are Samsung Electronics, LG Electronics, Hyundai Motors, Hynix Semiconductors and GM Daewoo Auto & Technology.

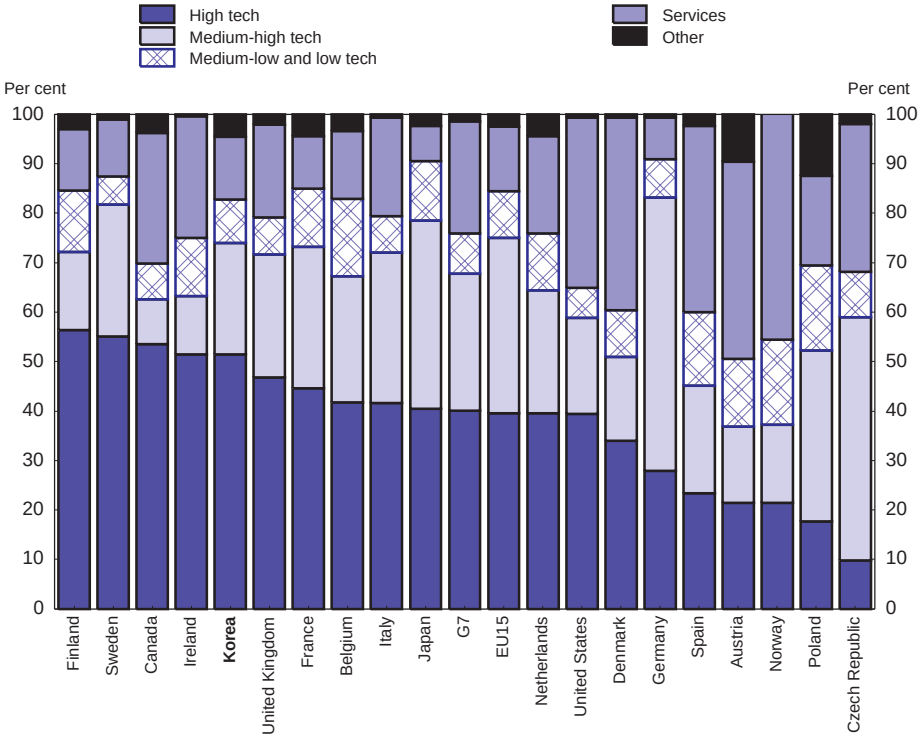
7. This survey (Um, 2004) followed the OECD Oslo Manual (OECD, 1997b). Small, medium-sized, and large enterprises were defined by employment of between 10 and 49, 50 and 249, and 250 or more employees, respectively.

8. According to the Third Community Innovation Survey (CIS3) for 16 European countries (Eurostat, 2004).

9. Linkages can take the form of joint research, personnel exchange, cross-patenting, licensing of technology, purchase of equipment and a variety of other channels (OECD, 1997a).

research and low responsiveness of the non-business sector - government research institutes (GRIs) and universities - to demand from the business sector. In general, GRIs and universities point to an absence of technological and absorptive capability in the business sector and its lack of interest in technology diffusion, while firms complain about the inability of the GRIs and universities to solve business' technical problems. In 2003, 97% of business-financed R&D was performed by the business sector itself, while GRIs and universities performed only 1% and 2%, respectively (Table 2). About half of government-financed R&D spending was channelled to GRIs, with smaller amounts granted to universities and the business sector. In sum, the limited interaction between the suppliers and users of technology hinders the effectiveness of Korea's R&D spending.

Figure 2. Business R&D expenditure by technology level



Source: *OECD in Figures* (2004).

12. Because the transfer of knowledge and technology takes place to a large extent through people, it is important to ensure that the regulatory framework and labour market foster the mobility of researchers between sectors. Such mobility has been limited in Korea. Another concern is that GRIs and firms have experienced a significant "brain drain" to the universities. In a survey about the desired job destination of researchers, employment at universities ranked first at 63%, followed by foreign institutions at 15%, while starting a business was preferred by 14%. Private firms and public institutions were the first choice of only 4% and 3% of researchers, respectively (Ko *et al.*, 2001). Despite relatively low wages, universities attract researchers because of the high level of social respect accorded to professors and job security, in contrast to significant job precariousness in the business labs, particularly since the financial crisis (Cho *et al.*, 2003). As a result, universities employed 72% of researchers with a PhD degree in 2003, and 30% of all researchers. Meanwhile, business-sector demand for highly qualified researchers has been limited by the

reliance on a catch-up strategy, which focuses on assimilation and improvement of existing technology rather than on radical innovation.

13. There have been significant changes in the financing of university R&D. In 1997, government financed half of university R&D expenditure, with about one-third self-financed. In 2003, 73% was from the government, with 13% self-financed (Table 2, Panel B). This change is largely due to government projects such as "Brain Korea 21" (BK 21), which aims at upgrading university research and establishing centres of excellence. However, universities' share of total R&D performed in Korea remained at 10% in 2003, about half of the OECD average, indicating that their human resources are under-utilised in the area of research (Jung and Ko, 2004). Moreover, the universities perform only a quarter of basic research, in contrast to most other OECD countries where they are the major players. Another problem, in addition to the low level of R&D activity and spending, is weak co-operation with industry, in part due to the government-led nature of research projects.

Table 2. Flows of R&D funds in 2003
A. R&D Funding

		Allocation between R&D actors[2]			
	Share of total R&D spending	Government	Universities	Business enterprises	Total
Government[1]	24.2	52.2	30.5	16.9	100.0
Universities	1.3	0.3	98.1	1.6	100.0
Business enterprises	74.0	1.4	1.9	96.7	100.0
Foreign sources	0.4	1.7	10.3	88.0	100.0

B. Sector performing R&D

		Funding source for R&D performed				
	Share of total R&D performed	Government	Universities	Business enterprises	Foreign sources	Total
Government[1]	13.8	92.4	0.0	7.5	0.1	100.0
Universities	10.1	73.0	13.0	13.6	0.4	100.0
Business enterprises	76.1	5.4	0.0	94.1	0.5	100.0

1. Includes private non-profit institutes.
2. By which sector performs the R&D.

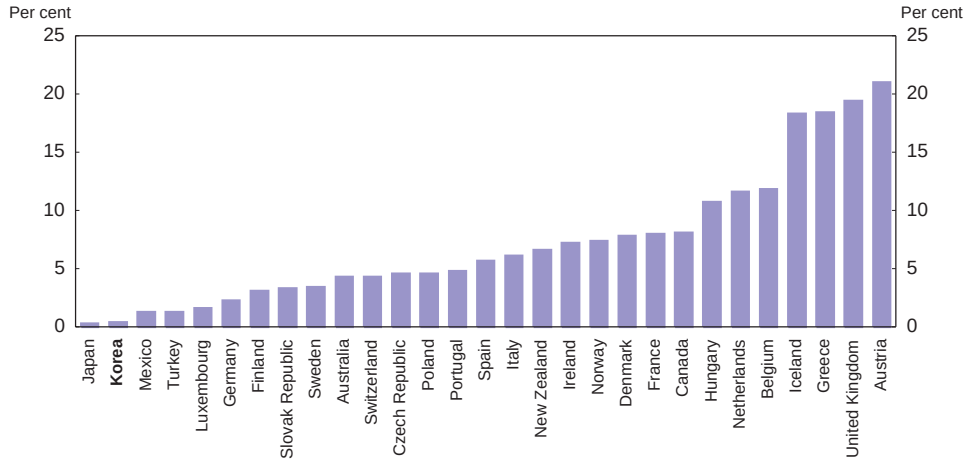
Source: *OECD R&D Statistics* (2004).

The lack of international linkages in R&D

14. In addition to the lack of co-operation between domestic actors in R&D, international collaboration is weak. Foreign sources financed only 0.4% of R&D activities in Korea in 2003, the lowest share along with Japan (Figure 3). In terms of the cross-border ownership of inventions, *i.e.,* the share of foreign ownership of domestic inventions or the inverse, Korea also ranks as one of the lowest in the OECD area (OECD, 2003f). The low level of inflows of FDI, which were restricted in the past, is one reason for the lack of foreign links. International isolation may limit the scope for technological progress,

as foreign sources of knowledge are increasingly important for innovation, leading to growing co-operation across national borders (OECD, 2005b). One positive sign is that the number of foreign R&D centres located in Korea has doubled to 122 since the financial crisis.

Figure 3. Foreign funding of R&D expenditures
Per cent of total R&D spending in 2003[1]



1. 2003 or latest year available.
Source: OECD, *Main Science and Technology Indicators* (2004).

Limited output of codified knowledge

15. Despite its relatively high level of R&D intensity, Korea's output of codified knowledge, in the form of patents and publications, is relatively weak as measured by the number of "triadic patent families" - patents filed in the United States, Japan and Europe. Korea is well below the expected level given both its income level and its amount of R&D spending (Figure 1, Panel B).[10] To some extent, this may be a legacy of focusing on catch-up rather than on the creation of new knowledge. In addition, there is some evidence that Korean firms prefer alternative protection methods, such as secrecy and lead-time, to patents (Um, 2004), which may be less favourable for the diffusion of knowledge than patents.

Inadequate diffusion of knowledge throughout the economy

16. Technology transfer and commercialisation have not been active in Korea, resulting in an under-utilisation of the fruits of innovation. As of 2004, 61% of patent rights had not been used (KIPO, 2004). In particular, a large share of the technologies invented in the public sector has been ignored by the private sector. By 2004, the proportion of transferred technologies that had been developed by the GRIs and universities was 18% according to a survey by the Ministry of Commerce, Energy and Industry. This may reflect the difficulty in evaluating specific technologies of GRIs and universities, as well as the fact that research in the public sector is often undertaken with little consideration of its potential commercial application. Compared to other countries, the income received by GRIs and universities from technology transfers is relatively small considering their patent stock (OECD, 2003h).

10. However, the number of Korean patents filed in the United States and Japan are higher than the expected level given Korea's income level and amount of R&D spending.

Recent government initiatives to restructure the national innovation system

17. In sum, Korea does not appear to be getting the full benefits possible from its high level of R&D spending. In 2003, the government placed science and technology (S&T) at the top of its policy agenda to spur economic growth. To this end, the administrative system for S&T was fundamentally restructured:

- The role of the Ministry of Science and Technology (MOST) was strengthened by making it the central agency for planning, co-ordinating, and evaluating S&T policies, in co-operation with other ministries, particularly Commerce, Industry and Energy and Information and Communication, while abolishing its R&D programmes that compete with other ministries. The minister of MOST was named as a third deputy prime minister.

- The National Science and Technology Council (NSTC), which includes the president and the minister of MOST as chairman and vice chairman, was granted full authority to allocate the government's R&D budget, which is targeted to double between 2003 and 2007.

In 2004, the government announced a plan, which is summarised in Box 2, to restructure the national innovation system. The plan emphasises shifting from a catch-up model to a more creative approach, increasing networking among players and shifting towards performance and demand-oriented paradigms.

Box 2 The government's programme to restructure the national innovation system

1. Measures to upgrade the innovation capacity of industry, universities and government research institutes

- Boost R&D spending to 3% of GDP by 2007 by providing effective tax incentives to the business sector.
- Foster 10 000 innovation-driven SMEs through technical and financial assistance, subsidies for employing R&D personnel, and an easing of regulations (*e.g.*, on land use, environment) on start-up companies.
- Increase basic research from 20% of the government R&D budget in 2004 to 25% by 2007, and raise the share of R&D that is performed in universities from 10% to 15% of total R&D over the same period.
- Enhance organisational flexibility and labour mobility in the GRIs, and expand their autonomy.
- Implement deregulation of such measures as the ceiling on chaebol shareholding and building controls in the capital region to promote business innovation activities in high-technology areas.

2. Measures to raise the efficiency of R&D investment and to secure highly qualified workers

- Raise the allocative efficiency of R&D investment by concentrating national R&D programmes on basic/generic research areas and by minimising the overlap between public and private spending.
- Nurture S&T manpower and minimise mismatches in the job market for skilled workers by strengthening the monitoring of demand and supply.
- Make engineering and vocational education more responsive to technology and business demand.
- Secure talented science and engineering students by expanding incentives at the tertiary level and reforming science education in the primary and secondary levels.

