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Trade and Innovation in the Korean Information and Communication Technology Sector

TRADE AND INNOVATION PROJECT - CASE STUDY NO. 5

Osamu Onodera

Hann Earl Kim

OECD

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TRADE AND INNOVATION PROJECT

CASE STUDY 5: TRADE AND INNOVATION IN THE KOREAN INFORMATION AND COMMUNICATION TECHNOLOGY SECTOR

OECD Trade Policy Working Paper No. 77

by Osamu Onodera and Hann Earl Kim

Nobuo Kiriyama: Tel: +33-1-45248937: nobuo.kiriyama@oecd.org

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ABSTRACT

This paper is one of five case studies which is a part of a larger project looking at the various effects that trade and investment can have on innovation. This paper studies the effect of trade and investment liberalisation on Korea's Information and communication technology (ICT) sector and finds that trade and investment have played a crucial role in innovation in the sector. In the initial stages of development, imported capital goods and components, joint ventures, licensing and Original Equipment Manufacturer (OEM) contracts were important sources of technology and exports were key to gain the necessary economies of scale for innovation. Free trade and investment policies in the 1990s and stronger protection of intellectual property rights have led to an increase in R&D and innovation and has led to the transformation of Korea into a knowledge based economy in the recent decade.

Keywords: innovation, Korea, information and communication technology, ICT, trade reform, Samsung, production network, intellectual property rights, IPR protection, patents, ITA, Information Technology Agreement

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The Working Party of the OECD Trade Committee discussed this report and agreed to make the findings more widely available through declassification on its responsibility. The views expressed in this paper do not necessarily reflect the views of the OECD or of its member governments. Then study is available on the OECD website in English and in French: http://oecd.org/trade.

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EXECUTIVE SUMMARY

Korea has achieved remarkable economic development and transformed itself from a largely agrarian society in the early 1960s to an industrialised country by the 1990s through aggressive acquisition of foreign technology and export-led growth. The trade and economic reforms from the mid-1990s had led to a further transformation of Korea, which is preparing Korea for the “knowledge economy” and a new age of development. From the mid-1990s, the information and communication technology (ICT) industry has become an engine of the economy, contributing over 40% of GDP growth in 2005 and 2006. ICT is literally acting as the core of innovative activity in Korea. This case study examines how trade and investment policies have affected innovation in the Korean ICT industry.

The roots of the current ICT industry can be found in the electronics industry in the 1960s. Contrary to general belief, foreign companies played an important role in the development of the Korean electronics sector from which the current ICT industry has grown. Foreign companies initially accounted for a third of Korea’s production and over half of its electronics exports until restrictive investment policies led to divestments and a decrease in FDI. Chaebols or Korean business groups became the main drivers of the industry, which grew rapidly relying on foreign technology sources such as foreign capital equipment and components, joint ventures, licensing and Original Equipment Manufacturer (OEM) contracts.

National innovative capacity was extremely limited at this initial stage and the government played an active role in supporting industry through trade policy, investment policy, industrial policy and R&D policy. The trade and investment policies were generally restrictive (relatively high tariffs and restrictive inward FDI policy) which worked to alleviate the investment related risks for domestic firms in the domestic market. Industrial policy in the form of tax incentives and access to low interest policy loans provided additional strong incentives for companies to invest resources in technology absorption, innovation and new export activities. Government played a key role in R&D, comprising 70% of gross expenditure in R&D in Korea, and playing a supportive role in the acquisition and diffusion of technology.

Throughout the 1970s and 80s, Korean companies enhanced their technological capability and diversified its product line, and the Korean ICT industry in the early 1990s had become a substantial presence in the global industry. However, it was still reliant on foreign technology and components, and OEM channels remained dominant. With China and East Asian countries catching up, the Korean ICT industry was facing a crossroads. Changes in government policies from the early- to mid-1990s, i.e. (1) open trade and investment policies, (2) R&D and intellectual property rights policies, and (3) use of international standards and deregulation, have been important factors taking Korean innovation in this sector to a new level.

More open trade and investment increased the incentives for innovation through greater competition. While tariffs in the ICT sector still exceeded 10% in the early 1990s, they were cut rapidly with the pace of liberalisation being accelerated as the WTO Information Technology Agreement came into force. The import “diversification” programme which had shielded Korean industry from Japanese competitors in the domestic market was progressively phased out, and FDI was increasingly opened up especially after the Asian financial crisis. Open trade and investment policies thus provided stronger incentives for Korean companies to innovate and seek out international markets while also improving access to a wider range of foreign technology.

The introduction of international standards and the deregulation of telecommunication services were extremely important for innovation in the telecom equipment industry. Korea was one of the early developers of the CDMA technology, one of the international standards in mobile telephony. Early

development of this emerging standard in cooperation with Qualcomm, a U.S. company, facilitated the entry of Korean manufacturers into foreign markets with the same standard including the U.S. Deregulation in the telecommunication services sector and introduction of effective competition contributed to the rapid growth of the domestic ICT market. The growing domestic market in turn allowed Korean companies to leverage economies of scale and increase innovation.

R&D policy and intellectual property rights policy supported the transformation of the ICT industry, sending a clear signal of the importance of technology and innovation. The R&D/GDP ratio increased from 0.8-2% in the 1980s to 3% after the turn of the century, 80% of which was financed by the private sector. Increased protection of intellectual property rights has led to a measurable increase in patent activity. The average number of patents granted in the US to Korean firms increased five-fold from about 200 per annum in 1987-1991 to about 1000 per annum in 1992-1996, and to over 3000 per annum in 1997-2001.

In formatisation policy which has focused on the establishment of the basic infrastructure, lowering of prices to ensure initial demand, use of governmental demand, education policies and effective competition among others has supported the increase of the domestic market. This mutual supportive combination of demand and supply policies have been one key feature of the Korean ICT miracle.

One company which epitomises the transformation of the Korean ICT sector is Samsung Electronics. Samsung Electronics is one of the world leaders in semiconductors, in particular DRAMs and flash memories, Liquid Crystal Displays (LCDs), mobile phones, and digital appliances such as flat panel TVs. While Samsung had quickly grown from an assembler of black and white TVs in the 1960s to one of the market leaders in DRAMs in the late 1980s, making use of foreign technology and based on foreign markets, it was generally a market follower rather than an innovator even in the late 1980s. Changes in the business environment in the early 1990s, i.e. (1) greater competition at the lower end of the market due to the increasing use of evolving production networks in the Asian region by Japanese producers, (2) increased competition in the Korean domestic market due to progressive trade and investment liberalisation and (3) withdrawal of the generalised system of preference (GSP) privileges in export markets, triggered a transformation of Samsung with a (1) greater emphasis on technology, (2) increased global production and sourcing, and (3) enhanced international sales and distribution. The fact that (1) Samsung now has research facilities not only in Europe, US and Japan but also in Russia, India and most recently China, (2) it now has 27 manufacturing facilities in 12 countries, with overseas production reaching 35.9% in 2007, and (3) it has doubled its sales network from 32 sales organisations in 23 countries in 2000, to 60 in 48 countries in all regions shows how global Samsung's operations have become as a result.

To conclude, trade and investment has played an extremely important role in innovation in the Korean ICT sector. In the initial stages of development, imported capital goods and components, joint-ventures, licensing were important sources of technology. Korea also depended on exports for economies of scale necessary to invest in the upgrading of its industry. Restrictive trade and investment policy in this initial stage may have alleviated investment related risks for domestic firms in the domestic market, and may have contributed to absorptive capacity. Restrictive trade and investment policies, however, may have slowly led to negative effects as competition was restricted in the domestic market and the development of production networks progressed elsewhere.

The transformation of Korea into a knowledge-based economy and its strengthening innovative capacity in the recent decade has been based on a much more liberal trade and investment policy. Freer trade and investment policies have led to greater incentives for R&D and innovation in the ICT industry. The introduction of international standards and deregulation of the telecommunication services market and introduction of effective competition led to rapid growth of the domestic ICT sector. As a result of such developments, Korea's innovation system is increasingly becoming more deeply integrated with the global innovation system at various levels from R&D, production, and sales.

I. Introduction

1.1 Background

1. Innovation and technological progress are key determinants of economic growth. By strengthening innovation capacity, countries, regions, cities and firms can become more competitive and be better prepared to face the challenges of globalisation. Innovation though is more than just the result of research and development (R&D); it is about the successful exploitation of new ideas and the invention, development and commercialisation of new technologies, services, business models and operational methods. Innovation is thus related to a process connecting knowledge and technology with the exploitation of market opportunities for new or improved products, services and business processes compared to those already available on the market.

2. There is today great interest in understanding how governments can promote innovation and the benefits it brings, as evidenced by the discussions at the OECD Ministerial Council Meeting in 2007. At the meeting, the OECD was mandated to develop an *OECD Innovation Strategy*, drawing on relevant work in several policy domains, including in the area of trade policy. The trade and investment environment is an important part of the "framework conditions" for innovation and entrepreneurship, and as such, trade and investment policies affect a country's innovation performance. To gain a better understanding of how trade and investment patterns and policies affect innovation performance, and interact with other key policies influencing innovation performance, the Trade Committee mandated the Secretariat to undertake a project to study the relationship between "Trade and Innovation" (see TAD/TC/WP(2007)11). This paper is one of five case studies which is a part of this broader research programme, and examines the role of trade in innovation in Korea's ICT (Information and Communication Technology) industry.

1.2 Objective, structure and methodology

3. The objective of this study is to examine how recent trade and investment patterns (including "trade in tasks" resulting from production and supply chain fragmentation) and Korean and global policies to ensure market openness and free trade have affected the innovation process in Korea's ICT industry, and more particularly in Samsung, which has become one of the leading firms in the ICT industry worldwide from a modest position in the past two decades. The study assesses how regulatory, trade, and investment policy choices have helped, alongside other key policies, to provide the right framework conditions for technology absorption and innovation. In addition, it examines how the private sector, and more particularly Samsung, has taken advantage of those conditions to enhance its innovation capacity. The objective of this study is not to provide a comprehensive history of Korea's development or to evaluate Korea's innovation policy. Rather it is an attempt to shed some light on the relationship between trade and innovation from the recent rapid growth of Korea's ICT industry in the past 15 years.

4. The study is structured as follows: *Section II* provides the background by providing a brief overview of structural changes in the Korean economy in the past 40 years and also outlines the fast rise of the Korean ICT industry, with a specific focus in the past 15 years. *Section III* then examines the key public policy choices, especially in trade and investment, which have strengthened the country's innovation capacity and performance. The success of the Korean ICT industry is of course due to the strategies and performances of key Korean companies, such as Samsung and Lucky Goldstar among others. Samsung's business strategy (particularly in relation to its global R&D, manufacturing and sourcing strategy) is therefore examined in *Section IV*. Finally, *Section V* outlines the key conclusions, lessons learnt, and challenges ahead. The study builds on a review of existing literature, including relevant OECD studies, as well as on interviews.