3. Measures to develop technology and to upgrade the diffusion mechanism

- Develop certain technologies to act as growth engines for the Korean economy.*
- Help the material and component-related industries improve their competitiveness.
- Develop technology in key areas such as future core technologies (*e.g.*, biotechnology and nanotechnology), mega-science (*e.g.*, space and marine technologies), energy, and public welfare (*e.g.*, health, transportation).

- Strengthen the diffusion mechanism by creating intermediaries between technology invention and diffusion, improving technology evaluation schemes, and strengthening the intellectual property rights system (*e.g.*, providing patent information and streamlining patenting procedures).
- Foster Daedeok Science Town as a R&D Special Region and develop regional innovation clusters.

4. Measures to upgrade the performance of the innovation system

- Strengthen linkages among business, government and universities.
- Fortify international collaboration, and establish an East Asia regional R&D hub in Korea.
- Construct a national information system for S&T by 2008.
- Establish a performance-oriented evaluation and management system.
- Strengthen the roles of the NSTC and MOST in co-ordinating S&T policies and allocating their budgets.

5. Measures to upgrade innovation infrastructure

- Create job opportunities through a virtuous circle of innovation, diffusion and employment.
- Improve the social compensation of highly qualified workers by reducing the burden of the alternative military service obligation, raising the share of science and engineer career tracks in the government, and expanding the reward system for scientists and engineers.
- Promote a S&T-friendly culture and social environment by national agenda-setting and diverse activities.
- Guarantee the social and ethical responsibility of S&T.

* Ten strategic industries were identified in August 2003 as future growth engines: 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.

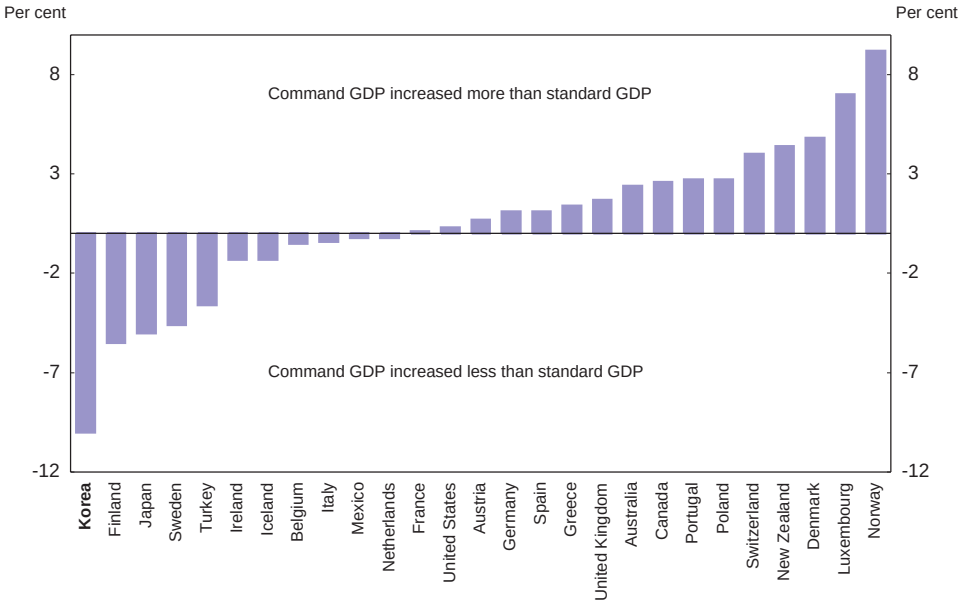
18. However, many of the key objectives in the programme have been under consideration during the last decade, which may imply that the weaknesses in the innovation system are not easy to tackle. There are a number of key concerns for Korea to benefit more fully from reform of its innovation system. *First*, innovation policy should be more fully integrated into the overall strategy of economic development. Given that the ultimate objective of innovation is to raise living standards, government programmes should be more focused on boosting productivity, rather than on upgrading technology itself. This requires greater linkages among policies for S&T, education, the product market and other areas, in part through increased co-operation among ministries. For example, securing highly qualified human capital for S&T requires greater co-ordination between the NSTC and the Human Resources Development Council (HRDC) in the Ministry of Education and Human Resource Development. The current public funding system for university R&D, which is fragmented among diverse ministries, also needs co-ordination between those two councils to improve allocative efficiency (Woo and Lee, 2004). Co-ordination between the two councils is to be enhanced by the recently created S&T Joint Committee for S&T Workforce Issues. Another priority should be to harmonise and minimise potential conflicts between the national innovation system and the recently launched Regional Innovation System (RIS), which emphasises balanced territorial development. Regional industrial policies driven by diverse ministries focusing on S&T, business and universities have suffered from weak co-operation. It is thus necessary to strengthen regional planning, co-ordination and evaluation capabilities and to build effective firm-supporting systems (Yun and Lee, 2004).

19. *Second*, although most countries have identified a limited number of priority sectors for public R&D expenditures (OECD, 2004m), picking winners and giving them undue emphasis could lead to a government failure or distortions. To avoid such problems in Korea, flexibility in implementing R&D programmes is required. This is especially important for the "next generation growth engine" programmes, in which the government is planning to invest 3.1 trillion won between 2004 and 2008 (0.4 trillion won in 2004, 6% of government R&D outlays). Perhaps more important is the signal provided to the private sector. For example, the shareholding ceiling imposed on chaebol-affiliated companies is waived for the ten strategic industries. The government's role in R&D should strengthen its focus on developing generic technologies and human capital in order to avoid crowding out private investment and to abide by international norms regulating government subsidies.

20. 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 firms in other countries also increase production in these areas. Indeed, Korea has experienced significant terms of trade losses in recent years. An accurate measure of living standards should take into account the impact from this income loss. One approach is to adjust GDP by the terms of trade effect, a measure known as the "command GDP" (Figure 4). The output increase since 1990 according to this measure is a full 10% below the conventional GDP, the largest such gap in the OECD area. Not surprisingly, other countries where ICT is important - Finland, Japan, Sweden and Ireland - also show a large gap. In sum, while the contribution of ICT to manufacturing productivity in Korea is the largest in the OECD area at 1 percentage point a year, it contributes importantly to the terms of trade loss, which reduces income by about 0.7 percentage points on average per year. This perspective suggests that there are gains to a diversified approach to R&D.

Figure 4. Impact of the terms of trade on income

Cumulative gap between command GDP and standard GDP between 1990 and 2004[1]



1. Command GDP adjusts standard GDP for the terms of trade effect by deflating exports by the import price deflator:
   Command GDP = TDDV + XGSV * (PXGS/PMGS) - MGSV
   where TDDV is real domestic demand, XGSV and MGSV are exports and imports in volume terms, and PXGS and PMGS are the export and import deflators.

Source: OECD, Economic Outlook database.

21. *Third*, the evaluation system for public R&D investment needs to be upgraded to improve budget allocation and its responsiveness to a diverse set of stakeholders. The current system is more centred on programme management rather than systemic performance evaluation (Suh, 2003). The evaluation of R&D programmes is entrusted to 12 management agencies, which also play a vital role in allocating R&D budgets. Recent initiatives to enact a law for performance-based evaluation are a step in the right direction.

22. *Fourth*, a key challenge is to make the innovation system more efficient and interactive by strengthening linkages among the institutions active in R&D, including foreign players. Although the government has already implemented programmes to raise the responsiveness of GRIs,[11] new approaches such as public/private partnerships may be beneficial (OECD, 2004m). To overcome the under-utilisation of human resources, the compensation scheme, including the ownership of intellectual property rights, needs to be reformed to reward research achievements. However, a more effective way may be to promote joint research and manpower exchanges across sectors (Ko *et al*., 2001), including technological co-operation between domestic and foreign firms. In the past, Korean firms have relied on "arm's length" methods to acquire foreign technologies. New modes of technology acquisition, such as foreign direct investment, joint research, cross-licensing and strategic alliances, need to be utilised more.

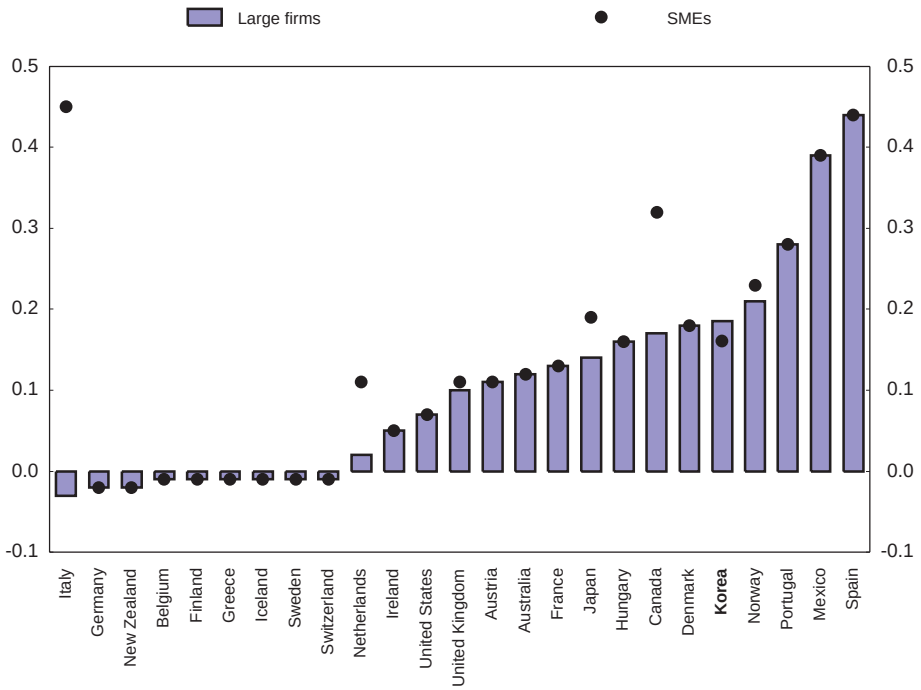
23. *Fifth*, it is at least as important to ask whether optimal use is being made of the existing stock of knowledge as it is to ask how that stock can be expanded. Effective use of existing technology depends on its diffusion. Increasing the R&D linkages between business, GRIs and universities is one strategy that is likely to encourage diffusion. In addition, the government recently introduced programmes to bring patent holders together with potential licensees and a public-private partnership was established to support SMEs in intellectual property matters (OECD, 2004g). At the same time, it is important to consider the role of intellectual property rights, regulatory features of product, capital and labour markets, and the availability of skilled human capital in diffusing technology. While policies in these areas usually aim at objectives other than innovation, they affect an economy's capacity to diffuse, as well as to create, new technologies. In the absence of an appropriate framework, policies to stimulate innovative activities in the private sector, which are discussed in the next section, are unlikely to be effective. The following sections look at the regulatory features of product, capital and labour markets and the development of skilled human capital.

Policies to encourage private-sector innovation

24. To encourage private-sector innovative activity, OECD countries use a variety of policies, including direct public funding and tax incentives for business R&D and support for entrepreneurship, notably SMEs and venture capital. Such intervention can be justified as necessary to offset market failures that reduce innovation expenditure below the socially desirable level. While fiscal incentives can be effective, their overall impact appears to be relatively small. Moreover, such policies can have high economic costs and entail substantial deadweight losses (Pain and Jaumotte, 2005). Compared to other OECD countries, tax incentives for R&D in Korea are generous (Figure 5) and cover every stage, *i.e.*, reserves, facility investment, R&D outlays and technology transfers. The strengthening of incentives helped to increase tax expenditures on R&D from 0.4 trillion won to 1.3 trillion won (0.2% of GDP) between 1999 and 2004. As noted in the programme to upgrade the national innovation system, the government intends to increase tax incentives for R&D.

11. These include: *i)* participation of the private sector in the NSTC and the boards of the research councils of GRIs; *ii)* preferential treatment of the private sector in funding national R&D programmes; and *iii)* reduction of block funding to the GRIs to encourage them to seek external funds from the private sector.

Figure 5. Tax treatment of R&D in OECD countries
Rate of tax subsidy for one unit of R&D in 2004(1)



1. For example, $1 of R&D spending in the United States resulted in 7 cents of tax relief.
Source: OECD, *Science, Technology and Industry Outlook* (2004) and Warda (2004).

25. Protecting intellectual property rights (IPRs) strengthens incentives for innovation. However, empirical research shows that the relationship between the IPR system, patenting and innovative activity is complex. The challenge is to design an IPR system that encourages the creation of knowledge by raising the returns to innovators on the one hand and at the same time promotes the diffusion of innovation. While the social cost of allowing exclusive use under patents can be high, in the absence of such protection inventors may prefer secrecy, which can be even more restrictive of the diffusion of knowledge. In Korea, empirical studies find a positive relationship between patent protection and technological innovation, product market competition and value added (Chung *et al*., 2004). Another study found that a 1% increase in intellectual property, as measured by the number of patent applications, raised output by 0.11% (Youn *et al*., 2003). For an enterprise, a 1% increase in patent registrations raises its own TFP by 0.03%, while a 1% increase in the sum of patent registrations by competing firms in the same industry is estimated to raise the average TFP by 0.12%. This implies that the social rate of return on patents is higher than the private rate in the absence of adequate IPR, reducing investment in patenting below the socially optimal level.

26. Empirical research shows that stronger IPR protection has a substantial positive effect on patenting (Pain and Jaumotte, 2005). The general tendency of IPR policy in most countries is to increase protection for intellectual property (Martinez and Guellec, 2004). Korea has also strengthened the legal framework for IPR protection, which should encourage patenting and thus boost growth. Its framework has been brought in line with global standards such as the WTO agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), although enforcement needs to be improved further to encourage

companies to invest in R&D and to file patents (see Box 3). 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 (IMD, 2004), and the World Economic Forum (WEF) ranked IPR protection at 23rd out of 104 countries (WEF, 2004).

Box 3 The evolution of intellectual property right protection in Korea

The level of IPR protection in Korea has risen in line with the country's economic development. Such a strategy facilitated Korea's catch-up approach to innovation by allowing it to benefit from reverse engineering and duplicative imitation at early stages of its development. As the country advanced toward the technology frontier, strengthening IPR protection was in the best interests of Korean firms. In addition, countries with stronger IPR protection tend to receive larger transfers of technology from multinational companies (Branstetter *et al.,* 2004).

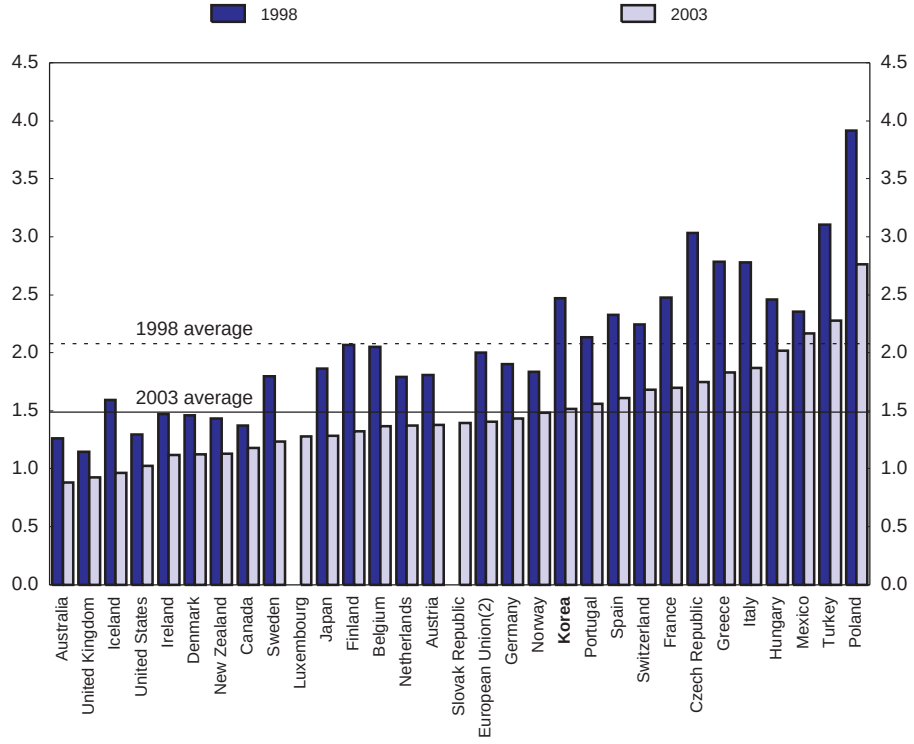
The first patent legislation was adopted in 1961 and amended to conform to the Paris Convention in 1981. However, the legislation did not cover food products, chemical substances and pharmaceuticals. Korea enacted the Computer Program Protection Act in 1986 in part to improve IPR protection for software. The patent, trademark and utility model laws were revised in 2001 to increase both fines and prison terms for violators of IPRs. This was followed by legislation in 2003 to strengthen enforcement, in part by giving police powers to the Standing Inspection Team of the Ministry of Information and Communication. In sum, the United States Trade Representative concluded in 2005 that "Korean patent law is fairly comprehensive, offering protection to most products and technologies" and that "Korea has taken significant steps to strengthen its intellectual property regime over the years". Remaining concerns focus on the effective enforcement of IPR for copyrighted materials.

The impact of the regulatory framework on innovation

Product market competition

27. Product market competition strengthens incentives to innovate, thereby promoting productivity growth. Empirical evidence suggests that product market regulation that inhibits competition reduces R&D spending, and is negatively correlated with TFP growth (Bassanini and Ernst, 2002). In addition, productivity is driven by "creative destruction" through new entry and exit 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 production 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 (Scarpetta *et al*., 2002). Although measuring the quality of regulation is not straightforward, the OECD product market regulation indicator ranked Korea among the middle of OECD countries in 2003, an improvement compared to 1998 (Figure 6). However, the detailed indicators show that barriers to entrepreneurship, trade and investment are relatively high, reflecting regulatory and administrative burdens and legal barriers (Conway *et al.*, 2005).

Figure 6. Product market regulation(1)



1. The scale of the indicator is from least to most restrictive of competition.
2. A simple average of the 15 countries then in the European Union.

Source: OECD, *Economic Policy Reforms* (2005).

Entry and exit barriers

28. Despite Korea's regulatory reform effort following the 1997 financial crisis (OECD, 2000), barriers to entry remain an important concern. A 2002 study found that 36% of all industries were subject to legal entry barriers, with the proportion higher in non-manufacturing (Jaehong Kim, 2002).[12] While the start-up time for a new business is not high compared to 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 3). Multiple contact points and administrative procedures should be replaced by one-stop shops. 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 (see the 2004 *Survey*).

12. The study also found that in addition to a higher number of barriers in the non-manufacturing sector, those barriers are stronger compared to the manufacturing sector. The scope of legal entry barriers in the study covered eight types of regulations, including state monopoly, licensing, approval and registration. However, the ratio of industries under legal entry barriers declined from 45% to 36% between 1992 and 2001.

29. Regulatory reform is thus a key aspect of reducing entry barriers. Korea launched a major regulatory reform effort in 1998 that reduced the total number of regulations by nearly half (see the 2000 *OECD Economic Survey of Korea*). The Prime Minister's Office, along with the Regulatory Reform Committee, recently launched several initiatives to review existing regulations (see Annex). Regulations that were justified by the existence of market failures or aimed at non-economic objectives should be reviewed. There are some restrictions that no longer have any economic justification other than the protection of incumbent firms, or result from the influence of special interest groups.

Table 3. Time and cost in starting or closing a business
2004

	Korea	OECD[1]
Starting a business		
Number of procedures	12	6
Time (days)	22	25
Cost (% of annual income per capita)	17.7	8.0
Minimum capital (% of annual income per capita)	332.0	44.1
Closing a business		
Time (years)	1.5	1.6
Cost (% of estate)	4.0	6.8
Recovery rate (cents on the dollar)	81.1	72.2

1. Includes 22 high-income OECD countries.
Source: World Bank (2005).

30. The exit mechanism in Korea appears to have improved, in part as the failure of so many large chaebol since 1997 suggests that no firm is "too big to fail". Moreover, the time and cost of closing a business are not high compared to other OECD countries (Table 3). However, the insolvency framework, which includes the Bankruptcy Act, the Company Reorganisation Act, the Composition Act and the 2001 Corporate Restructuring Promotion Act, is complex and fragmented. Moreover, the widespread use of workout programmes outside of the court system weakens the exit mechanism. A recent study comparing restructuring methods suggests that the performance of workout programmes falls short of that of legal procedures (Dongsoo Kang *et al*., 2004). An effective exit mechanism should allocate risk among market participants in a predictable and transparent manner, while maintaining economic value. A new unified insolvency law, which is to be implemented in 2006, consolidates the bankruptcy and company re-organisation laws and abolishes the composition procedure. Improving the exit mechanism is a priority as the large number of firms with an interest coverage ratio below one indicates that there is a significant amount of restructuring still to come.[13]

Improving framework conditions in the service sector

31. Services have accounted for a growing share of the Korean economy, rising from 47% to 56% between 1980 and 2004 in terms of value added. This reflects demand-side factors, such as a high income elasticity of demand for some services and population ageing. The share of employment in services is increasing even faster due to significantly lower productivity growth in services than in manufacturing.

13. In 2003, 27.5% of externally audited firms had operating profits that were insufficient to cover interest expenses. Moreover, 11.6% had an interest coverage ratio of less than one in both 2002 and 2003, while 5.9% had ratios of less than one for the period 2001-03 (see the 2005 *OECD Economic Survey of Korea*).

Indeed, the share of service-sector employment increased from 37% to 64% between 1980 and 2004, reflecting rapid structural change in Korea. However, the service sector remains relatively small in Korea compared to the OECD averages of more than 70% in terms of both value added and employment (Table 4). Consequently, the share of the service sector is expected to continue rising toward the OECD average. Persistent low productivity in the service sector in Korea would therefore impose a considerable drag on Korea's economic performance, in part by penalising the manufacturing sector, which incorporates a wide range of services in its production activities.

Table 4. Employment and productivity by sector[1]

	Korea	OECD
A. Employment and value added[2]		
Share of total employment, 2001 (%)		
Manufacturing (15-37)	19.7	16.0
Services (50-99)	62.3	71.1
Share of total value added, 2001 (%)		
Manufacturing (15-37)	30.3	17.3
Services (50-99)	53.9	72.0
B. Labour productivity in services[2]		
Value added per worker in 2001, manufacturing =100		
Services (50-99)	56.2	93.4
Wholesale & retail trade, hotels and restaurants (50-52, 55)	29.0	67.0
C. Unpaid workers as a share of employment, 2003 (%)[3]		
Total economy (01-99)	34.9	16.5
Services (50-99)	34.3	19.2
Wholesale & retail trade, hotels and restaurants (50-52, 55)	50.5	29.8

1. The numbers in parentheses show the ISIC (Rev.3) codes.
2. The OECD total is for 24 countries in which both employment and value added data are available. Value added is converted at PPP exchange rates to obtain the total.
3. The OECD total is based on 26 countries, using data for the latest year available.

Source: OECD STAN Database for Industrial Analysis (2005/01) and OECD Labour Force Database (2004).

32. Labour productivity in Korea's service sector is only 56% of that in manufacturing, considerably below the 93% level in the OECD area as a whole (Panel B).[14] In particular, health and social services in Korea have one of the poorest performances in terms of the growth of value added and labour productivity (Wölfl, 2005). Korea's health expenditures are less than 6% of GDP, the second lowest in the OECD, and the number of physicians and nurses per 1 000 population is also relatively low (OECD, 2004i). Employment in social services, including childcare, medical treatment and educational services, accounts for 14% of total employment, about half of the OECD average (Hwang and Jeong, 2005). Adjusted for Korea's income level, the share of the service sector in value added is 12 percentage points below its expected level (Kongsrud and Wanner, 2005).