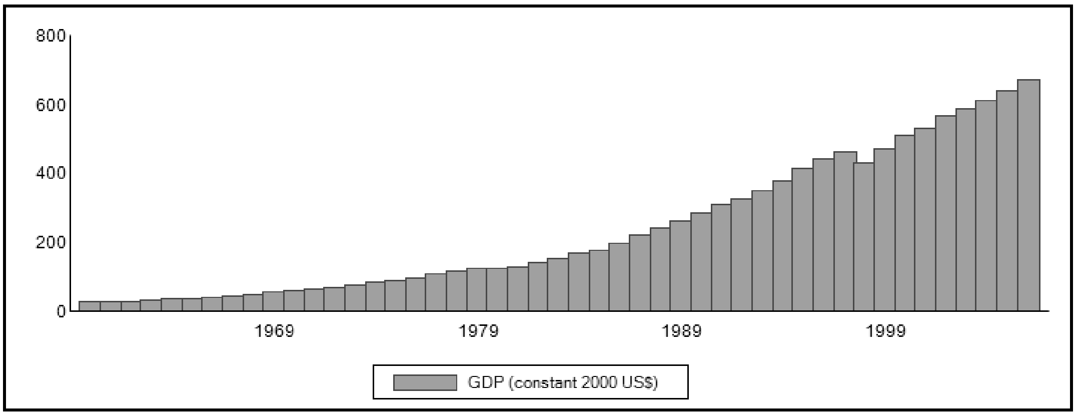
II. Overview of Korea's economic development and ICT industry

2.1 Overview of Korea's economic development and structural changes in the economy

5. Korea has achieved one of the fastest rates of economic development of any country in the world. Economic development took off from the 1960s and the country grew at an average annual growth rate of 9% in the next three consecutive decades (Figure 1). In 1995, the national income per capita reached USD 10,000. While the Korean economy suffered a downturn in the Asian financial crisis in 1997, its economy made an early and strong rebound.[1] After substantial structural reform triggered by the Asian crisis, Korea's economy has expanded at a 4.3% annual rate between 2002 and 2007 (OECD, 2007).

6. Korea's achievement is remarkable for two reasons. First is the speed with which Korea has achieved industrialisation: from an economy with 36.9% of GDP in agriculture and exports consisting of primary goods (45.4%) and light manufactures (45.4%) in 1962, Korea has become an economy with only 4% of GDP in agriculture and over 80% of exports in heavy and chemical manufactures in forty years (Table 1). Second is the radical transformation in the recent 15 years from a catch-up economy until the mid-1990s, to an increasingly innovative knowledge-based economy. Korea now has an industrial structure which generally resembles other OECD countries, which is continuing to improve its comparative advantage in high-technology products.

Figure 1. Korea's GDP (1960-2006)
(billion USD)



(Source: WDI Indicators online)

Table 1. Composition of Korea's Exports, Imports and GDP, 1962-2002
(%)

	Exports			Imports			GDP			Export /GDP	Import /GDP
	Primary	Manufactures		Raw materials	Capital goods	Consumer goods	Primary	Manu-facturing	Service		
		Light	Heavy& Chemical								
1962	45.4	45.4	9.2				36.9	14.5	48.6	5	17
1972	12.1	66.6	21.3	51.5	29.9	18.1	27.0	22.3	50.8	19	24
1982	7.9	43.0	49.0	64.0	25.7	10.3	14.5	27.9	57.7	33	36
1992	4.2	32.9	62.9	52.5	37.9	9.2	7.4	28.7	63.8	27	28
2002	2.5	14.9	82.7	50.0	37.1	12.4	4.0	29.2	66.8	35	34

Source : Table 10.2 in Young (2005) based on data from Korea International Trade Association supplemented by data on export/GDP and import/GDP from WDI indicators.

1 . Output increased almost 11% for the year 1999 (OECD, 2000).

7. Table 2 taken from Hong (2005) provides an overview of the various stages of Korea's industrial development and its relation to technological development. Korea's development started with an inward looking, import substitution policy in the early 1960s but quickly switched to an export-oriented industrialisation strategy in the mid-1960s focused on light industries. This was followed in the 1970s by a strong push to expand heavy and chemical industries. The government introduced a broad range of interventionist policy instruments to support the large-scale, risky investments. While such policies did indeed lead to large scale investment in these industries, it also induced over-investment, inefficient resource allocation and macroeconomic instability, which necessitated the introduction of a stabilisation policy in the early 1980s. From the 1980s onwards, the government has taken a more market oriented approach to industrial policy, gradually reducing its role in credit allocation, but nonetheless playing a key role in promoting more technology-intensive industries.

Table 2. Development of industry and technology

	Industrial development	Technology development	Highlight
1960s	• Develop import-substitution industries • Expand export-oriented light industries • Support producer goods industries	• Strengthen S&T education • Deepen scientific and technological infrastructure • Promote foreign technology imports	• 1960: $79 • Labour
1970s	• Expand heavy and chemical industries • Shift emphasis from capital import to technology import • Strengthen export-oriented industrial competitiveness	• Expand technical training • Improve institutional mechanism for adapting imported technology • Promote research applicable to industrial needs	• 1970: $253 • Labour and capital
1980s	• Transform industrial structure to one of comparative advantage • Expand technology-intensive industry • Encourage manpower development and improve productivity of industries	• Develop and acquire top-level scientists and engineers • Perform national R&D projects efficiently • Promote industrial technology development	• 1980: $1 655 • Capital and technology
1990s	• Promote industrial restructuring and technical innovation • Promote efficient use of human and other resources • Improve information networks	• Reinforce national R&D projects • Strengthen demand-oriented technology development system • Institutional reforms	• 1990: $5 890 • Technology and innovation
2000-2003	• Move towards High tech and high value-added industries • Develop IT industry • Search the next generation engine of growth	• Strengthen national and regional innovation systems • Internationalise R&D systems and information networks • R&D increase in IT, BT, NT, ET, CT	•2000: $9 823 •Innovation and KBE

(Source: Hong (2005), Table 3.1)

8. There are four notable features. First is the key role that government played in development. While private sector businesses have been the main driver of industrial and technological development, the government played a key role at various stages of industrial development using various policy instruments including special tax treatment and preferential access to credit through policy loans.

9. Second is the large role played by chaebols, which are multi-company business groups operating in a wide range of markets under common entrepreneurial and financial control (OECD, 2000b). Although each company is legally independent, the *chaebols* are characterised by high levels of ownership by the founding family and by member companies. The group companies are typically diversified across a wide

array of industries and also had high levels of debt.[2] These chaebols were the main conduits of industrial policy and the main recipients of the policy loans which were the drivers of industrialisation. Although Korea's industrial policy has shifted its focus to small and medium enterprises, chaebols continue to play a large role in the Korean economy.

10. Third, the industrialisation process has been strongly led by exports (Table 1). This is reflected in (1) the rapid increase in the export to GDP ratio from 5% in 1962 to 33% in 1982 despite rapid GDP growth, (2) the rapid increase in the share of manufactures to total exports, and (3) the shift in the composition from light manufactures to heavy & chemical manufactures.

11. Fourth but not least, there has been a strong reliance on foreign technology. Imports of capital and intermediate goods and services have remained important throughout, as evidenced in the high share of capital goods in imports which have stood at around 25% to 40% (Table 1). Other sources of foreign technology such as joint ventures, licensing and reverse engineering of foreign products have all been used at various points in time. Strategic alliances on a more equal footing have become more important as the technological capability of Korean companies has become higher. In terms of the national innovation system, the system has gradually shifted from a system focused on introduction of foreign technology and imitation to a system more focused on technology and value creation.

12. Korea's experience shows that catch-up through imitation require conscious effort and well-designed policies. Imitation and learning is path dependent and influenced by accumulated technological capabilities and supporting policies and institutions (Hong, 2005). It also underlines the importance of foreign technology and foreign markets which are enabled through trade. The ICT industry has been the driver of Korea's latest step in upgrading its industry, to which we next turn to.

2.2 The ICT sector in the economy

13. The ICT industry has become an increasingly important sector of the Korean economy, in recent years becoming its engine of growth. A combination of industrial policy, informatisation policy, trade and investment policy, and science and technology policy have been successful in stimulation the creation of a virtuous cycle of demand and supply in the ICT sector. This is all the more amazing as Korea was only at the world average in fixed line penetration as recently as 1980.[3] The share of the ICT sector in GDP increased from 9.5% in 2000 to 16.9% of GDP in 2007 (Table 3). This has led Korea to have one of the leading ICT infrastructures in the world (Table 4). When limited to the share of ICT manufacturing in total manufacturing, the share is 20.2% which is matched only by Finland (Figure 2). While the IT sector contributed approximately 10% to GDP growth in 1996, the ICT sector's share in GDP growth has continued to grow, and was over 40% in 2005 and 2006 (Table 5).

14. The ICT sector constitutes roughly one third of Korea's exports, which is the highest in OECD (Figure 3). An analysis of revealed comparative advantage shows that Korea has a considerable

2 . Such debts were often undertaken with explicit/implicit governmental backing. Thus the Korean model was often equated with "tight cooperation between the state and the chaebols". Debt levels have fallen somewhat after the Asian financial crisis.

3 . Korea is the leading example of a country with a low level of ICT access to one of the highest in the world. In the 1960s it has a penetration of 0.36 fixed lines per 100 inhabitants, barely one tenth of the then world average. As recently as 1980, it was only at the world average. At present, over 90 percent of households have a fixed line and mobile penetration has also reached similar levels. (ITU, 2003)

comparative advantage in ICT products (Table 6). The Balassa index[4] for high technology and ICT products was 1.63 in 2004, and in particular was 3.19 in radio, TV and communication equipment.

15. Moreover ICT manufacturing has been a big driver of productivity growth in Korea. Pilat et al. (2002) looks at the contribution of ICT in labour productivity and find that ICT manufacturing contributed 0.85% out of 4.94% of total labour productivity growth in the period 1990-1995, and 0.81% out of 2.70% in the period 1995-2000 (Figure 4).

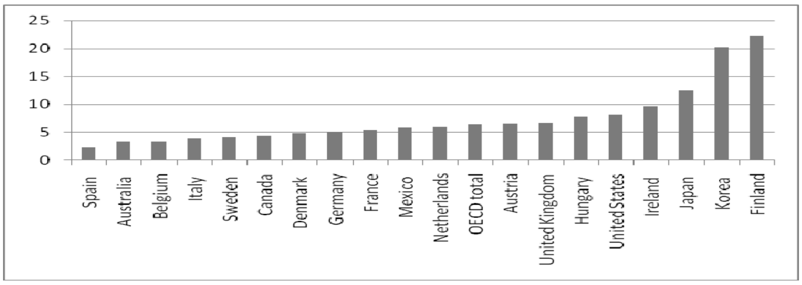
Table 3. Ratio of ICT industry to GDP

(Units: 100 billion won, %)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GDP (A)*	4.429.6	4,642.3	4,376.5	4,756.2	5,140.5	5,344.2	5,704.4	5,879.9	6,177.5	6,439.9	6,763.1	7,098.3
IT Industry (B)	196.4	219.2	269.7	364.8	488.3	539.5	634.2	724.3	850.9	965.8	1,095.9	1,200.1
Ratio(B/A)	4.4	4.7	6.2	7.7	9.5	10.1	11.1	12.3	13.8	15.0	16.2	16.9

Source: Bank of Korea (2008)

Figure 2. Share of ICT manufacturing in total manufacturing value added, 2003



Source: OECD (2006)

Table 4. IT Infrastructure and Penetration

Category		2000	2001	2002	2003	2004	2005	2006(P)
Broadband Internet Services	Subscriber (10,000 households)	401	781	1,040	1,118	1,192	1,219	1,404
	Subscriber per 100 households	25	49	63	66	69	68	77
Internet Usage	User (10,000 persons)	1,904	2,438	2,627	2,922	3,158	3,301	3,412
	User per 100 inhabitants	45	57	59	66	70	73	75
Mobile Phone Services	Subscriber (10,000 persons)	2,682	2,904	3,234	3,359	3,659	3,834	
	Subscriber per 100 inhabitants	57	61	68	70	76	80	
e-Commerce	Transaction Volume (Trillion KRW)	58	119	178	235	314	358	
	Transaction Rate (%)	4.5	9.1	12.8	15.1	19.3	19.8	
IPv6 Address		5	11	15	18	31	4,145	
Internet Banking Subscriber (10,000 persons)		409	1,131	1,771	2,275	2,427	2,673	3,454

Source : www.nia.or.kr

4 . The Balassa Index is calculated as the share of country i's exports of product j in world exports of j, divided by the share of country i's total exports in total world exports. If the index is greater than 1, then a country has a relative comparative advantage in product *i*. A Ballasa index of 1.63 shows that Korea exports 1.63 times more than the average country.

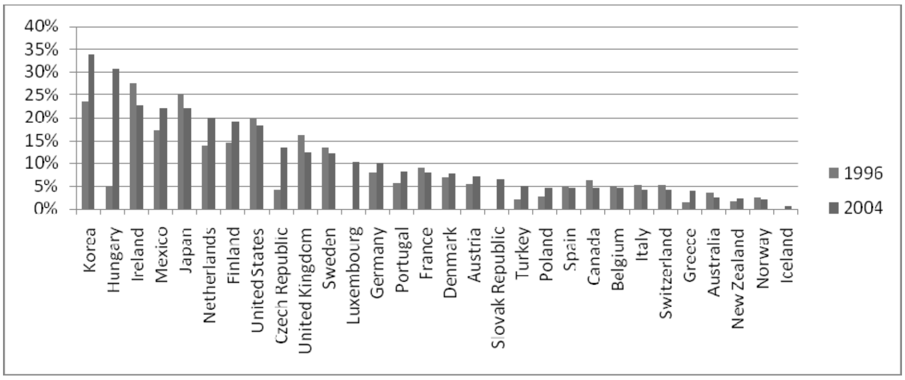
Table 5. Contribution of IT to GDP Growth

(Unit: percent)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Contribution	10.6	10.8	-19.0	25.1	32.1	25.2	26.3	51.3	42.5	43.8	40.3	31.1

Source: Bank of Korea (2008)

Figure 3. Share of ICT goods in total merchandise exports, 1996-2004



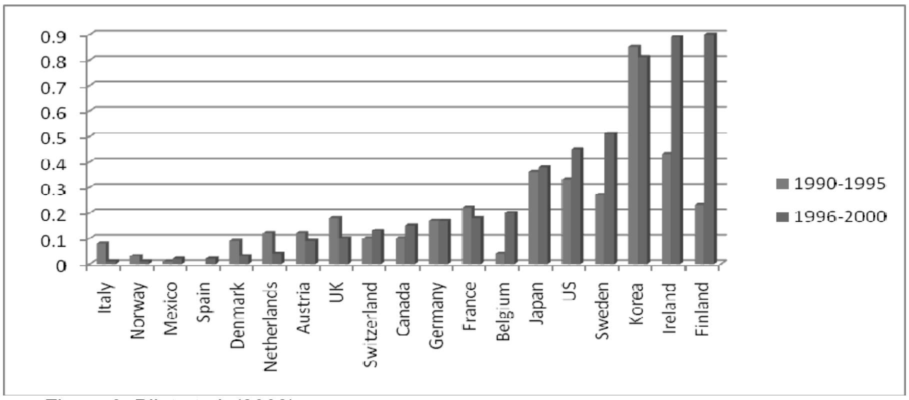
Source : Figure 2.11, OECD (2006)

Table 6. Composition of Korea's exports

	Share (per cent)		Revealed comparative advantage	
	1992	**2004**	**1992**	**2004**
High technology and ICT products	**25.8**	**39.2**	**1.33**	**1.63**
Computer and office products	4.0	9.0	0.91	1.73
Semiconductors and electronic valves	10.6	11.0	3.62	2.30
Radio, TV and communication equipment	8.5	15.3	2.31	3.19
Precision, medical and optical instruments	1.3	2.4	0.39	0.65
Medium-high technology	**20.4**	**35.2**	**0.60**	**1.10**
Electrical machinery	2.2	3.2	0.59	0.77
Chemical products	7.2	10.2	0.99	1.26
Motor vehicle and trailer	5.8	13.6	0.50	1.33
Home appliance and machinery equipment	3.0	8.0	0.46	0.91
Medium-low technology	**18.7**	**17.3**	**1.45**	**1.43**
Low technology	**31.6**	**8.8**	**1.44**	**0.49**
Non-manufacturing	**1.5**	**0.4**	**0.18**	**0.03**

Source : Extraction from Table 2.2, OECD (2007) citing Joon-Kyung Kim, Yanseon Kim and Chung H. Lee (2006)

Figure 4. Contributions of ICT manufacturing to labour productivity growth (1990-2000)



Source : Figure 3, Pilat et al. (2002)

2.3 Emergence of the ICT sector in the 1960-1995 – Period of emulation

16. The roots of the Korean ICT industry can be found in the electronics industry in the 1960s. The industry at the time was comprised of two parts;[5] a small group of domestic companies which conducted the assembly of black and white TVs and radios, and a second group of foreign companies, consisting of US semiconductor firms like Fairchild and Motorola which set up assembly operations of discrete devices. The first group of domestic companies was still small in size at this time, and focused on the domestic market which was protected by tariffs. The foreign companies assembled products for the export market, taking advantage of the lower wages in Korea. With US investment, the Korean semiconductor industry grew very quickly and as early as 1969 semiconductor exports represented 5.6% of total Korean exports (Kim, 1998). In 1972, foreign firms accounted for about a third of Korea's electronic production and 55% of its exports; their share in exports fell below 40% only in 1980 (Bloom, 1992). The Export Processing Zones in Masan and Iksan also succeeded in attracting inward FDI from Japan in the 1970s, especially in the electronics sector (Engman et al., 2007).

17. In the 1970s as government policies became more demanding towards foreign capital in terms of greater value added and greater transfer of technology, however, a number of foreign companies divested from the market, and inward FDI languished (Table 7). Chaebols thus became the main drivers of the industry. However, the chaebol had to rely on foreign technology sources such as foreign equipment and component suppliers, joint-ventures, licensing, and OEM contracts, as they did not have the relevant technology. Up to the 1980s, Korean producers conducted joined ventures and concluded licensing contracts with large foreign companies, like Phillips, Micron, Intel, Toshiba, Sharp, Fujitsu, AT&T, NEC, etc. (Kim, K, 1998).

Table 7. Inbound FDI to Korea (1966-2000)

(Unit $ million)

	1966-1974	1975-1983	1984-1994	1995-2000
Electric and Electronics	10	17	86	894
Total	65	120	1308	5438

Source: Based on Tables 6-9 Yun (2007) using MOCIE database

18. OEM contracts proved a particularly important route of entry into the electronics industry as OEM clients provided guidance on technological and quality requirements for their products, as well as providing a market for the end products, which allows companies to achieve economies of scale.[6] As foreign companies became more cautious towards the licensing of technology, Korean companies also increasingly used "reverse engineering" when introducing new product lines.

19. The 1980s led to a further broadening of the product line to chip production, video tape recorders, electronic switches, and other high tech products, and between 1985 and 1993, the Korean electronics industry grew at a spectacular speed of 23.2% (Kim, 1998). Figures 5 and 6 show how Korea's IT exports took off and increased their share in total exports. From about 2 billion US dollars in 1980, exports more

5 . A detailed description of the evolution of the Korean electronics industry up to the late 1980s can be found in Bloom (1992).

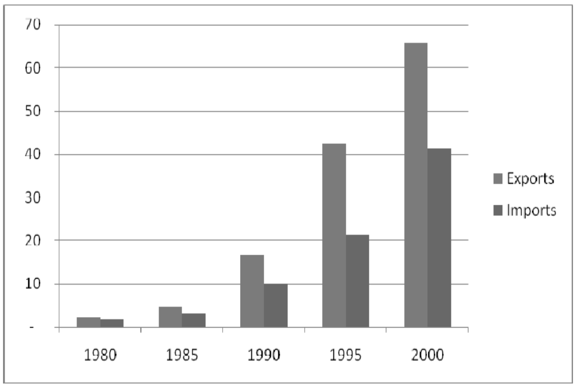
6 . As noted in Ernst (2000), OEM arrangements can have substantial drawbacks. A firm may become locked into an OEM relationship to the extent it is hindered from developing its own independent brand name recognition and marketing channels. Profit margins are substantially lower in OEM sales than in own brand sales. Lower profit margins in turn makes it more difficult to make the R&D and marketing investments necessary to build own brand products.

than doubled to 4.5 billion USD in 1985, and continued to grow rapidly to 16.6 billion USD in 1990 and 42 billion USD in 1995. Imports also continued to increase although at a slower pace.

20. Figure 7 shows how the main export products have shifted. In 1980, TV receivers (20%), radios (14%) and cathode ray tubes etc (25%) were the main drivers of exports. In the 1980s, computers and parts thereof emerged as an export product with a share in ICT exports of 13% in 1985 and 16% in 1990, and the share of radios and TVs decreased to 11% and 13% respectively. The share of cathode ray tubes etc. increased from 25% in 1985 to 46% in 1995 as a result of outward FDI and overseas production. Imports have increased in the entire period although at a slower pace than export growth which indicates the continued dependence on imported capital and intermediate goods. Quality continued to improve and some Korean manufacturers started to explore original brand name (OBN) strategies, although they remained heavily reliant on OEM manufacturing.

Figure 5. Exports and imports of ICT and electronics (1980-2000)

(billion USD)

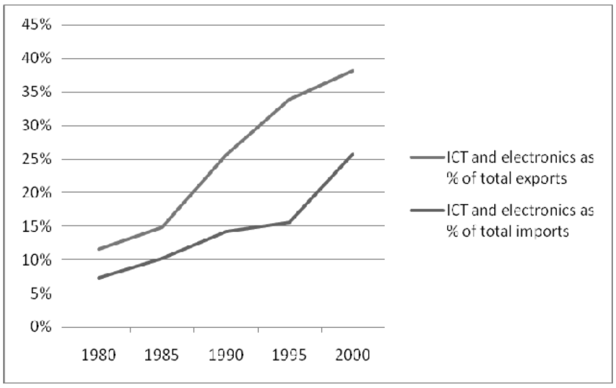


Note. ICT and electronics consist of SITC Rev.2 Categories 75 (Office machines and automatic data processing equipment), 76 (telecommunications and sound recording), and 77 (electronic products) which is wider than the OECD definition of ICT goods.

(Source: WITS)

Figure 6. Share of ICT and electronics in total exports and imports (1980-2000)

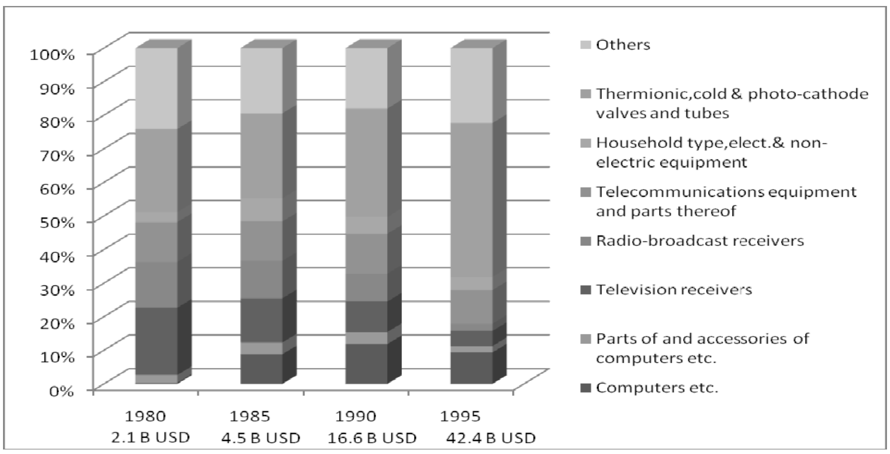
(percentage of total exports and imports)



Note. ICT and electronics consist of SITC Rev.2 Categories 75 (Office machines and automatic data processing equipment), 76 (telecommunications and sound recording), and 77 (electronic products) which is wider than the OECD definition of ICT goods.