33. Low productivity in the service sector is explained by a number of factors. *First*, industrial policies favouring exports and the manufacturing sector have had an adverse impact on services. *Second*, entry barriers are generally higher in the service sector, as noted above, weakening competition. *Third*, the market size of services is small and there is a lack of experience (KDI, 2003). *Fourth*, there is a large

14. The relatively small gap between manufacturing and services in the OECD area is due to high labour productivity levels in some service industries. In particular, labour productivity in finance, insurance, real estate and business services is about 80% higher than in manufacturing..

inflow of older workers, given the early age of retirement of employees from firms, generally at around age 50. Lacking other alternatives, three-quarters become self-employed, primarily in the service sector (see the 2005 *OECD Economic Survey of Korea*). Consequently, one-third of workers in services are either self-employed or family workers compared to an average of 19% in the OECD area (Panel C).[15] *Fifth*, small establishments are prevalent in services. In particular, mom-and-pop type stores dominate the distribution sector, given the large supply of low-skilled and displaced workers, low capital requirements and barriers to the entry of larger stores. The small size of retail outlets limits the scope for economies of scale, making it difficult to benefit fully from Korea's advanced ICT infrastructure. Indeed, diffusion of ICT, which has been a major contributor to growth in the OECD area, is closely linked with establishment size (OECD, 2004k). Despite its specialisation in manufacturing ICT products, Korea has considerable scope to reap the productivity gains from increased use of ICT equipment in other sectors, particularly services, and its spill-over effects (Box 4).

34. Korea's service sector needs restructuring to boost its productivity and to mitigate the polarisation in sectoral performance and the resulting widening in income inequality. A priority should be to promote a pro-competitive regulatory environment by lowering entry barriers.[16] Three areas stand out in this regard. *First*, although regulations on retail trade at the central government level have been almost phased out (except those related to zoning and environmental considerations), there remain obstacles at the local level to opening large-scale stores (OECD, 2004b). The elimination of such obstacles would promote the consolidation of small stores.[17] Empirical evidence points clearly to large productivity gains from the liberalisation of entry in retail trade over the past two to three decades (Nicoletti and Scarpetta, 2003), in part due to the expansion of large-format outlets using new technology (Kongsrud and Wanner, 2005). *Second*, in professional services, such as law and accounting, regulations on entry and business activity should be lowered further (OECD, 2004b). *Third*, in social services, several studies have documented positive effects from expanding user choice and competition on performance in healthcare, childcare and long-term care (Lundsgaard, 2002).[18] Finally, remaining policies that discriminate in favour of manufacturing should be abolished. For example, electricity tariffs for manufacturing firms should not be kept below other sectors. The fact that the government's list of future growth engines is concentrated in technologies associated with manufacturing may suggest a continuing focus on that sector.

15. The share of unpaid workers is especially high in the distribution, hotel and restaurant category (Table 4.4, Panel C), which accounts for 26% of total employment and 40% of service-sector employment. Labour productivity is low at only 29% of that in manufacturing.

16. Many of the recommendations in the special chapter in the 2004 *OECD Economic Survey of Korea* aimed at strengthening competition in services. These recommendations, as well as progress in their implementation, are shown in Annex 1.A1.

17. At the same time, extending active labour market policies, such as job-placement service and vocational training, to non-wage workers would help them adjust to structural changes in services (Keum *et al.*, 2003).

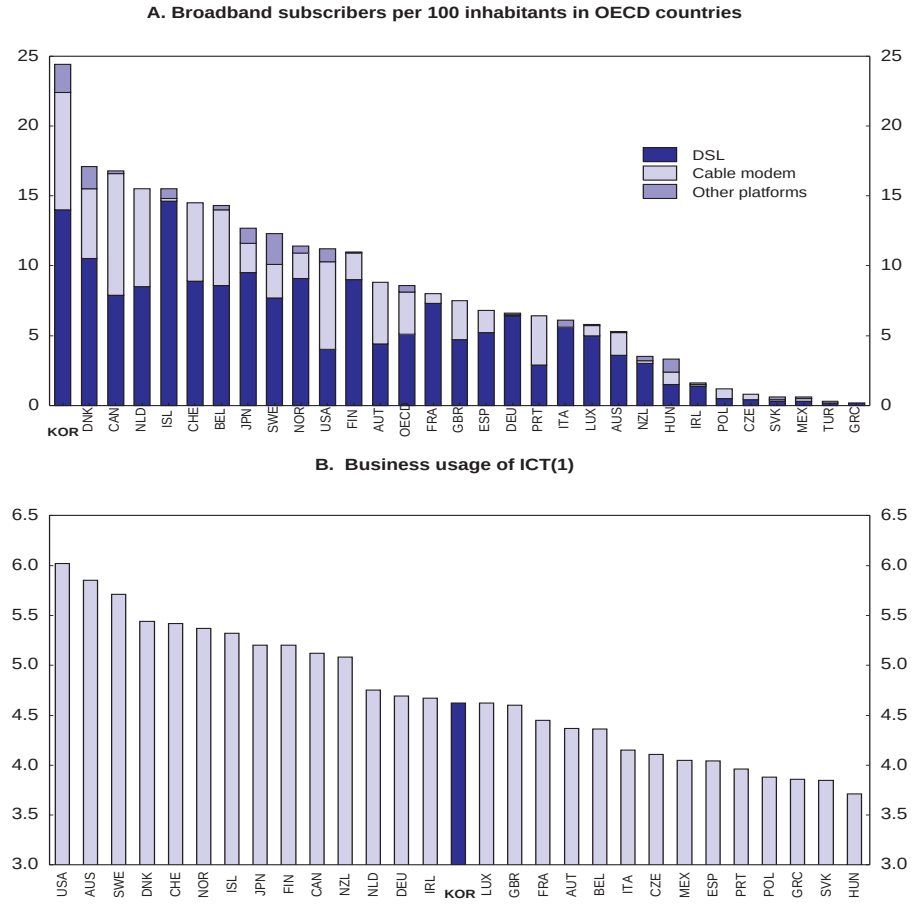
18. One measure to achieve this would be to introduce private health insurance. According to a 2001 task force report submitted to the government, tight regulation of medical spending aimed at promoting the financial stability of the National Health Insurance has hindered innovation and competition in the health sector.

Box 4 The ICT sector in Korea

ICT intensity, defined as the ratio of ICT production to GDP, was 7.9% in Korea in 2003, the third-highest in the OECD. Korea's strength in ICT is most prominent in manufacturing, where it ranks first according to the OECD's "revealed comparative advantage" measure. In 2004, Korean ICT exports reached $74 billion (30% of total exports) with a $34 billion trade surplus in this sector. The leading ICT products are semiconductors, mobile phones, LCD, and digital TV. Three Korean companies - Samsung Electronics, LG Electronics and Korea Telecom - were included among the world's top 50 ICT firms based on 2003 revenues. Close to 1 percentage point of Korea's aggregate labour productivity growth in the second half of the 1990s came from ICT manufacturing (Figure 1.7), the highest contribution in the OECD area (Pilat, 2003).

The economic impact of ICT is closely linked to the extent to which it is diffused throughout the economy, reflecting the fact that ICT is a network technology: the more people and firms that use the network, the more benefits it generates (OECD, 2004n). In 2004, Korea's broadband penetration rate was the highest in the OECD (Figure 7) while the price of Internet access was low. However, experience in OECD countries shows that the availability of ICT does not readily translate into its effective use in enterprises. In Korea, business-sector use of ICT ranks in the middle of OECD countries, despite the high availability of the Internet and the country's prowess in ICT manufacturing (Panel B). Business diffusion appears uneven despite rapid progress in some areas. Korean firms are not strong in integrating business processes, or in implementing intra-firm organisational changes and inter-firm collaboration along value chains. This is partly due to the large share of small establishments, which are not fully exploiting ICT because of a lack of awareness, personnel and specialist services.

Figure 7. Internet and its business use
June 2004



1. Chart indicates the score on the business usage sub-index of the World Economic Forum Networked Readiness index for 2003-04. Business usage is determined by factors such as the level of B2B and B2C e-commerce, the use of ICT for activities like marketing, and levels of on-line transactions.
Source: OECD, *Communications Outlook* (2005).

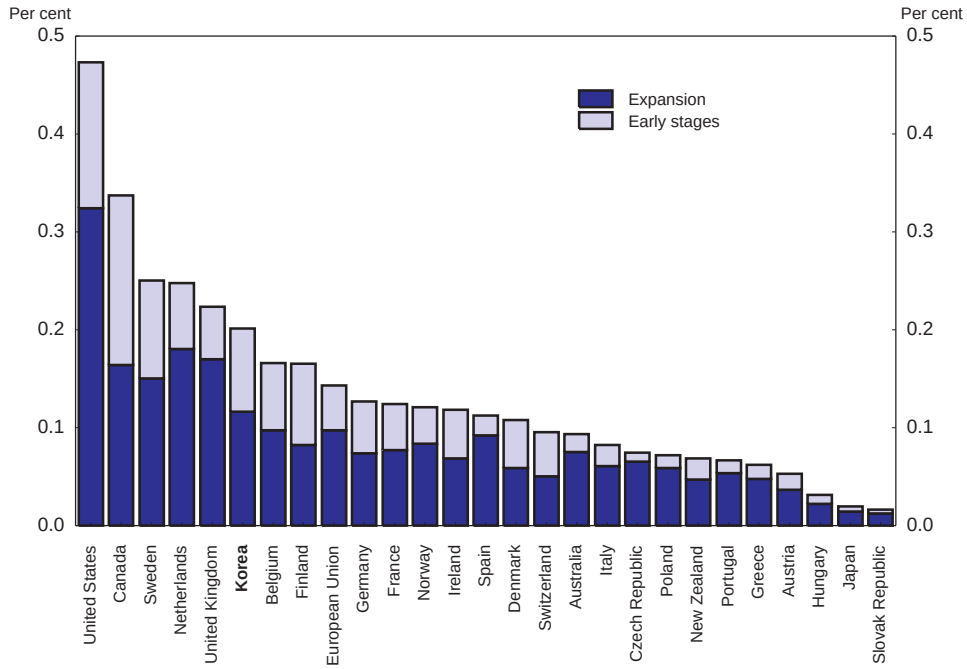
The market for risk capital and venture business[19]

35. The financing environment for SMEs has improved dramatically since the 1997 crisis. With chaebol-affiliated companies focused on de-leveraging and banks more aware of the risks of lending to this sector, there has been a large expansion of loans to smaller companies. However, bank lending to SMEs relies heavily on real estate collateral or credit guarantees provided by the public sector (see the 2005 *OECD Economic Survey of Korea*). Investment in innovation is, by its nature, particularly risky, as a large proportion of the assets - such as human capital and new ideas - are intangible, which also limits their use as collateral. Moreover, bank lending is a less appropriate method of financing for venture business than equity. The inherent risks, combined with the information asymmetry between innovating firms and providers of external finance, discourage conventional financing of start-ups based on innovation. Venture capitalists fill the financing void, in addition to typically providing management services for these companies. Hence, well functioning markets for risk and venture capital are indispensable for innovation-based start-ups, including the opportunity to list on the stock exchange. Listing not only provides a source of funding, but also an exit opportunity for venture capitalists, which encourages their entry.

36. Korea jump-started its venture capital market in 1998 through a direct infusion of equity capital from the public sector, generous tax incentives and equity guarantees. This was accompanied by the introduction of a certification system in 1997 that designated certain SMEs as "venture businesses". The government's role in developing the venture business sector is part of its strategy to accelerate business restructuring and shift the weight of the economy from chaebol to start-ups in knowledge-based industries. With venture capital investment amounting to 0.2% of GDP, Korea ranks sixth among OECD countries (Figure 8). Korea shows a relatively good performance in early-stage financing compared to other OECD countries. In Korea, 40% of this investment has been in ICT. The major sources of venture capital have been the government (31% in 2004), in contrast to other OECD countries where the public-sector role has been gradually phased out. Corporations, banks and insurance companies are other important sources of funds. However, the roles of pension funds, individuals (business angels) and cross-border transactions have been relatively minor. Government policies to launch a venture capital market contributed to a bubble in the second-tier stock market (see below), which was followed by a crash, and the market remained sluggish through 2004. Consequently, the total amount of venture capital investment declined by two-thirds, from 2.0 trillion won in 2000 to 0.6 trillion won during each year between 2002 and 2004.

19. This section draws on Baygan (2003) and OECD (2003b).

Figure 8. Venture capital investment by stages
Per cent of GDP, 1999-2002(1)



1. 1998-2001 for Australia, Japan, Korea and New Zealand. The definition of private equity/venture capital tends to vary by country.

Source: Baygan (2003).

37. Venture capital investment has been centred on firms certified by the government as venture businesses. Firms that qualify receive a number of benefits (beyond those available to all SMEs), such as a reduced minimum capital requirement, tax exemptions, loans for start-ups, credit guarantees, and relaxed listing requirements for the second-tier stock exchange, the Korean Securities Dealers Automated Quotation (KOSDAQ). Although the support system may have helped encourage entrepreneurship and innovation activities in some SMEs, a number of unqualified firms have attempted, and in some cases, succeeded in being certified, thus reducing the credibility of this sector as a whole. In 2002, the government tightened the certification criteria by introducing a technology and innovation assessment by independent institutions and abolishing some qualitative criteria. Consequently, the number of certified venture businesses declined by 30% to 8 000 in 2004. Currently, a SME can be certified as a venture business by the Small and Medium Business Administration if it meets one of three criteria: *i)* it received equity investment from venture capitalists amounting to more than 10% of its capital; *ii)* the amount (over 50 million won) and intensity of its R&D spending is high; and *iii)* it uses new technologies, such as those protected by patents. As of 2004, only 5% and 18% of venture businesses qualified under the first two criteria, while 77% were approved under the third.

38. The KOSDAQ market was established in 1996 to promote the access of SMEs to equity funding through easier entry requirements and less stringent operating obligations than the Korea Stock Exchange (KSE). In addition, a special listing standard for venture business was introduced within the KOSDAQ. Standard requirements for paid-in capital, level of assets, business performance and debt to equity ratios are not applied to venture businesses. The KOSDAQ market experienced a boom, followed by the technology market crash that led to a 90% fall in the stock price index, a much bigger drop than the

declines in the KSE and in other second-tier markets such as NASDAQ and the Swedish O-List. Although continued IPOs boosted the number of listed companies from 453 to 890 between 1999 and 2004, market capitalisation has fallen to 31 trillion won (4% of GDP), one-third of its 2000 peak of 99 trillion won.

39. The government introduced a number of programmes for venture businesses in 2004 to boost entrepreneurship and to overcome the weaknesses in the risk capital market:

- The Korea Technology Credit Guarantee Fund (KOTEC) has shifted the target of its credit guarantees towards start-ups and technology companies.
- Corporate credit bureaus have been established and the disclosure system for venture businesses was tightened.
- A private equity fund (PEF) law was introduced in December 2004. As of April 2005, five funds (with a total of 0.8 trillion won) had been established.
- Venture capital firms were allowed to acquire more than 51% of shares in their invested firms, allowing them to fully realise the upside potential.
- Reforms in the KOSDAQ and the "over-the-counter" market were introduced to induce viable start-ups and to restore trust among investors.

In contrast to the policies in the late 1990s that contributed to the bubble in the venture business area, this package should help improve the framework for this sector. Some of these measures, such as the establishment of credit bureaus, will strengthen market orientation. However, there is a risk of mismatches in the demand and supply for venture capital if the entrepreneurial sector provides insufficient investment opportunities, resulting in an excess of venture funds chasing too few start-ups. Private equity would then be concentrated on later-stage investments and traditional industrial sectors, with far less impact on potential growth. Thus, a key priority is to create an environment that encourages the supply of investment-ready SMEs. In addition, it is important to boost the private sector's role in venture funding. Government programmes should focus on leveraging and diversifying private sources of venture capital and moving small firms away from dependence on public debt guarantees and public funding.

40. However, overcoming weak funding from private sources may require additional reforms. *First*, more liberal policies for institutional investors, combined with improved standards for transparency and disclosure, are desirable. The introduction of a retirement pension system in the corporate sector in 2005 may have a positive impact on the development of the venture capital market, although there is considerable distrust in Korea of pension funds that pursue "high risk, high return" strategies. However, their investment portfolios should be closely supervised to protect the interests of beneficiaries. *Second*, rebuilding the confidence of stock market investors, who were hurt by the technology market crash, should be given priority. Strengthened screening procedures, disclosure requirements and delisting conditions would be beneficial. Class action suits, which will be allowed in 2007 for small listed firms with less than 2 trillion won in assets, should also enhance transparency. *Third*, the venture business certification system should be allowed to expire in 2005 as scheduled to create a more market-oriented business environment.

Labour market institutions

41. Labour market institutions and regulations can have a significant impact on the structure of innovation and the adoption of new technologies, which require adjustments in firms' workforces to change skill compositions or work practices in order to be fully effective. Empirical evidence in the OECD area suggests a negative correlation between the strictness of employment protection legislation and the

share of investment spending devoted to ICT (Pain and Jaumotte, 2005). Although protection for regular workers is relatively high, Korea's overall protection level is in the middle of OECD countries, reflecting the easing of controls on the use of non-regular workers (OECD, 2004h). The increase in the share of non-regular workers to 30% in 2004, one of the highest levels in the OECD, facilitates labour-market adjustment and thereby the use of new technology. However, it creates equity concerns (see the 2005 *OECD Economic Survey of Korea*) and may limit incentives for in-house training of employees by boosting turnover and shortening tenure.

42. In general, though, there is little evidence that employment rigidity in Korea has seriously hindered innovation activities thus far. This may be due to the fact that Korean firms are engaged primarily in "cumulative innovation", which relies more on firm-specific work competencies. However, a study found that it is difficult to combine "numerical" and "functional" flexibility in Korea (Dongbae Kim *et al.*, 2004). Workplaces that achieve numerical flexibility by decreasing the number of regular workers have low functional flexibility, which promotes skill accumulation and flexible organisation, thus limiting the scope for job rotation. Indeed, the resulting lack of development of an "internal" labour market may hinder firms from fully exploiting their knowledge base (see the discussion below on vocational training).

Securing the supply of highly qualified human capital

43. The supply of well qualified labour is a key ingredient in the generation and diffusion of innovation.[20] Increased human capital not only raises labour productivity, but also serves as a driver of technological progress through a significantly positive effect on business-sector R&D. The OECD *Growth Study* estimated that the long-run effect on GDP per capita of one additional year of education ranges from 4% to 7% (OECD, 2003g). Korea has a remarkable record in expanding student enrolments 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 tertiary education (Figure 9). Moreover, rising educational enrolment has been accompanied by exceptionally good student achievement on international standardised tests. In the OECD's PISA study, Korean fifteen-year-olds have some of the highest scores in mathematics, reading, science and problem solving, placing them second overall (OECD, 2004e).

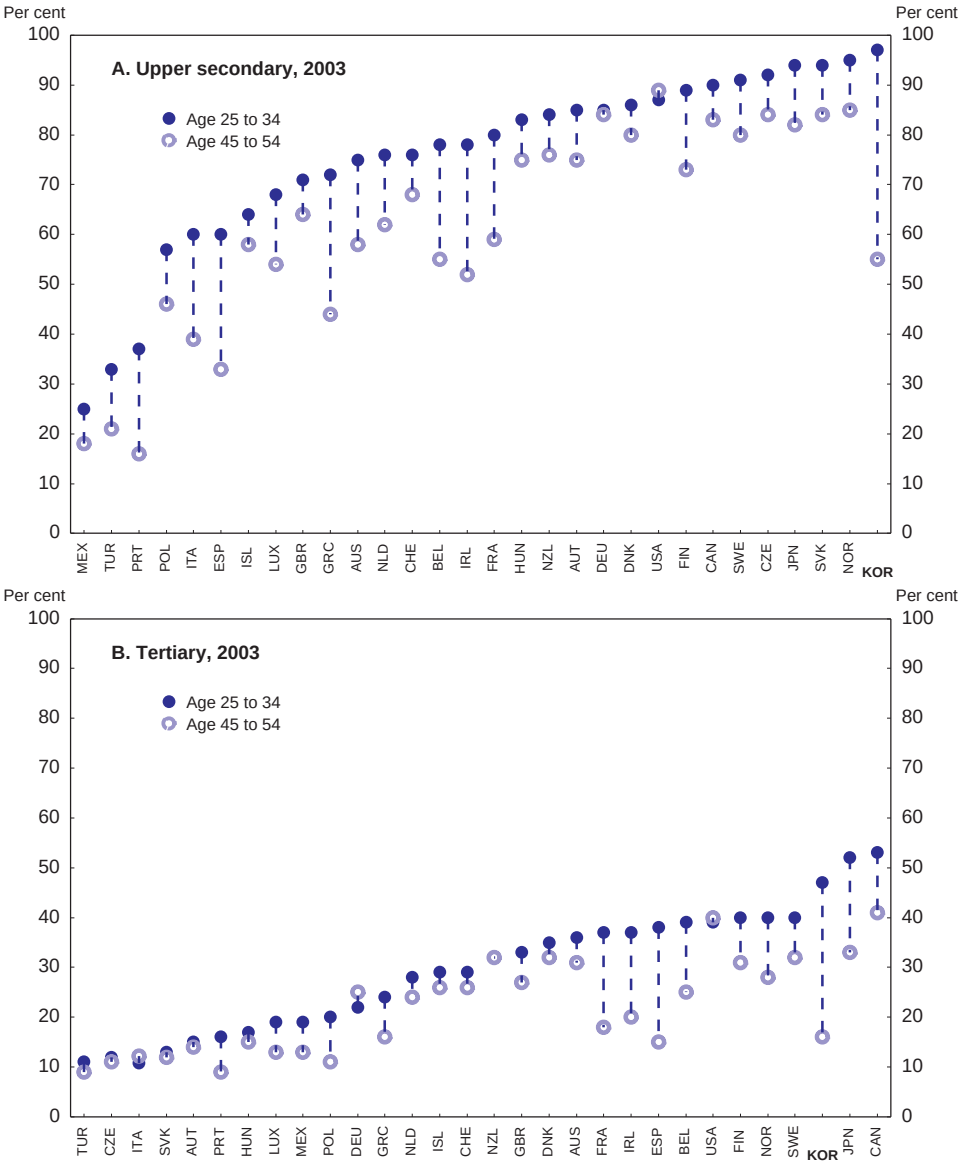
44. However, there is widespread public discontent in Korea regarding the education system. The same PISA study shows a low level of satisfaction towards schools and a high level of "out-of-school" activities.[21] Moreover, companies complain about the low quality of education. Based on an opinion survey of executives, the IMD ranked the usefulness of Korea's university education at 59th out of 60 economies, and the difficulty of finding qualified engineers in the domestic market at 52nd. The overall competitiveness of Korea's education system was placed 44th (IMD, 2004). The WEF ranked the quality of Korea's education system 60th out of 104 countries (WEF, 2004). Although the national zeal for education enhances Korea's growth potential, there is concern that the education system may be incapable of enhancing the country's competitiveness in a global economy driven by knowledge. This section discusses the high level of private education expenditure, problems in tertiary education, declining interest in science and engineering and the limited opportunities for lifelong learning and vocational training.

20. For more information concerning highly-skilled workers in S&T in Korea, see Sim (2005).

21. See indices showing attitudes toward school, students' sense of belonging at school, principals' perceptions of the morale and commitment of teachers, and student learning time (OECD, 2004e).

Figure 9. Educational attainments of the population

Percentage of age group



Source: OECD, *Education at a Glance* (2005).

The high level of private expenditure on education

45. Korea spent 7.1% of GDP for educational institutions at all levels in 2002, the third-highest among OECD countries (Figure 10). While public-sector expenditures, at 4.2% of GDP, was below the OECD average of 4.9%, private outlays were the highest in the OECD area at 2.9%. This does not include spending for students' out-of-school activities, especially private tutoring provided at institutes (*hakwon*). A Korean Educational Development Institute (KEDI) survey of parents reported that 73% of primary and secondary students received private tutoring after school hours, with total expenditure estimated at 13.6 trillion won, 2.3% of GDP (Choi *et al*., 2003). Meanwhile, according to the government's Social

Indicators Survey, which is based on household expenditures, spending on private tutoring exceeds private expenditure on educational institutions by 30%, implying a larger amount than that of the KEDI survey (NSO, 2004). In any case, private tutoring expenditures appear to have risen significantly over the past few decades.[22]

46. The high and rising reliance on private tutoring in the primary and secondary levels has been regarded by Koreans as a social disease that imposes a number of costs (KEDI, 2003).[23] *First*, it competes and overlaps with public education, thus raising total expenditures on education unnecessarily. *Second*, the high burden of private tutoring hinders equal access to educational opportunities, raising equity issues. *Third*, it makes it difficult for the public education system to cope with students of widely differing educational levels. *Fourth*, the highly competitive nature of the education system risks hampering the full development of children (United Nations, 2003). 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 (OECD, 2004e). The government has repeatedly tried to reduce private tutoring by abolishing entrance exams for secondary education,[24] expanding investment on public education, and even banning private tutoring. However, those actions have not been successful, as the share of students who receive tutoring and its total cost continue to increase.