(Source: WITS)

Figure 7. Share of major ICT products in ICT and electronics exports (1980-1995)



Note. ICT and electronics consist of SITC Rev.2 Categories 75 (Office machines and automatic data processing equipment), 76 (telecommunications and sound recording), and 77 (electronic products) which is wider than the OECD definition of ICT goods.

(Source: WITS)

21. It was also in the latter half of the 1980s that Korean electronics firms started to invest overseas. These initial outward investments were made in Korea's main export markets of North America and Europe where Korean firms were becoming increasingly subject to antidumping cases as Korean companies became competitive[7]. Overseas FDI remained relatively small compared to Japanese companies even in the beginning of the 1990s even as Japanese companies increased overseas production from the late 1980s to the early 1990s (Table 8).

Table 8. Overseas Production Ratio of the Korean and Japanese Electronics Industries

		1991	1992	1993	1994	1995
Colour TVs	Korea	NA	19%	20%	27%	28%
	Japan	63%	67%	72%	86% a	NA
Video Casette Recorders	Korea	NA	16%	NA	17%	20%
	Japan	29%	36%	48%	71% b	NA

Note: Overseas production ratio in the table is the ratio of the unit quantity produced overseas divided by the total unit quantity produced overseas and in the home country. a: the figure of Sharp's overseas production ratio. b: the figure of Sanyo's overseas production ratio.

Source : Kim (1997)

22. One of the key subsectors that emerged in this period was the semiconductor industry, which started in the mid 1970s and rapidly grew as Korean companies caught up with technology leaders in the area of DRAMs. Korean companies capitalised on their existing capabilities in mass-production processes, and undertook an enormous effort to absorb foreign technology. The escalating trade conflicts between the United States and Japan[8] also provided a boost. Korea's share in the world market for 256K chips which was 13% in 1987, grew to 29% (compared to Japan 47.9% and US 20.5%) and overtook Japan as Samsung became one of the dominant suppliers of 1M chips.

23. Throughout the period between 1960 and the mid 1980s, the government played an active role supporting the development of the electronics industry through trade policy, investment policy, industrial policy, R&D policy and informatisation policy. The isolated effects of each of these polices is difficult to assess, and it is difficult to judge whether restrictive trade and investment policies had a positive effect on nascent Korean industries such as electronics. However, the general policy environment no doubt worked to alleviate investment related risks and provided strong incentives for companies to invest resources in technology absorption, innovation and new export activities. The technological absorption capacity of Korean firms which were limited at the beginning of the 1960s increased, which is reflected in the increasing R&D of these firms.

7 . Fifteen antidumping cases were initiated against Korean electronics exports between 1973 and 1989, and nine cases resulted in the imposition of duties. Of the nine, four were imposed by the European Community (on video tapes, video cassette recorders, compact disk players, and small colour TVs), two each by Australia (fluorescent lamps and audio tapes) and the United States (colour TVs and colour picture tubes), and one by Canada (microwave ovens) (Bark, 1991).

8 . This resulted in the first semiconductor trade agreement (1986-1991) which made Japanese manufacturers wary of price cuts and market expansion, benefiting Korean manufacturers (Kim, 1998).

Box 1. Supportive government policies in the period of emulation (1960s – 1990s)

Trade policy

One way in which the government promoted development of the electronics industry was through selective trade policy. Although tariffs were gradually cut, Korea maintained relatively high levels of tariffs of 13-20% up to the 1980s while allowing duty free access to capital and intermediate inputs for exports. An import diversification programme was also put in place in 1978, which restricted imports of designated items from countries with which Korea had an "excessive" trade deficit, in particular Japan. This programme had the effect of shielding certain domestic industries including electronics from foreign competition. However, it did not prevent imports of vital key components: for example, despite this programme Korea's electronics industry continued to import a wide variety of components from Japan. It did however allow Korean electronics companies to enjoy higher prices in domestic markets for consumer electronics, which was a basis for the imposition of anti-dumping duties by some countries on imports from Korea.

Investment policy

Another way in which the government conducted industrial policy was through selective investment policies. The initial FDI policy at the beginning of the 1960s was to encourage inward-FDI. However, FDI policy turned restrictive and selective from around 1962 when the five year economic development plans started. In many areas FDI became restricted. While the initial policy welcoming FDI had led to some inward-FDI in the 1960s, the subsequent tightening of FDI policy brought some divestment and low levels of inward-FDI.

In 1984, Korea reformed the law to allow FDI into more sectors, changing FDI restrictions from a positive list to a negative list, and relaxed the requirements preventing majority foreign ownership. This change in attitude reflected the growing difficulty in raising foreign commercial loans from international capital markets after the second oil crisis, along with rising pressure from trade partners (Kwon, 2003). FDI regulations were subsequently progressively liberalised as Korea prepared for accession to the OECD in 1996.

Policy related to outward FDI was also restrictive from the 1960s up to 1981 as it was considered necessary to restrict capital flows for balance of payment reasons. As exports grew and the need to restrict outward capital flows eased, outward-FDI policy was relaxed in 1981. Views towards outward FDI became more positive and some policies were put into place to facilitate outward FDI for example by including access to loans from the Korea Ex-Im Bank and access to overseas investment insurance by the Korean export insurance company as well as the signing of a number or BITs.

Industrial policy

Although not extensive as the HCI (Heavy and Chemical Industry) drive, the electronic industry was a subject of industrial policy, for example through the Electronics Industry Promotion Act in 1969, and its amendment in 1981. The Semiconductor Industry Promotion Plan which, in addition to a wide range of tax incentives, provided substantial policy loans to activities related to the development of domestic wafer fabrication that was introduced in 1983 is another example. "Left on their own, most Korean electronics producers would arguably have hesitated to pursue high cost, high risk strategies, had they not been induced to do so by a variety of policy interventions that were market-augmenting (reducing risks and uncertainties) rather than market-repressing planning (increasing fragmentation of the market or rent-seeking opportunities)" (Johnson, 1987 cited in Mytelka and Ernst, 1998). Although such policies would likely be WTO inconsistent and it is doubtful whether they would be replicable in the current economic and technological environment, such policies may have been one factor which enabled chaebols to engage in the high-risk investment required for technology acquisition and upgrading of production.

Science and technology policy

In the 1970s and 1980s, government was the main source of R&D expenditure in the country as the private sector did not have large resources available. In order to enhance domestic R&D capability, the government established ten government research institutes in various areas in the 1970s (Hong, 2005) which included the Korea Institute of Electronics Technology (KIET) established in 1976; since renamed the Electronics and Telecommunications Research Institute (ETRI).9 Korea's science and technology policy during the 1980s emphasised the localisation of key strategic technologies, development of highly skilled technological manpower, and promotion of private-sector R&D capabilities (Hong, 2005). Table 8 shows how the government was initially the main conductor of

9 . KIET provided the semiconductor and computer firms with technology in the industry's nascent stage. For example, it played a key role in the development of the TDX (digital exchange) which was the Korean version of a digital telecommunication switching system. Despite its initial importance it cannot be denied that its importance has declined as industry's capabilities have increased. According to EIAK (1989), despite helpful work, it was by and large inferior to the private electronics firms with respect to its quality of manpower and research capability (Kim, 1998).

R&D, with the private sector gradually taking over the majority in the 1980s.

There were other major changes in science and technology policy related to the ICT sector. One was the establishment of the Ministry of Information and Communication in 1994 to integrate decentralized ICT-related functions including R&D, and to promote the ICT industry as a strategic driver of national development. Another was the establishment of an 'IT Promotion Fund' which was independent from the government's general budget. The Fund has played a crucial role for the strategic investment on ICT R&D, because it made possible the ability to secure necessary resources for public R&D in the ICT sector without undergoing competition from other areas. Major accomplishments in ICT R&D in the 1980s and early 1990s include developments in TDX (digital exchange), D-RAM and CDMA commercialization technology.

Table 9. Evolution of Gross Expenditure in research and development (GERD) in Korea

	1970	1980	1990	2000
GERD (USD, million)	33	428	4,676	10,993
Government vs Private (ratio)	71:29	64:36	19:81	28:72
R&D/GDP (percent)	0.38	0.77	1.87	2.39
Researcher (persons)	5,628	18,434	70,503	159,973

Source : Ministry of Science and Technology. Korea Institute of S&T Evaluation and Planning (2003), Report on the Survey of R&D in Science and Technology

Informatisation policy

Informatisation policy has also played a key role in the development of the ICT industry from the demand side. Korea embarked upon a series of ICT plans starting in 1987, which has provided a vision and strategy of how the government sees the information society, which has structured the direction of government policies and provided the private sector valuable information on how the sector can be expected to evolve. In conjunction with other policies to drive prices low to elicit demand in the government and education sector, pro-competition policies, etc. these policies have contributed to the rapid informatisation of the Korean economy especially after the establishment of the Ministry of Information and Communications in the mid-1990s.

2.4 Acceleration of the development of Korea's ICT industry in the late 1990s - present – Increasing interdependence

(1) Changing pattern of Korea's ICT trade

24. The structure of the ICT industry has changed rapidly in the past 15 year and can be characterised by (1) the fast rise of the telecom equipment sector, (2) integrated production with Asian countries, and (3) a shift in export destinations as a result of shifting production patterns. Figure 8 and 9 shows how exports and imports of ICT related products have increased from 1995. Figure 10 shows more clearly how telecommunication equipment and parts thereof have increased their share in exports rapidly while computer and parts thereof have decreased their share.

Figure 8. Exports of ICT and electronic products (1995-2006)
(billion USD)

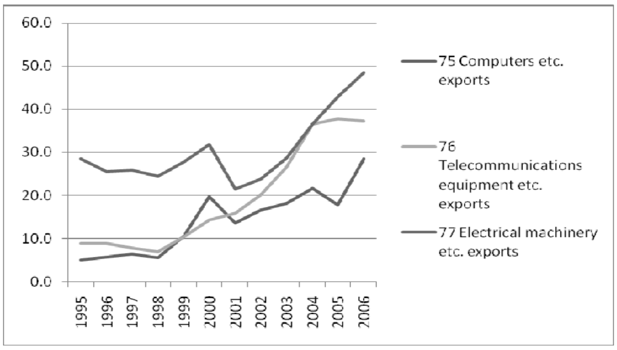
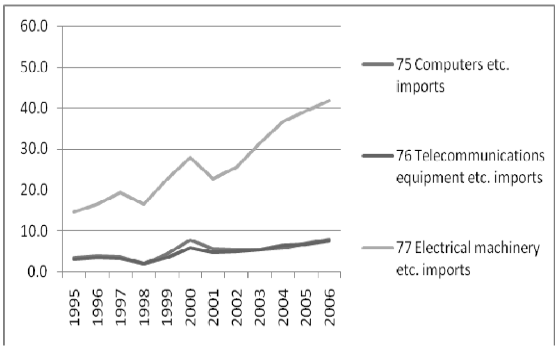


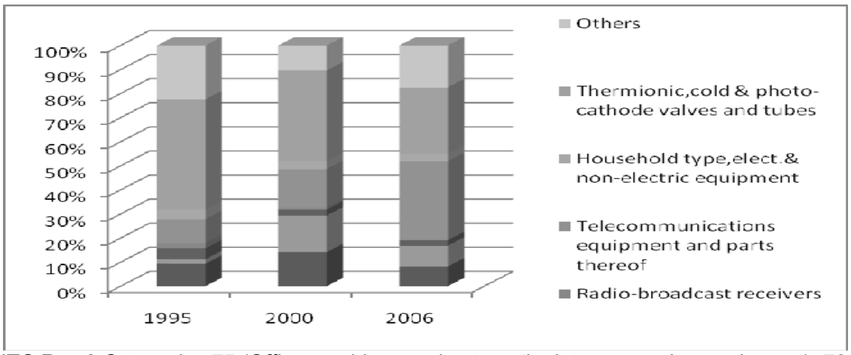
Figure 9. Imports of ICT and electronic products (1995-2006)
(billion USD)



Note. SITC Rev.2 Categories 75 (Office machines and automatic data processing equipment), 76 (telecommunications and sound recording), and 77 (electronic products)

(Source: WITS)

Figure 10. Shifting composition of ICT exports



Note. SITC Rev.2 Categories 75 (Office machines and automatic data processing equipment), 76 (telecommunications and sound recording), and 77 (electronic products)

(Source: WITS)

25. Table 10 which looks at IT product trade by region illustrates the changing patterns of trade. First, the major portion of the increasing trade surplus between 1999 and 2005 results from export to China which has grown 6 times in the same period. While exports to Japan and EU have doubled from 1999 to 2006, exports to the U.S. and ASEAN have not increased. On the other hand, imports from China has increased by a factor of six, and imports from ASEAN have doubled, and imports from Japan have grown somewhat while imports from the US have remained stable. This is a reflection of the growing production network in the Asian region. Establishment of manufacturing bases by Korean countries in low cost countries such as China have led to an export of semi-produced parts and components to these manufacturing bases. Such semi-produced parts and components are subsequently processed and directly exported from there to end-markets like U.S. Thus while direct exports to the U.S. have shown a modest increase while that to China has substantially increased, at least a part of exports to China reflect indirect exports to the US. The same applies to the case of imports as direct imports from the U.S. have been replaced by indirect imports with some processing made through ASEAN countries and China. Second, the substantial increase of trade figures with Japan and EU indicates that Korean firms have broadened their trade partners. Exposure to other countries as both markets and sources, and an increase in competition is believed to have a positive effect on the competitiveness of Korean firms.