47. 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. A recent study found a significantly positive relationship with schooling dissatisfaction,[25] as well as some effect from income, area of residence and mother's education level. However, the secondary school "equalisation policy" and the quantitative nature of the selection process for university entrance had no significant effect on the level of tutoring (Hyunjin Kim, 2004). Another study found 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 (Taejong Kim, 2004). Since the restrictions on private tutoring were ruled unconstitutional by the Constitutional Court in 2000, the government has launched a total of 33 action plans aimed at reducing the amount of private tutoring by half, from 14 trillion won to 7 trillion won. Many of the plans focus on increasing the quality of public education. In the 2004 five-year fiscal plan, spending on elementary and secondary education is to increase by 36% (MPB, 2004). The plan assumes that nominal GDP rises about 8% a year - or 36% by 2008 - keeping such outlays at around the 3¼ per cent of GDP recorded in 2002. Other aspects include providing more diverse after-school activities and changing the heavy cultural emphasis on educational credentials.

22. For example, private tutoring in 1990 was estimated at 1.2% and 1.4% of GDP by two separate studies (Taejong Kim, 2004 and Choi *et al*., 2003).

23. There are two kinds of private tutoring. One (PT1) is for improving talents such as drawing, music, and developing skills in the "3Rs" (reading, writing, arithmetic). The second (PT2) is aimed at raising academic achievement in such subjects as Korean, English and Math. Expenditure on PT2 does not so much compensate for poor school quality, but is geared largely towards the university entrance exam. According to the KEDI survey, 83% of those with private tutoring received PT2 (Choi *et al*., 2003).

24. The "equalisation policy", which replaced competitive entrance exams by a system of random allocation, was introduced for lower secondary schools in 1969 and for upper secondary schools in 1974. However, adoption of the policy for the upper secondary level depends on the decision of the provincial educational governments. In 2004, the policy was applied to 57% of general high schools and 72% of students. Most of the areas where this policy is not applied are located in rural regions.

25. The criteria for determining satisfaction included the effectiveness of teaching and the availability of individualised teaching.

48. However, achieving the objective of reducing private tutoring outlays will be difficult given the high priority attached to education, especially at elite universities, by the public. Indeed, the rigid hierarchy of universities has a powerful influence in determining career success and social status. According to a survey, 61% answered that "academic cliques" are the most important factor determining success in life for individuals of similar ability, followed by the level of educational achievement and regional background at 16% and 9%, respectively (Jung and Lee, 2003). The importance attached to gaining admission to elite universities dictates not only the secondary school curricula and the university admission system, but also increases the burden of private tutoring on families seeking additional learning opportunities.

49. The value of education at an elite university puts pressure on students to get high scores on the university entrance exam, the Academic Ability Test. Such an approach encourages homogeneity rather than preparing students for a world in which creativity to develop new ideas is essential. Reform of the university entrance system is thus a key to improving education. The system was changed in 1998 to allow universities to develop their own criteria and select students based on broader criteria than just test scores. However, a recent survey shows that the implementation of the new system has been slow and limited due to a lack of consensus on how to evaluate student performance and a lack of resources to guide students (Yang, 2004). Under an October 2004 plan, admission will be based more on overall performance in secondary school and less on the entrance exam. Successfully implementing this reform, which is planned for 2008, would help shift the educational system away from learning by rote and toward more creativity.

50. In addition, structural reforms in secondary education are needed. Decentralisation to bring decision-making power and accountability closer to those who teach and manage schools would enhance quality and responsiveness (see the 2005 *OECD Economic Survey of Korea*). In fact, there has been some progress in this regard. Between 1998 and 2003, the share of decisions taken at the school level rose from 25% to 48%, while that of the central government declined from 37% to 9% (OECD, 2004c), Many decisions - budgets, student assessments, textbooks and courses - are now under the responsibility of each school (OECD, 2004e), although teacher-related issues are not. However, behavioural factors and the vertical relationship between schools and supervisors hinder the extent of autonomous decision-making at the school level (Sung-Yeol Kim, 2002). In addition, the scope to create independent private schools[26] and curricula should be expanded to increase flexibility in education and enlarge the choices of students and schools.

Tertiary education should be reformed

51. The labour market has shown a "skill mismatch" in which workers at both low and high skill levels are in short supply, while the middle level is oversupplied.[27] Consequently, SMEs in labour-intensive industries face chronic problems in finding an adequate number of employees, a factor contributing to their shift to lower-wage countries. On the other hand, companies complain about the low quality of domestic tertiary education and the skill level of graduates, which leads some to prefer hiring more experienced workers. According to a 2004 survey by the Federation of Korean Industries, 78% of companies replied that tertiary education has serious problems in supplying skilled workers, and it takes

26. In Korea, private schools at the secondary level follow the same programme as public schools and receive public funding (Lundsgaard, 2002). The pilot programme begun in 2000 to allow independent private schools has resulted in the creation of six such schools.

27. Around 23% of workers think that they are overqualified, and the shares are especially high for those with a post-secondary non-tertiary level education and the graduates of vocational junior colleges (Nam *et al*., 2004). Between 1990 and 2003, the wage gap between graduates of upper secondary schools and vocational junior colleges narrowed from 17% to only 2%.

between 23 and 30 months to train new employees.[28] The degree of mismatch and concerns about the quality of education is reflected in the high unemployment rate of 9.6% for youth in the 15 to 24 age group in 2003. It was thus 2.7 times higher than the overall unemployment rate, compared to an OECD average of 1.9 times. In addition, half of workers are employed in a different field than the one they studied in school. The problems in matching the supply and demand for workers, especially for the highly qualified, will be exacerbated by structural changes, notably the growing role of high-technology sectors. The government hopes that increased co-operation between education and business will better match education with labour market needs. However, a more fundamental structural reform that emphasises market demand and competition is required, combined with the reforms at the secondary level discussed above.

52. International flows of students also illustrate the quality deficiencies of Korean tertiary education. Korea accounts for almost 5% of foreign student flows to the OECD area, making it the second-largest source after China. However, its role as a destination is among the lowest in the OECD (OECD, 2004d): only 0.1% of all tertiary level students in Korea are from abroad, with about half from China. The limited number of foreign students is partly due to the fact that most university programmes are not offered in English or other foreign languages. Moreover, some foreign universities are stingy in accrediting diplomas and qualifications acquired in Korea, and even the country's best universities have difficulty in gaining wide recognition in the international educational community.[29]

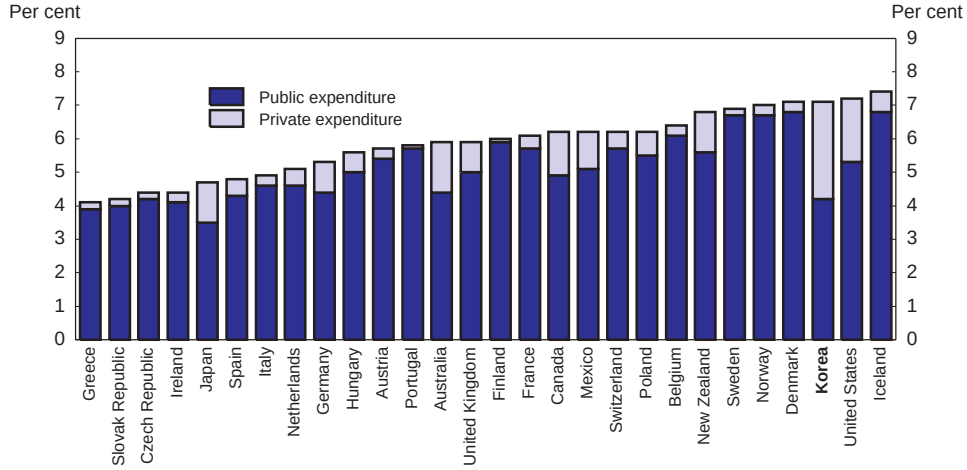
53. The *first* priority that should guide reform at the tertiary level is to upgrade quality by expanding financial resources. Although total expenditure on education in Korea is high (Figure 10), spending per student at the tertiary level was less than half of the OECD average in 2002 (Figure 11). This reflects the low level of public funding; government expenditures on tertiary education amounted to less than $ 1 000 (at PPP exchange rates), compared to an OECD average of around $8 000 (Panel B), reflecting the longstanding emphasis on primary and secondary education. Moreover, the important role of private universities, which account for more than 80% of tertiary educational institutions and students, keeps public spending low. The rapid expansion of tertiary education, reflected in the rise in the advancement rate from secondary to tertiary education from 33% of the age cohort in 1990 to 81% 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.[30] Korea thus needs a better balance between quantitative expansion and quality promotion in tertiary education. However, reform requires consideration of a number of complex issues: *i)* the already high level of overall educational spending, including private tutoring; *ii)* the balance between public and private financing; *iii)* the allocation of funds between different levels of education; *iv)* efficiency in the allocation and use of funds; and *v)* linking public funding to performance and restructuring (Woo *et al*., 2002 and Lee and Ban, 2004).

28. Another survey of 600 companies and 200 universities targeted at the science and engineering area showed similar concerns about the quality of education (Jung and Choi, 2002). However, students have a somewhat different perspective: another survey reported that 60% believe that tertiary education promotes the development of core competencies (Kim *et al.*, 2002).

29. For example, no Korean universities were included among the world's top 50 universities according to a ranking by the Times in 2004.

30. Moreover, the ratio of non-full-time faculty (such as part-time lecturers and adjunct professors) to full-time faculty rose from 0.9 to 1.6 between 1990 and 2004 in universities, and from 1.0 to 2.7 in vocational junior colleges (MOEHRD and KEDI, 2004).

Figure 10. Expenditure on educational institutions
Per cent of GDP in 2002

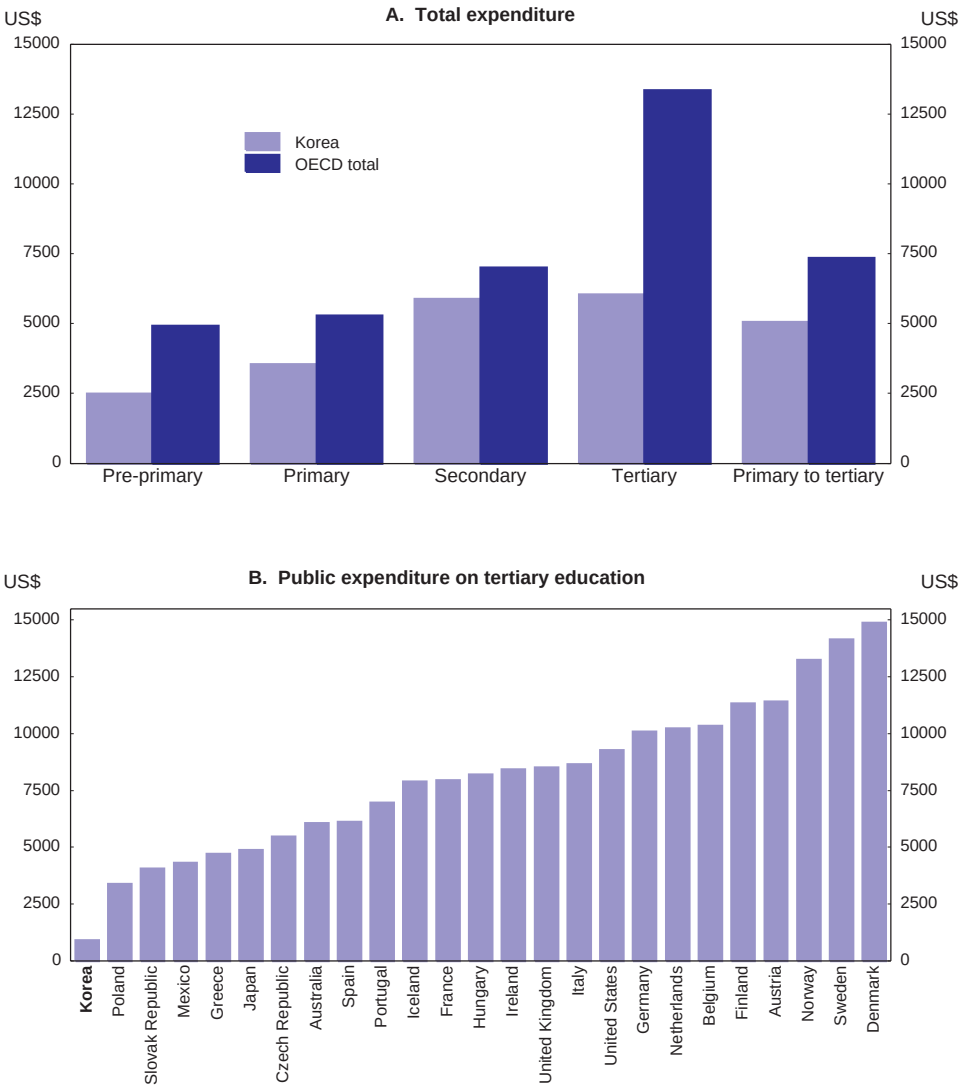


Source: OECD, *Education at a Glance* (2005).