Table 10. IT Product Trade Figures by Region

		1999	2000	2001	2002	2003	2004	2005
US	Export to	13,484	18,079	12,435	12,533	13,228	16,883	13,115
	Import from	9,863	11,745	7,228	7,203	7,712	8,421	8,619
	Surplus (Deficit)	3,621	6,334	5,207	5,330	5,516	8,462	4,496
Japan	Export to	4,999	7,121	5,131	5,098	6,062	7,264	7,629
	Import from	8,396	10,716	8,654	9,835	12,143	13,724	12,932
	Surplus (Deficit)	(3,397)	(3,595)	(3,523)	(4,737)	(6,081)	(6,460)	(5,303)
China*	Export to	5,539	7,891	7,563	12,872	19,824	27,657	35,618
	Import from	2,001	3,010	3,276	4,206	6,412	9,178	12,126
	Surplus (Deficit)	3,538	4,881	4,287	8,666	13,412	18,479	23,492
EU	Export to	8,389	11,050	8,276	9,422	10,847	16,406	18,635
	Import from	1,942	3,005	2,443	2,410	2,564	3,009	3,336
	Surplus (Deficit)	6,447	8,045	5,833	7,012	8,283	13,397	15,299
ASEAN	Export to	8,236	9,145	6,594	7,706	8,821	10,047	9,973
	Import from	4,458	7,400	6,282	6,679	7,535	8,063	9,040
	Surplus (Deficit)	3,778	1,745	312	1,027	1,286	1,984	933
Other	Export to	7,846	9,803	8,477	9,495	11,767	15,424	17,363
	Import from	3,674	5,684	5,056	5,565	6,072	7,360	7,897
	Surplus (Deficit)	4,172	4,119	3,421	3,930	5,695	8,064	9,466
Total	Export to	48,493	63,089	48,476	57,126	70,549	93,681	102,333
	Import from	30,334	41,560	32,939	35,898	42,438	49,755	53,950
	Surplus (Deficit)	18,159	21,529	15,537	21,228	28,111	43,926	48,383

* Including Hong Kong
Source: Annual Report on Information and Communication 2006,
Ministry of Information and Communication

26. Table 11 which takes a closer look at mobile telephone equipment and telecommunication parts and accessories show a better picture of how production networks have evolved. Exports of mobile handsets have increased from 584.5 million USD to 17.3 billion USD, mainly driven by growth in the US market and subsequently in the European market. Telecommunication parts and accessories which initially were not the main source of export growth have increased rapidly driven mainly by growth of China. Looking at imports of telecommunication parts and accessories, the figures show how China and ASEAN have increased their shares from 9% to 38% and from 11% to 16% while interestingly Japan and US's share have declined.

Table 11. Mobile telephone related goods trade

			1995		2000		2006	
			Mil USD	(%)	Mil USD	(%)	Mil USD	(%)
7643	Radio telephony etc. exports	China	0.6	0%	16.2	0%	288.1	2%
		ASEAN 5	15.5	3%	767.8	14%	1363.8	8%
		EU 25	99.0	17%	864.1	15%	6625.5	38%
		Japan	0.7	0%	30.2	1%	513.7	3%
		US	348.5	60%	2422.1	43%	3990.8	23%
		World	584.5	100%	5672.7	100%	17335.1	100%
7649	Telecomms parts/access exports	China	136.5	7%	573.6	17%	5216.7	36%
		ASEAN 5	389.7	21%	473.5	14%	886.0	6%
		EU 25	382.8	20%	561.7	17%	2160.6	15%
		Japan	253.8	14%	355.7	11%	252.7	2%
		US	123.4	7%	363.4	11%	825.8	6%
		World	1867.9	100%	3383.7	100%	14648.0	100%
7649	Telecomms parts/access imports	China	120.8	9%	262.9	11%	1151.0	38%
		ASEAN 5	152.3	11%	172.6	7%	469.5	16%
		EU 25	72.9	5%	224.1	10%	362.4	12%
		Japan	654.4	49%	1076.3	46%	538.9	18%
		US	240.0	18%	449.5	19%	285.4	9%
		World	1339.3	100%	2339.7	100%	3004.7	100%

(Note: SITC Rev 3 basis. Telecommunication parts and accessories include parts and accessories of other telephony equipment

Source : WITS

27. Korea has consistently accumulated trade deficits with Japan and this amount has continued to increase. Although the Korean IT industry has reached the competitive frontier in final products such as mobile communication and electronic devices, it is widely believed that it still heavily depends on advanced manufacturing equipments and core components imported from Japan and the U.S. As a result, the more final products the Korean companies sell, the more advanced manufacturing equipments and core components they need to import. For example, more than 60% of the components in mobile communication devices were imported in the late 1990s.[10]

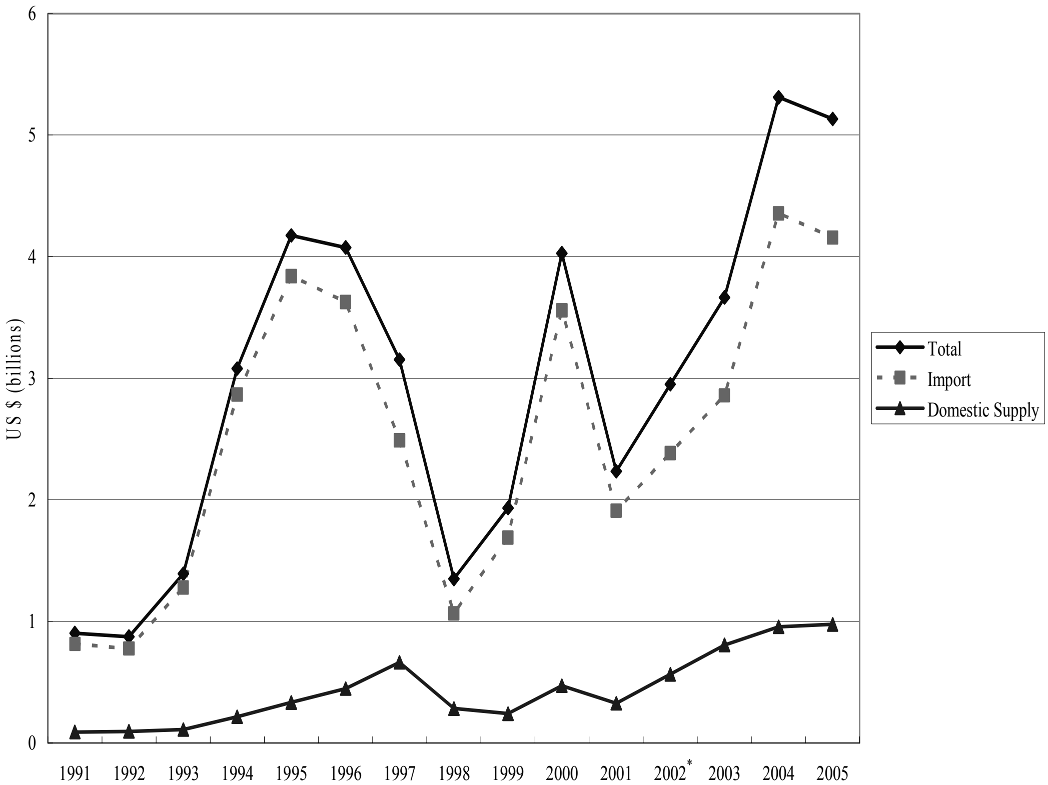
28. While this stylised fact does continue to hold for some areas such as semiconductor manufacturing equipment, with regard to telephony parts and accessories, for example, the data shows that Korea's dependency on developed countries is decreasing. Table 11 shows that the increase in imports of telecom parts has been much smaller than the increase in exports of final products and parts. Moreover,

10 Park, J. and Hahn, S. (1999) "The analysis of the impact of abolishing import source diversification regulation in the mobile communication devices" Information and Communication Policy, vol. 11, no. 6, pp. 23-39. (in Korean)

with regard to sourcing of telecom parts and accessories, there has been a rapid shift to China and ASEAN from the turn of the century with China increasing its share from 9% in 1995 to 38% in 2006, while the share of Japan and the US have decreased from 49% and 18% to 18% and 9% respectively. Considering the large IT trade surplus Korea has towards China and ASEAN which exceeds the deficits towards Japan by a factor of 4, it seems more accurate to see Korea as being a part of a large Asian ICT production network, in which Korea is becoming a supplier of key components as well as a final goods producer.

29. In the case of the semiconductor industry, advanced manufacturing equipments have primarily been dependent on imports from Japan and the U.S. Since the late 1990s, however, two noticeable changes have emerged. First, the portion of semiconductor manufacturing equipments supplied by Korean equipment suppliers has increased. While domestic suppliers accounted for about only 10% of the manufacturing equipment used by semiconductor manufacturers in the early 1990s, their market share has significantly increased since 1997, mainly in assembly and packaging equipments.[11][12] (Figure 11, Table 12). Secondly, the abolition in the 1990s of the import diversification policy has led to a shift from US suppliers to Japanese suppliers. Figure 12 indicates that the share of the U.S. in semiconductor equipment imports decreased from 50% in 1995 to a low of 37% in 1998 and has since then stood between 35-45%.

Figure 11. Korean semiconductor equipment market: Import and domestic supply



** Due to the lack of 2002 figure, the average of 2001 and 2003 figures was employed.*
(Source) Keller, W. and Pauly, L. (2001) and KSIA (2006)

11 . It is believed that the strong drive of the Korean government to support component and equipment manufacturers in key industries enhanced the capabilities of the local suppliers.

12 . The technology related to assembly and packaging equipments are easier to acquire compared to wafer processing and testing equipments, where entry barriers are considerably higher.

Table 12. Domestic Supplies and Imports in the Korean Semiconductor Equipment Market

(Unit: Million USD, Share of Domestic Supply)

	2003		2004		2005	
	Imports	Share of domestic supply	Imports	Share of domestic supply	Imports	Share of domestic supply
Wafer Processing Equipment	2,702	18.4%	4,011	14.7%	3,830	18.0%
Assembly and Packaging Equipment	277	37.9%	368	44.7%	255	43.2%
Testing Equipment	687	29.0%	932	19.4%	1,046	16.2%
Total	**3,666**	**22.0%**	**5,311**	**17.7%**	**5,132**	**18.9%**

Source: KSIA

Figure 12. Import of semiconductor manufacturing equipment

Figure 12.a (total imports and imports from US)
(million USD)

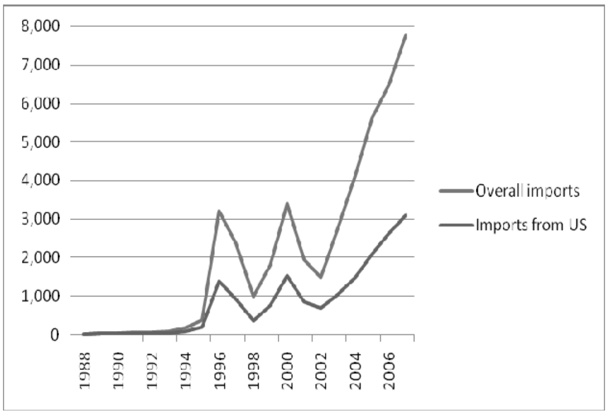
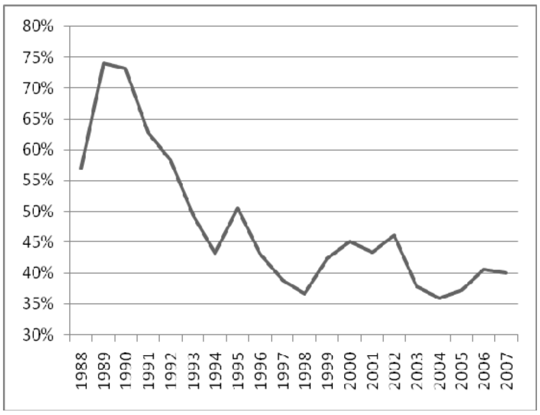


Figure 12.b (Share of US in total imports)
(percent)



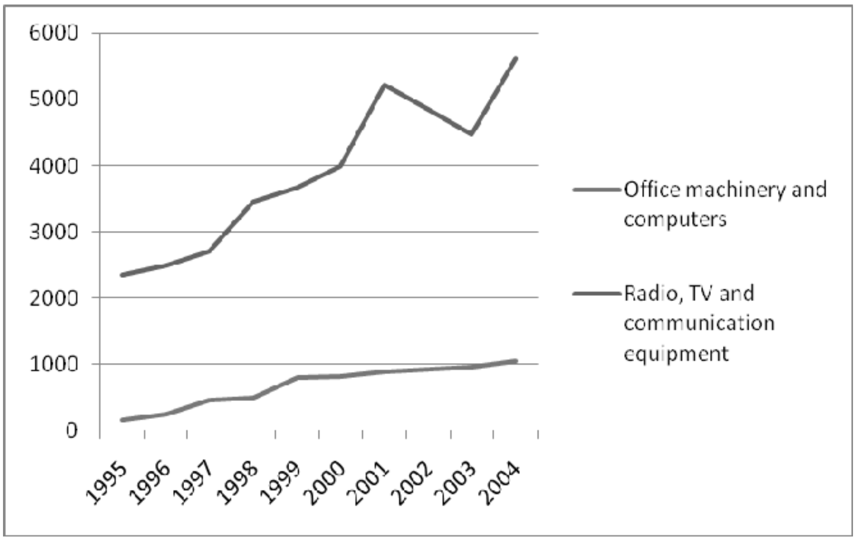
(Source: KIET)

(2) Changing pattern of Korea's ICT investment

30. Looking at FDI flows, both outflows and inflows have increased extensively from the mid 1990s. Outward investment in the ICT sector increased largely as a result of competitive pressures which dictate the need to utilise cheaper production overseas (Figure 13). Inward FDI rapidly increased in the post Asian crisis as Korean companies made a number of important divestments (Figure 14), and the ICT sector has consistently kept a prominent position in inward FDI since the turn of the century (Table 13). One prominent example is the area of Liquid Crystal Displays (LCDs) where Korea has become a leading global supplier. Foreign suppliers of flat glass (Asahi Glass, Nippon Electric Glass, Schott and NSG), polarising material (Sumitomo chemicals, Nitto Denko, and 3M), back light module related (Asahi chemicals, Toray, Harrison Toshiba Lighting), Liquid Crystals (Merck), etc. have flocked to make investments in Korea, which has led to an emergence of an industry cluster.[13] The number of research centres established in Korea in the ICT sector have also increased in recent years, which reflects the growing technological capabilities of Korea in this sector (Table 14).

13 . Shintaku (2008) citing presentation by Koo Bon-Kwan from Samsung Research Institute.

Figure 13. Korea's ICT outward investment stock



Note: Due to unavailability of data 2002 figures are shown as the average of 2001 and 2003

Source: OECD Stat

Figure 14. Inward FDI into Korea (1980-2007)

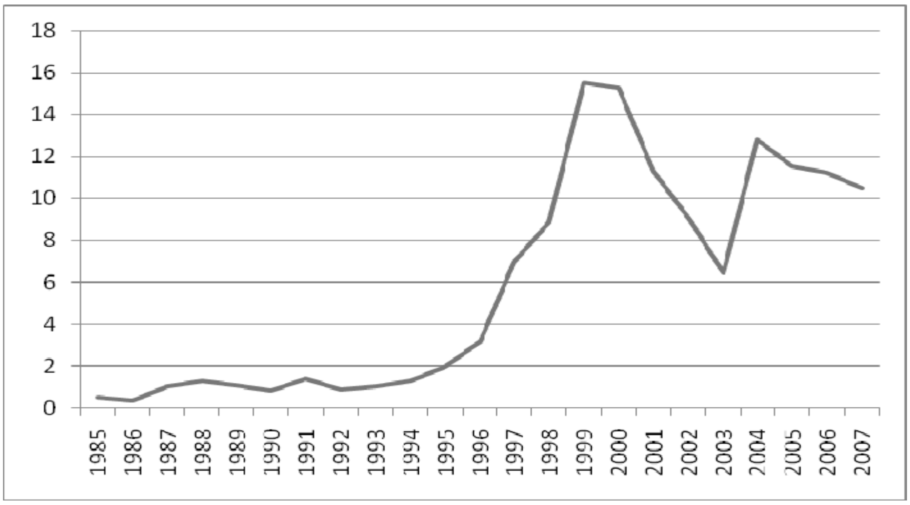


Table 13. Inward FDI to Korea (IT sector)
(Unit $ billion)

	2000	2001	2002	2003	2004	2005	2006	2007
Overall	15.3	11.3	9.1	6.5	12.8	11.6	11.2	10.5
IT Sector	2.7	2.1	0.6	1.0	3.2	2.6	2.3	1.5
· IT Service	0.4	0.3	0.1	0.5	0.1	0.9	0.1	0.4
· IT Device	1.9	1.6	0.4	0.3	2.8	1.0	1.7	0.8
· Software	0.4	0.2	0.1	0.2	0.3	0.7	0.4	0.3

Source: IT Statistics Information Center (www.iti.or.kr), Bank of Korea (ecos.bok.or.kr)

Table 14. Research centres established in Korea (2004-2006)

Company	Established	Activities
Intel	Mar. 2004	Digital home; Wireless
Fraunhofer IGD	May 2004	Virtual simulation
IBM	Jun. 2004	Telematics; Embedded software
Siemens	Jun. 2004	Network equipments
Hewlett Packard	Oct. 2004	FRID; Ubiquitous mobility
Agilent	Feb. 2005	Wireless RF module
Microsoft	Mar. 2005	Mobile device and solution
Sun	Apr. 2005	Mobile software; Embedded software
ON Semiconductor	May 2005	Mobile solution and component development
AMD	Dec. 2005	PMP, DMB, Wibro platform
SAP	Jan. 2006	Ubiquitous based business platform
Texas Instruments	Mar. 2006	T-DMB; Mobile WiMAX device platform solution
Motorola	Nov. 2006	u-City applicable sensor network system development
Oracle	Dec. 2006	N/A
BEA Systems	Dec. 2006	IP based communication and SOA technology

Source : Ministry of Information and Communication (2006)

III. Transformation of the ICT sector since the mid 1990s - role of Korea's public policies

31. The degree of openness of the economy plays a key role in the innovation performance of a country, by facilitating technology transfer, increasing competitive pressure and allowing for economies of scale. In Korea, the enhanced openness to trade after the mid 1990s, trade liberalisation on a global basis through the WTO Information Technology Agreement, deregulation and standards, and a more liberal investment policy all contributed to transformation of the ICT sector into an industry based on innovation.

3.1 Enhanced openness of Korea's ICT sector

(1) Trade liberalisation

32. The electrical machinery and ICT related goods sector has experienced considerable trade liberalisation since the early 1990s. Tariffs which still exceeded 10% in the early 1990s have been cut rapidly, with the pace of liberalisation being accelerated as the ITA came into force (Figure 15, Box 2). The phasing out of the "diversification" programme which progressed in the 1990s was considered a huge challenge to Korea's industry at the time. As expected, the import of items which were taken off the list in 1999 did increase rapidly. For example, in 2002, imports of such items as passenger cars, camcorders, and colour TVs jumped by 77% from the previous year, while total imports had increased only by 6% over the same period.[14] However, the policy change also had the effect of pushing Korean firms to be more competitive,[15] and in some sectors, such as telecommunication equipment, reliance on Japanese parts and components have decreased.

14 The Hankyoreh, January 15, 2003.

15 ETNews, August 26, 2004.

Figure 15. Korea's MFN tariffs for ICT related products

Description	ISIC Rev.2	1988	1992	1996	1999	2002	2004	2006
Manufacture of electrical machinery apparatus, applicances and supplies	383	14.80	10.56	7.92	4.39	2.23	2.48	2.47
Manufacture of electrical industrial machinery and apparatus	3831	19.60	10.90	7.52	7.73	4.74	4.82	4.62
Manufacture of radio, television and communication equipment and apparatus	3832	13.14	10.42	7.99	3.55	1.28	1.29	1.15
Manufacture of electrical appliances and housewares	3833	16.09	12.60	8.00	8.00	8.00	8.00	8.00
Manufacture of electrical apparatus and supplies nec	3839	20.77	11.26	8.00	7.80	7.16	7.00	6.93

(Source: UNCTAD TRAINS database)

Box 2. The WTO Information Technology Agreement

The WTO information Technology Agreement (ITA) is a voluntary or plurilateral initiative to liberalise trade in information technology products under the framework of the World Trade Organisation (WTO). It provides a binding mechanism to eliminate tariffs on a set of predefined IT products and provides a review mechanism for non-tariff barriers. The ITA entered into force in 1997 when 40 WTO participants, including Korea, covering 90 percent of world trade in IT products agreed to sign the declaration. This group has subsequently expanded to include 67 participants including newly acceding countries such as China and accounting for 97percent of world trade.

Despite considerable tariff reduction, Korea still had relatively high tariffs on some ICT related products as of 1997, which ranged from 7.9% to 23.6%. As an initial signatory to the WTO Information Technology Agreement, Korea started to gradually cut tariffs on information technology products included in the agreements. Most of the tariff cuts were made with an end date of 2000 with the exception of some communication equipment and certain semiconductors which were considered more sensitive.[16] The ITA tariff cuts increased competition in the domestic market, leading to a considerable increase in imports of ITA goods but it also led to an increase in exports. Imports of IT products grew at a compounded annual growth rate (CAGR) of 9.8% while exports grew even faster at a CAGR of 11.4% (Lee, 2007). While the ITA has led to an increase in imports, the effect of the ITA on Korean industry through an increase in exports and international production network seems to have been larger.

(2) Investment policy

33. As noted in previous sections, investment policy up to the 1980s affected the evolution of the Korean electronics and ICT industry by restricting inward-FDI. The much liberalised FDI policy in the 1990s onwards, together with the aforementioned liberal trade policy has had the effect of promoting competition and innovation. Here we briefly look at how inward and outward FDI policy have changed after the 1990s.