54. Achieving the best financing mix between public and private sources is complicated by the dominant role of private universities. User charges, at 84% of total tertiary education costs, are the highest in the OECD. The heavy reliance on user charges creates equity concerns about the access of low-income households to higher education (OECD, 2003b). Moreover, the level of public subsidies, *i.e.*, scholarships, grants, student loans, transfers and payments, to support tuition payments is significantly lower in Korea than in other OECD countries, while the access of low-income households to the financial market is limited. This problem could be addressed through increasing scholarships and loans that are subsidised or income-contingent policies, an approach widely used in other OECD countries (Blöndal *et al.*, 2002). The creation in 2005 of the Credit Guarantee Trust on Student Loans, in which the government will guarantee student loans, will benefit a wide range of students, particularly those from low-income families.

55. Another challenge is to balance public expenditures between different levels of education. Public spending on the tertiary level was 0.3% of GDP in 2002, much lower than the 3.3% spent on primary and secondary schools. In contrast, outlays in the OECD area are divided more evenly at 1.0% and 3.5%, respectively (OECD, 2005a). Public expenditure on the tertiary level in Korea is to increase by 39% in nominal terms between 2004 and 2008, compared to 36% for primary and secondary schools (MPB, 2004). Flexibility in allocating expenditures is limited by a law requiring the government to spend 19.4% of revenue from national taxes (excluding earmarked taxes and duties), plus all of the revenue from the education tax, for primary and secondary education. While this scheme has helped expand basic education, it limits the scope for funding tertiary education. One source of potential saving is capital expenditure, which amounted to 21% of education spending in 2001, more than double the OECD mean. Its share is likely to decrease in Korea, given the declining number of students.

Figure 11. Expenditure on educational institutions per student in 2002
US dollars using PPP's, based on full-time equivalents



Source: OECD, *Education at a Glance*, 2005.

56. *Second*, restructuring and consolidation of universities is required. The expected decline in the youth population provides a good opportunity to achieve cost savings that can be used to boost the quality of tertiary education. Due to the declining fertility rate, over-capacity in tertiary education is already apparent among provincial universities, and the gap will widen over the next decade. It is estimated that by 2012, the population of the age groups between 5-14 and 20-29 will be 78% and 81%, respectively, of their 2002 levels (OECD, 2004c). The government announced a plan in 2004 to encourage the restructuring of the tertiary education sector through M&As, mergers and the exit of non-viable universities with the goal of enhancing the competitiveness of this sector. By mid-2005, eight of the 50 national universities had reached agreements on terms of consolidation, in addition to the merger of two national universities in 2004.

57. *Third*, greater deregulation is needed to help the universities respond better to signals from their stakeholders and to stimulate competition among them. While the abolition of remaining regulations on public university tuition in 2003 was an important step, more changes are needed. The major task is to re-design the role of the central government, notably the Ministry of Education and Human Resource Development. Its new role should consist of making macro-level strategic decisions, securing resources, ensuring overall co-ordination and evaluation, setting standards and providing support services. At the regional level, the co-ordinating role of the local governments among industry and universities needs to be encouraged. This has been neglected due in part to the separation of local government between general and educational functions. Recently, there have been some improvements, such as the role of general local governments in selecting proposals under the "New University for Regional Innovation" (NURI) project.

58. *Fourth*, the lack of competition should be overcome. The rigid hierarchy of universities in Seoul and the information asymmetry between education service providers and consumers discourages competition between universities, which is needed to improve their performance as well as to guide the restructuring process. At the same time, the lack of a fair evaluation system for professors hinders healthy competition among the teaching staff, while competition among students at the tertiary level is weak in contrast to the primary and secondary schools. In both colleges and universities, there are very few challenging programmes for gifted students, and widespread "paternalism" hinders universities from using strong incentives, such as flunking out students, to encourage good performance. It is important to provide more information about universities' performance to promote competition. The decision to disclose the success of the graduates of each university in finding jobs - a reform that faced strong resistance from low-ranked universities - is significant and should be expanded to cover more information. It is also important to develop a transparent mechanism to assess the quality of teaching. An independent national body with clearly defined criteria and standards should be established to undertake these tasks.

59. Opening the tertiary education market to accredited foreign providers would be an effective way to stimulate competition and upgrade the competitiveness of Korean universities.[31] At present, no foreign tertiary-level institutions with a majority share of investment are operating in Korea. Some conditions to ensure the quality of education and to protect consumers, such as standards for setting up campuses (buildings and property), act as entry barriers. In addition, the non-profit juridical person requirement for schools discourages the entry of foreign educational institutions by prohibiting them from remitting profits. Recently, the government enacted a bill that relaxed the establishment standards on foreign institutions in the three "Free Economic Zones" (Incheon, Busan and Gwangyang) and Jeju "Free International City". An increased foreign presence is desirable. Consideration should also be given as to how to ensure the quality of foreign providers and the impact of foreign suppliers on the post-secondary system as a whole (OECD, 2004d).

60. *Fifth*, more diversification is needed. Except for some institutions such as KAIST and POSTECH, Korean universities operate in a "department store" style, offering a broad range of disciplines rather than concentrating in areas in which they have a competitive advantage. Provincial universities tend to follow the trends set by the top-ranked institutions, which are concentrated around Seoul, regardless of their ability to afford them. This results in homogeneity among universities, thereby reducing their relevance and flexibility to respond to local development needs. Instead, each institution should develop its

31. The issue of trade liberalisation in educational services has been included in the current negotiations under the General Agreement on Trade in Services in the WTO. While still limited in scale, institutional mobility has become an increasingly important feature of cross-border education, with British and Australian educational institutions as the main suppliers, while those from the United States, France and Canada are active as well (OECD, 2004d). Currently, the OECD and UNESCO are drafting non-binding guidelines on quality for the provision of cross-border higher education. The guidelines can be found on the OECD's website at *http://www.oecd.org/dataoecd/34/42/34732302.pdf*.

own programmes in light of its institutional strengths and local needs. This would result in a system in which universities specialised in certain areas, while maintaining a few institutions that cover all disciplines. Diversification has already started with the government's "Brain Korea 21" (BK 21) and "New University for Regional Innovation" (NURI) projects, which use public investment to establish a few centres of excellence in tertiary education.[32] However, a lack of institutional capacity in many universities and the absence of competition among them make diversifying the educational system difficult. Rather than having the government designate centres of excellence, universities should compete for research funding in order to develop their own competencies.

61. *Sixth*, industry-university relationships should be further strengthened. A law promoting industry-university partnership for the commercialisation of research results was revised in 2003, and special entities for this purpose were established within the universities in 2004.[33] Greater priority should be given to developing more extensive and varied forms of industry-university co-operation. For example, input from the business sector should be used to improve forecasts of labour demand and to revise the curricula to include subjects and technologies important to firms. In addition, labour mobility between industry and universities for faculty and compulsory traineeships for students in firms should be encouraged. However, the most important challenge is to overcome the inertia of universities, which tend to remain aloof from the business world, focusing on academic content rather than on its application.

62. In sum, global experience and research on education reform demonstrate that consensus building, clear goals, strong leadership, the ability to make adjustments during the process, measurable indicators and the availability of a support infrastructure are critical to success. The required changes need the support and participation of all stakeholders, including the government, parents, teachers, unions and the business sector. This is especially important in Korea, given the importance attached to education and the widespread distrust of reform initiatives, reflecting the unsatisfactory outcomes of past efforts.

Concerns about labour shortages in science and technology

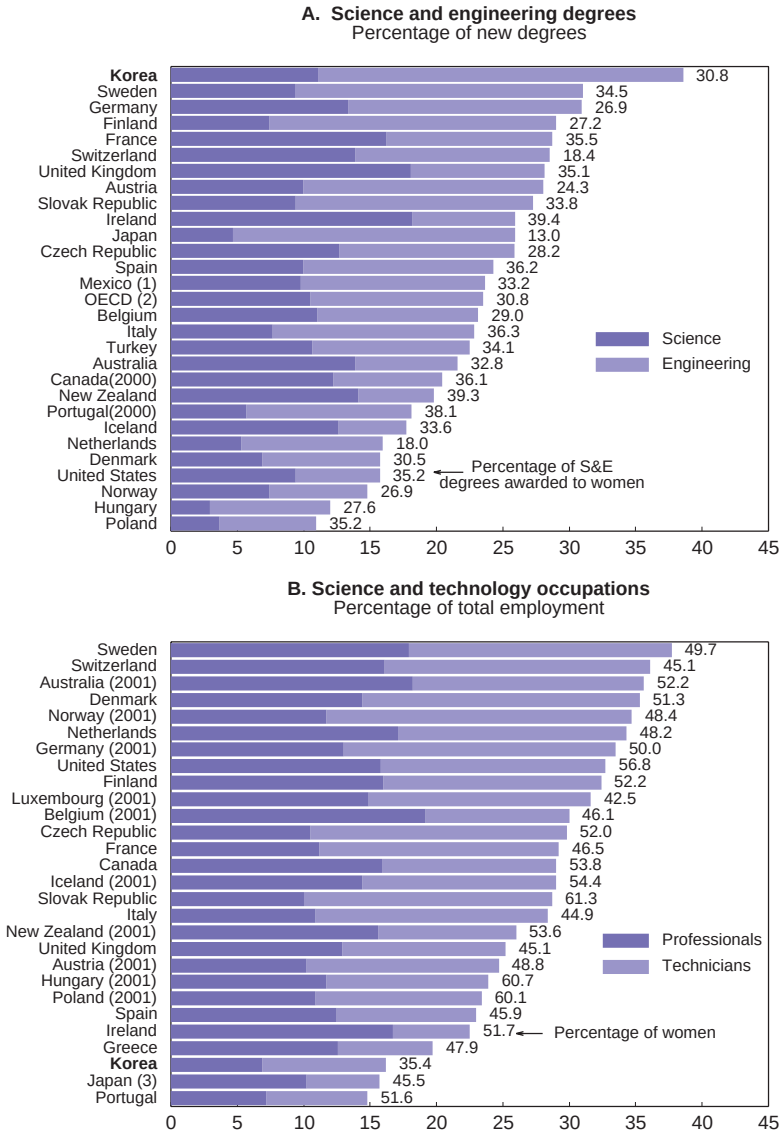
63. Korea worries that the future supply of science and engineering graduates will be inadequate (OECD, 2003d), despite the fact that it has a remarkably high share of students in these areas. Indeed, these subjects account for 40% of new university degrees, the highest proportion in the OECD (Figure 12, Panel A). The concerns are less focused on a potential quantitative shortage than on qualitative issues. *First*, the quality of students in science and engineering, as shown in their scores on the Academic Ability Test, has been declining. This may reflect labour market signals favouring such majors as social science, business, law, education and medicine (Jang, 2002). Although the cause of the wage differential is not entirely clear, an international comparison shows that regulations on some professional services are relatively restrictive in Korea, in contrast to strong competition in engineering (Nguyen-Hong, 2000). *Second*, there are complaints from the business sector about the quality of science and engineering graduates and their low employability in science and technology (HRST) occupations (Panel B). The government recently initiated measures to induce gifted students to study science and engineering by offering incentives such as expanded scholarships and an increased quota of science and engineering career tracks in the civil service. However, a more effective approach would be to strengthen competition in professional services through deregulation and a lowering of entry barriers. In addition, faced with

32. The BK 21 project, which mainly targets graduate schools, invested about 1.4 trillion won during the period 1999 to 2005, and the government plans to introduce a post-BK 21 project for the next period 2006-12. Meanwhile, the NURI project, which started in 2004, plans to invest 1.4 trillion won in local universities over the period 2004-08.