34. While Korea had already started along the path of a more open FDI policy around the mid - 1980s, the Asian financial crisis in 1997 provided a major turning point as Korea was forced to rely on foreign funding to restructure the economy. Korea undertook major liberalisation in FDI through the New Foreign Investment Promotion Act (1998, revised in 1999) and went a step further, putting into place a range of incentives to promote inward FDI. Incentives provided to greenfield investment and foreign stock acquisitions in eligible advanced technology investments and industry-supporting service industries include full and partial corporate income tax concessions for up to a total of ten years; similar concessions on various local taxes (acquisition, property, registration, and land taxes); and full exemptions from customs duties (customs, special excise, and value-added taxes) on imported capital goods for up to three

16 . The former had an end date of 2002 while the latter had an end date of 2004.

years. Korea also operates an elaborate system of zones to provide tax and other incentives, such as rent subsidies on state land (WTO, 2005). These pro-inward FDI policies together with the increasing clout of the Korean ICT industry has contributed to the recent rapid increase in FDI in high technology sectors.

35. Korea has also put in place pro-outward FDI policies in place as the importance of production networks have increased. A brief analysis of Korea's BITs finds that up to the 1980s, BITS were more often signed with developed countries with the intention of promoting inward FDI. From the mid-1980s onwards there seems to be a greater focus on providing protection to Korean investors overseas. Korea currently has 62 bilateral investment treaties in force (Table 15)[17].

Table 15. Korea's bilateral investment treaties

Year	-1980	1981-1990	1991-1995	1996-2000	2001-
No of BITs entered into force In period	7	7	16	18	5
Countries (year)	Belgium/Lux (1976), France (1979), Germany (1967), Netherlands (1975, 2005), Sri Lanka (1980), Switzerland (1971, 2006), Tunisia (1975), UK (1976)	Bangladesh(1988), Denmark (1988), Hungary (1989), Pakistan (1990), Poland (1990), Senegal (1985), Thailand (1989, 2002)	Austria (1991), China(1992), Czech rep. (1995), Greece (1995), Indonesia (1994), Italy (1992), Lithuania (1993), Mongolia (1991), Paraguay (1993), Peru (1994), Russia (1991), Spain (1994), Tajikistan (1995), Turkey (1994), Uzbekistan (1992), Vietnam (1993)	Argentina (1996), Belarus (1997), Bolivia (1997), Egypt (1997), Finland (1996), Hong Kong (1997), India (1996), Kazakhstan (1996), Lao Rep. (1996), Latvia (1997), Mexico (2000), Nicaragua (2001), Panama (2002), Portugal (1996), Serbia (2000), South Africa (1997), Sweden (1997), Ukraine (1997)	Costa Rica (2002), Israel (2003), Japan (2003), Jordan (2004), Saudi Arabia (2002)

Source : Based on ICSID database on bilateral investment treaties available at http://icsid.worldbank.org

3.2 Other relevant policies

36. While the openness of the economy has been an important factor for improving Korea's innovation performance, it should not be considered in isolation. Open trade and investment regimes are not a sufficient condition for triggering the development and absorption of technology and innovation. R&D policies, education policies and the fostering of links between industry and academia have played an important role in the innovation system, which we describe briefly in this section.

(1) R&D policy

37. Table 16 shows how Korean government R&D programmes have shifted from one that is government led to one increasingly led by the private sector with government playing more of a catalyst role. The share of government expenditure in gross expenditure on research and development (GERD) in the 1970s which was as high as 50% has gradually decreased to 20% in the 1990s and 2000s. The ICT sector has been a main driver of R&D investment in recent years constituting around 45% of the total, with the private sector accounting for roughly 90% which is higher than the average 80% (Table 17).

17 . Korea has also signed BITS with Algeria (1999), Brazil (1995), Croatia (2005), Dominican Rep. (2006), Iran (1998), Lebanon (2006), Malaysia (1998), Philippines (1994), Romania (1990), Tanzania (1998), and Zaire (1990) which have not entered into force.

Table 16. History of Korean government R&D programmes

Innovation model	Decade	Emphasis and Initiatives	Remarks
Linear innovation model stage	1960s (Infant stage of ST policy)	• Imports of foreign technology • Laws for ST promotion • Established MOST, KIST, etc.	R&D/GDP=0.3%
	1970s (Building institutions)	• Imitation and reverse engineering • Laws for R&D promotion • Established 16 GRIs	R&D/GDP=0.4~0.8% (Public:private = 50:50)
Interactive innovation model stage	1980s (National R&D Programme)	• Development of indigenous technology • Started National R&D programme • Promotion of private sector's laboratories	R&D/GDP=0.8~2% (Public:private = 20:80)
	1990s (Diversification of government R&D)	• Development of high-tech • Promotion of university research • Started Highly Advanced National (HAN) Project	R&D/GDP = 2~3% (Public:private = 20:80)
Integrated innovation model stage	2000s (Elaboration of government R&D)	• Development of innovation-based economy • Started Creative Research programme, National Research Laboratory Programme, The 21 Century Frontier Programme, etc.	R&D/GDP = 3% (Public:private = 20:80)

Source : Hong (2005), Table 3.2

Table 17. R&D investment (2000-2004)

(100 million won, percent)

	2001	2002	2003	2004	2005	2006
Science and technology sector	161,105	173,251	190,687	221,853	241,554	273,457
Of which ICT sector	71,100	72,191	78,463	103,707	112,830	130,283
% of ICT sector to total	44.1%	41.7%	41.1%	46.7%	46.7%	47.6%
ICT of which public sector	7,720	11,196	9,624	11,399	12,028	13,656
ICT of which private sector	63,379	60,995	68,839	92,308	100,802	116,627
% of private sector in ICT R&D	89%	84%	88%	89%	89%	90%

Source : www.itstat.go.kr

(2) IPR policy

38. Protection of intellectual property rights (IPR) is considered important both in order to promote invention and to promote diffusion of technology. IPR protection in Korea had been relatively weak although on par or better than countries at comparable levels of development, but has been progressively been strengthened. For example, a look at the evolution of the patent rights index[18], one finds that (1) Korea's patent rights index was relatively high at 2.12 in the 1970s although lagging behind OECD countries, (2) it has progressively improved at a faster pace than other countries at comparable levels of development, with the largest improvement between 1985 and 1990, and (3) it now stands at 4.33 which is broadly comparable with other OECD countries (Table 18). There have been three main changes in

18 . The patents right index is an index constructed to assess the strength of patent protection by Ginarte and Park (1997). It is constructed by assigning figures of zero (weakest) to five (strongest) for five components: extent of coverage, membership in international treaties, duration of protection, absence of restriction on rights, and statutory enforcement provisions, and then aggregating the results. See Park and Lippoldt (2008) for details.

Korea's IPR protection; (1) revision of the patent law in 1980 in compliance with the Paris Convention for the Protection of Industrial Property and in 1982 in compliance with the Patent Cooperation Treaty (PCT); (2) revision of the patent law in 1986 to introduce the substance patent for pharmaceutical and chemical materials; and (3) revision of the patent law in 1995 in compliance with the Uruguay Round TRIPs Agreement (Song, 2006).

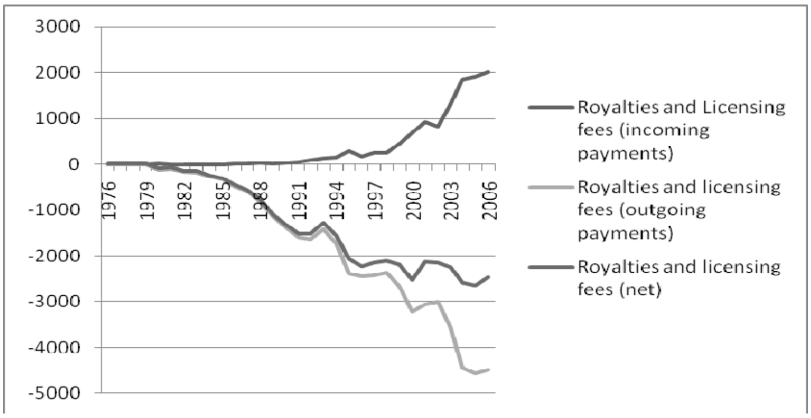
Table 18. Evolution of the patent rights Index (1970-2005)

Country\Year	1970	1975	1980	1985	1990	1995	2000	2005
Rep of Korea	2.12	2.25	2.45	2.65	3.69	3.89	4.13	4.33
Brazil	1.21	1.08	1.28	1.28	1.28	1.48	3.59	3.59
China				1.33	1.33	2.12	3.09	4.08
Chinese Taipei	1.26	1.26	1.26	1.26	1.26	3.17	3.29	3.74
Malaysia	1.59	1.59	1.59	1.92	2.05	2.70	3.03	3.48
Philippines	2.16	2.16	2.16	2.36	2.36	2.56	3.98	4.18
Singapore	1.51	1.51	1.71	1.71	2.04	3.88	4.01	4.21
Thailand	0.75	0.75	1.21	1.21	1.21	2.41	2.53	2.66
France	3.23	3.23	3.63	3.76	3.88	4.54	4.67	4.67
Germany	3.01	3.01	3.64	3.84	3.97	4.17	4.50	4.50
Japan	2.40	2.78	3.43	3.43	3.88	4.42	4.67	4.67
Mexico	1.12	1.12	1.12	1.35	1.36	3.14	3.68	3.88
Turkey	1.20	1.20	1.20	1.20	1.20	2.65	4.01	4.01
United States	3.83	3.83	4.35	4.68	4.68	4.88	4.88	4.88

Source : Based on data in Park and Lippoldt (2008)

39. Figure 16 shows how royalties and licensing fees, which reflect inward technology transfer, have increased over the years as Korea's IPR regime has improved and the economy has developed. Royalties and licensing fees payments increased rapidly during the 1980s and have continued to increase except for brief periods of time. While there continues to be a significant net outflow in terms of royalties and licensing fees, incoming payments have also increased rapidly from the mid 1990s. This is due to several factors; (1) enhanced technological capability as reflected in patent data; (2) increase in outward foreign direct investment[19]; and (3) improvement in IPR protection in developing countries with the TRIPs agreement.

Figure 16. Royalties and licensing fees
(Millions current USD)



(Source: IMF Balance of Payment Statistics: Code 2266.9 and Code 3266.9)

19 . An increase in outward FDI tends to lead to an increase in inward royalty payments as foreign subsidiaries make royalty and licensing fee payments to the parent company.

40. The number of patents filed by Korean companies has increased rapidly since the early 1990s (Table 19, Figure 17). ICT companies have been the main drivers of the recent increase, constituting over 60% of US patents filed by Korean companies over the period 2000-2006 (Figure 18)). Korea has increased its share of US patents in both the telecommunication equipment sector and semiconductor segment rapidly from the early 1990s which reflects the increasing emphasis that Korean companies are placing on intellectual property rights (Figure 19 and Figure 20).

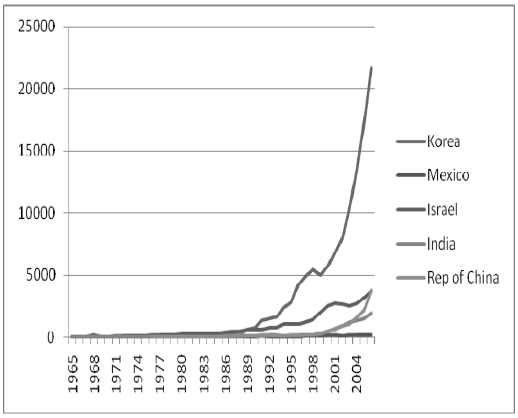
Table 19. Average U.S. utility patent counts by country (1963-2007)

	1963-86	1987-1991	1992-1996	1997-2001	2002-2007
Rep. of Korea	10.8	194.0	982.8	3112.8	4785.5
Mexico	52.2	38.6	41.4	67.0	77.7
Israel	86.2	282.2	373.4	756.8	1085.0
India	12.0	17.0	30.6	110.6	394.2
People's Rep of China	4.9	43.8	50.0	107.6	470.8

Note. U.S. patent count per annum calculated over period. 10.8 shows that an average of 10.8 patents were granted to Korean residents between 1963-1986.