33. Over 70% of universities have filed a patent in ICT or electronics (OECD, 2003h). The law allows universities and firms to decide how to share the gains from the commercialisation of research results.

international competition in securing highly qualified human capital in the global market, domestic policies regarding immigration and education for foreign students need to be more accommodative.

Figure 12. Human resources in science and engineering in 2002



1. Excludes tertiary-type A second degree programmes.
2. Average of shares for countries available. Excludes Canada, Portugal and Luxembourg.
3. National estimates.

Source: OECD Education Database and OECD, *Science, Technology and Industry Scoreboard*, 2005.

Lifelong learning and vocational training

64. Lifelong learning in Korea tends to be considered a matter of individual choice. The central government budget for lifelong learning is 0.8 trillion won (0.1% of GDP) and is managed by diverse ministries carrying out fragmented activities in a sporadic manner (KEDI, 2004). Three-quarters of this amount is devoted to vocational training and job placement programmes. While the overall participation rate in lifelong education is low at around 20%, it rises with the level of education, as in most OECD countries. Indeed, the participation rates in Korea were 5% for those with a primary-school education, 9% for lower secondary, 19% for upper secondary and 43% for tertiary (NSO, 2004). This pattern raises the risk of social polarisation (OECD, 2002c and World Bank, 2003). The limited scale of lifelong learning may reflect weak incentives facing workers, given that wages are heavily determined by seniority. However, changing demand for skills in the labour force in the context of the shift to a knowledge-based economy suggest a rationale for a public role in lifelong learning. This is particularly true in Korea, given its rapid pace of structural change and population ageing. 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 co-ordination within government and between social partners is required (OECD, 2003a).[34]

65. Although there is a growing emphasis in the OECD area on upgrading workers' skills, as reflected in the *OECD Jobs Strategy* (OECD, 2004h), spending on training in the Korean business sector fell from 2.1% of total labour costs in 1996 to 1.5% in 2003. It is thus lower than the 2.3% average in the EU countries in 1999 (Eurostat, 2002). In Korean SMEs, training outlays were only 0.5% of total labour costs, well below the level in large firms. In addition, assistance for vocational training is regarded to some extent as a fringe benefit for workers. As firms have become more sensitive to pressures to achieve profitability, they prefer to "buy" rather than "make" workers. There is thus a risk of underinvestment in human capital, which in turn hinders the development of internal labour markets. This may reflect the generally weak priority attached to career development on the part of both employers and employees, combined with a lack of compensation for additional training (Soon-Hie Kang *et al*., 2001).

66. Many countries have introduced strategies, such as training levies and spending requirements on employers, tax incentives, loan guarantees and training vouchers, to promote vocational training (OECD, 2003e). However, the key to upgrading workers' skills appears to be a shared vision about vocational training between employers and workers. Co-operative efforts to develop and fund vocational training schemes would be enhanced by more harmonious relations among social partners and more structured involvement of employee representatives (Ok and Tergeist, 2003). Vocational consortia and collective training should also be encouraged, especially for smaller companies, as shown in the cases of Samsung Heavy Industries and Volvo, which pooled resources to create joint training centres for partners, including suppliers, distributors and subcontractors, most of whom are SMEs (OECD, 2004h).

Conclusion

67. In sum, Korea is well positioned to achieve high total factor productivity growth and catch up to the leading OECD countries, given its large investment in R&D and education and world-class ICT infrastructure. However, the 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

34. This issue is also discussed in OECD (2004), *Co-Financing Lifelong Learning: Towards a Systemic Approach*.

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, while encouraging greater innovation efforts and the diffusion of technology to the lagging sectors of the economy. 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. Accomplishing these objectives requires improving the R&D framework, in part by using effective policies to promote private-sector R&D, reforming product market regulations so as to encourage innovation and ensuring adequate human capital, notably through reform of tertiary education. Restructuring Korea's national innovation system is thus a top national priority. Specific recommendations in each of these areas are summarised in Box 5.

Box 5 Summary of recommendations to encourage innovation

The R&D system

- Better co-ordinate policies concerning science and technology, education and industry and integrate them more fully in the overall strategy of economic development.
- Maintain flexibility in setting priorities, thereby limiting the risks inherent in concentrating R&D efforts in the sectors identified as future growth engines.
- Increase the responsiveness of public R&D expenditures to the private sector in part through a performance-based evaluation system.
- Strengthen linkages in R&D among businesses, universities and government research institutes, in part by enhancing labour market flexibility and favouring co-operative projects in the allocation of funding.
- Upgrade the R&D role of the universities, which account for only 10% of R&D performed in Korea.
- Promote technological co-operation between domestic and foreign players, in part through ensuring openness to inflows of foreign direct investment.
- Follow through on plans to encourage the diffusion of knowledge by strengthening the business-university-GRI interface and bringing patent holders together with potential licensees.

Promoting private-sector R&D activities

- Ensure that tax incentives are effective in boosting R&D while limiting deadweight costs.
- Further improve enforcement of intellectual property rights and increase public awareness of their importance.

Regulatory reform and the framework for encouraging innovation

- Further strengthen product market competition by lowering entry barriers, streamlining regulations including those on land use, and replacing multiple contact points and administrative procedures by one-stop shops.
- Continue to deregulate and foster competition in services, in particular, retail trade, professional services and social services.
- Simplify the regulatory framework for land and make it more transparent.
- Use the Regulatory Reform Committee to eliminate unnecessary regulations.
- Effectively implement the new unified insolvency law to provide more efficient ways for firms to re-organise or exit, while reducing reliance on informal workouts, thus preventing delays and reducing uncertainty.
- Abolish remaining policies that discriminate in favour of manufacturing.
- Concentrate government's role in the risk capital market on leveraging private-sector participation,

especially by institutional investors, through improved standards for transparency and disclosure.

- Restore investor confidence in the second-tier stock market through strengthened screening procedures, disclosure requirements and delisting conditions.
- Abolish the government certification system for venture businesses in 2005 as scheduled.
- Relax employment protection, which reduces incentives to innovate, while creating a dual labour market.

Development of human capital

- Improve the quality of education at the primary and secondary level to better prepare students to participate in a knowledge-based economy.
- Enhance the autonomy of individual schools in practice and diversify the types of schools and curricula at the secondary level.
- Continue to diversify the university entrance system, in part by reducing the weight of the entrance exam.
- Restructure the tertiary education sector through competition by disclosing performance information for each university and develop a transparent mechanism, such as an independent national body with clearly defined criteria and standards, to assess the quality of educational services.
- Allow the entry of foreign institutions in order to strengthen competition.
- Further deregulate tertiary education.
- Re-balance financial resources in favour of tertiary education to reverse the decline in its quality.
- Increase scholarships and loans to ensure access to tertiary education for low-income students.
- Encourage efforts by universities to diversify with an aim of establishing centres of excellence.
- Implement incentive schemes for universities to strengthen industry-university relationships, including the commercialisation of technology developed in universities.
- Expand lifelong learning opportunities, particularly for those with lower educational attainments.
- Encourage vocational training through co-operative efforts among social partners including labour, management and government.

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Annex

Progress in regulatory reform in Korea

Korea launched a major regulatory reform effort in 1998. In particular, the Regulatory Reform Committee (RRC) was created and charged with eliminating half of the 11 095 regulations then in effect (see the 2000 *OECD Economic Survey of Korea*). The RRC succeeded in eliminating 49% of the regulations, while nearly half of the remaining regulations were improved. The RRC was also assigned the role of reviewing proposed regulations. However, since then, the number of regulations has increased to nearly 8 000, reflecting the emergence of new issues and concerns. Moreover, there has been criticism that regulations are hampering the creation of new enterprises and employment. The authorities have recently launched several initiatives to reform regulation.

The Regulatory Reform Task Force Team

The government established the Regulatory Reform Task Force Team (TFT) in the Prime Minister's office in August 2004 with the goal of boosting growth and creating jobs. The TFT, which is composed of 25 private-sector experts and 26 government officials, is focusing on 65 strategic tasks selected by businesses (Table A1). The emphasis is on solving practical problems identified through opinion surveys of firms. The TFT, which will operate for two years, is distinct from the RRC, which sets the basic regulatory reform policy and reviews new regulations. Quarterly plans to implement the TFT's decisions have been established and the results are reported to the Prime Minister.

Reforming existing regulations

At the August 2004 ministerial-level meeting on regulatory reform, it was decided that all regulations should be examined and reformed, starting from a zero base. All government ministries are participating in this initiative and are selecting regulations for reform based on proposals from enterprises and the public. About 1 000 of the total 7 900 regulations under the responsibility of the ministries have been selected for improvement in 2005. These include, for example, deregulation of the securities company business, extension of the term for tariff drawbacks, and simplification of burial ground reporting procedures. As of the end of April 2005, the number of reforms completed by the ministries had reached 403. The regulatory reform implementation progress will be monitored and the results will be assessed at the end of the 2005.

Reforming quasi-administrative regulations

The government has commissioned a growing number of administrative duties to quasi-public organisations, resulting in an increasing number of "quasi-administrative" regulations. These include rules regarding the articles of incorporation of such organisations and on the activities of their members. All of the regulations imposed on the 512 quasi-public organisations have been reviewed since the beginning of 2005. Of these, 269 were abolished and 763 were improved. Such changes, for example, include the free withdrawal of the members from quasi-public organisations and abolishing the requirement that the relevant ministry approve the executives elected to head them. The relevant ministry will examine and monitor quasi-public organisations in order to reform problematic regulations.

The establishment of a Business Difficulties Resolution Center (Ombudsman System)

In order to resolve difficulties faced by firms due to unreasonable regulations or the actions of the civil servants in administering regulations, a Business Difficulties Resolution Center was established in the Prime Minister's office in April 2004. The staff of 11 had resolved 356 of the 598 cases it had received by the end of June 2005. The Center appears to be successful in resolving the concerns of companies, while encouraging appropriate regulatory actions by ministries and local governments. In the future, the Center will take an active role to identify priorities for improving the efficiency of regulatory procedures.

Table A1. Strategic tasks of Regulatory Task Force Team

Month and year	Task
August 2004	Procedures for starting businesses and establishing factories Construction of golf courses
November	Establishment & operation of large-scale retail stores Administrative investigation system Investments in the logistics industry University administration system
December	Traditional markets Self-governing bodies
January 2005	Construction industry (including supervision of bidding) Public infrastructure investment by the private sector Air transportation Cultural affairs and artistic creativity
March	Small-scale construction of apartment houses Ground transportation Maritime transportation Vocational training system
May	Traffic-related systems (including driver's licences) The start-up and establishment of corporations Personal information protection Use of public information E-commerce
June	Overlapping administrative regulations Internal regulations on administration Tourism & leisure industry New technology and new product development Development of medical supplies and the food industry Medical services
July	Industrialised zones Housing and real-estate finance
September	Business education Distribution of agricultural and maritime products Various indicator systems Outdoor advertising system Broadcast advertising system
October	Various mandatory employment systems Various statutory expenses (quasi-taxes) Entry and operation in the financial industry Financial supervision and the depositor protection system

November	Network industry equipment Management system for national & publicly owned property Entry and operation in the IT business Entry and operation in the broadcasting business
December	E-government Water quality preservation area
February 2006	New distribution sector Public financial system Private insurance
March	Software industry Various heavy taxation systems IPO market system Administrative reports for elementary & middle schools Establishment of institutions of higher education
April	The establishment of private educational institutions Lifelong education Regulations related to foreigners
May	Industrial accidents Safety & health Job creation support measures for social welfare-related firms
June	Large enterprise discrimination Admission to business organisations and their activities Employment security system
July	Various impact analysis systems Permit and reporting procedures related to environmental regulations Waste treatment and recycling Labour union activity

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