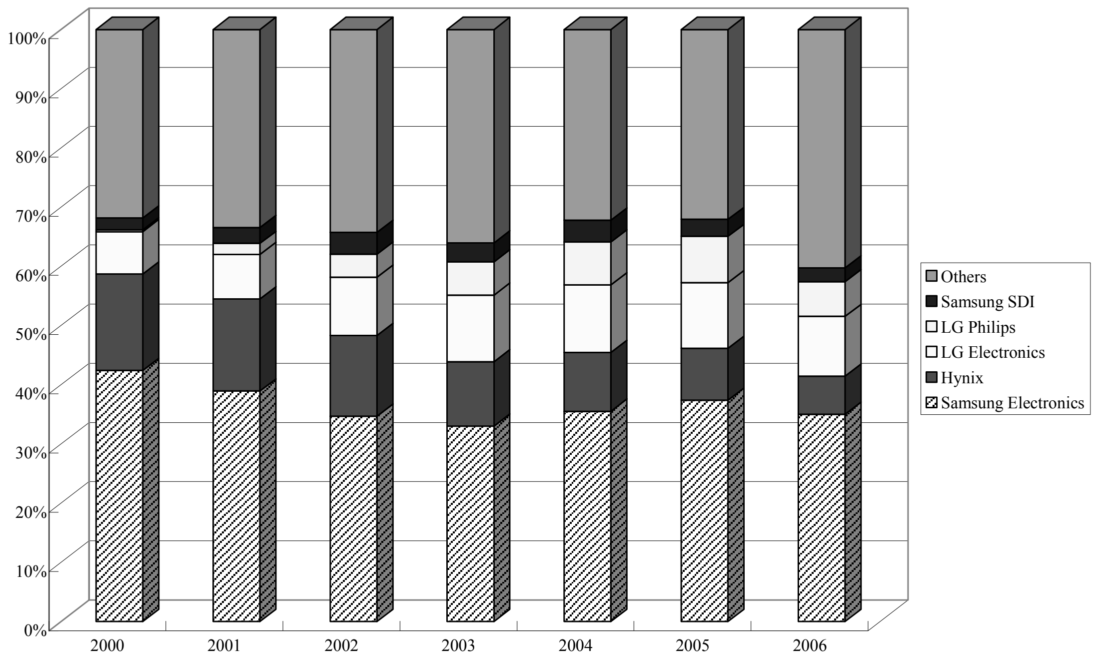
Source : Based on U.S. Patent and Trademark Office (2007)

Figure 17. Number of utility patent applications filed in the United States (1965-2006)



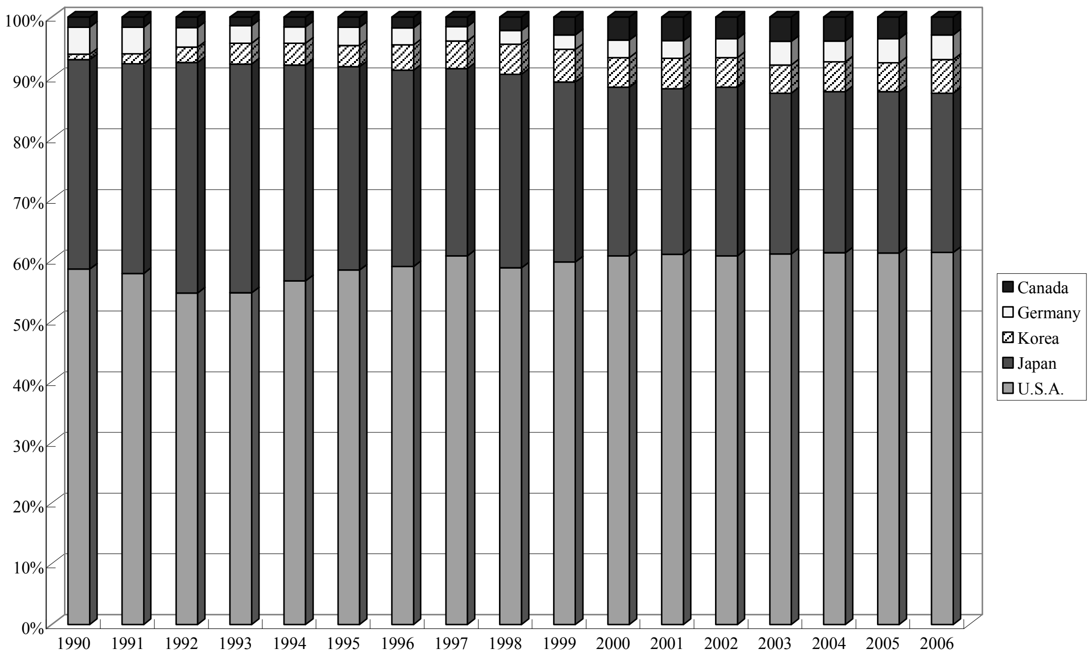
Source: U.S. Patent and Trademark Office (2007)

Figure 18. The share of US patents filed by the top five Korean companies (2000-2006)



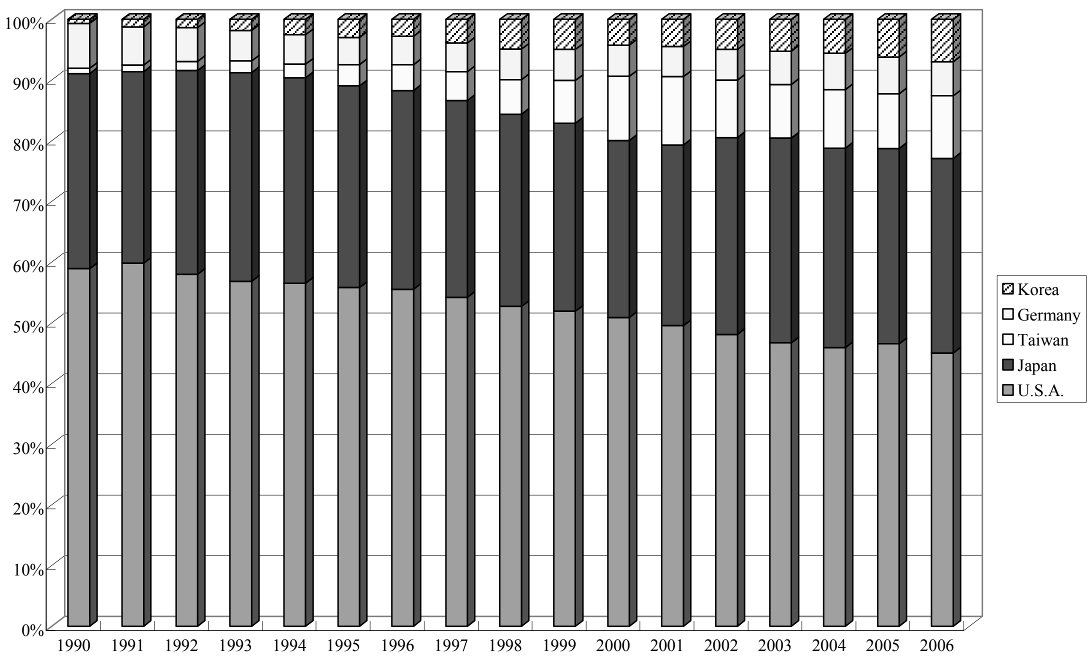
Source: Technological competitiveness of Korea: Analysis of U.S. patents. Korean Intellectual Property Office. 2007.

Figure 19. The share of US patents filed in the communication equipment/device sector (1990-2006)



Source: Technological competitiveness of Korea: Analysis of U.S. patents. Korean Intellectual Property Office. 2007.

Figure 20. The share of US patents filed in the semiconductor segment (1990-2006)



Source: Technological competitiveness of Korea: Analysis of U.S. patents. Korean Intellectual Property Office. 2007.

(3) Introduction of international standards and deregulation of telecommunication services

41. Standards and regulations have a strong effect in the telecommunication sector, and one factor that has been very important in the rapid growth of the telecommunication equipment sector in Korea has been the introduction of international standards. Korea was one of the early developers of CDMA, a basic technology developed by Qualcomm. Samsung developed its first CDMA phone in March 1996, and as of the end of 1997 had a market share of 57% in the CDMA market.[20] Samsung entered the US cdmaOne market relatively early in 1997 since the Korean firms had struck a special deal with Qualcomm in return for Korea's wholesale adoption of CDMA (Funk, 2002). Samsung also benefited from Korea's weak currency and the high growth in their CDMA domestic market where it was the number one supplier (Funk, 2002). The US market did not become larger than the Korean market until mid-1999 and economies of scale achieved through domestic sales helped Samsung acquire a growing part of the US market in 1997, 1998 and 1999. It also entered other CDMA markets such as Hong Kong (1997) and Brazil (1998), and accounted for more than 50% of the worldwide CDMA market in 1999 (Lee and Lee, 2004). However, the worldwide CDMA market was far smaller than the GSM market, which accounted for 70% of the total world mobile communication market at the time, and so Samsung made a decision to enter the GSM market. Samsung was subsequently able to use the capabilities acquired in the CDMA market to subsequently enter the GSM market although this required substantial additional resources.

42. The deregulation in the mobile telecommunication market together with introduction of effective competition has also contributed to rapid growth and increased levels of innovation in the Korean ICT industry. Korea took the first steps in opening its telecommunication market to competition by allowing duopoly in international telecommunication services in 1990, followed by introduction of duopoly for mobile services in 1994, and the provision of licenses to new entrants in a variety of service areas from 1996 onwards, and has continued to progressively reform this sector (Table 20).[21] The development of the telecommunication service industry in Korea has been impressive, and revenue has grown at 20% between 1992-97, with a rapid build-up of the national public telecommunications infrastructure and of cellular mobile markets (OECD, 2000b). The mobile market in Korea, driven by competition, has grown significantly. In 1995-98 mobile revenues increased nearly six-fold. In August 1999, the rate of penetration of cellular mobile phones reached 43.4% of the population, the fifth highest rate in the OECD (OECD, 2000b). In 2007, the penetration rate was 89.9% far exceeding the OECD average of 80% in 2005.

43. Deregulation in telecommunication services was a key factor in the rapid growth of the domestic market, which in turn together with the early adoption of international standards were the key factors which facilitated Samsung's entry into the global telecommunication equipment market.

Table 20. Number of carriers participating in each market

Category	Local	Long - distance	Int'l	Cellular	PCS	CATV	
						SO	NO
1991	1	1	2	1	-	-	-
1991-95	1	2	2	2	-	53	3
1995-98	2	3	3	2	3	77	104
2005	3	5	5	1	2	2	119

Source : OECD (2007b)

20 . Samsung also had 58% in the PCS market at the time.

21 . See OECD (1997) and Chapter 5 in OECD (2007) for detailed discussion on deregulation in the telecommunication sector in Korea.

(4) Informatisation policy and the creation of domestic demand[22]

44. As stated in Box 1, the Korean government has implemented informatisation policies based on a series of ICT plans from the mid 1980s. The Korean Information Infrastructure (KII) initiative initiated in the mid 1990s proved to be a landmark as it included the construction of a national high speed backbone, the development of ICT applications, and the promotion of R&D and IT related pilot projects. This has contributed to the demand for ICT products and services in the domestic market. Two key informatisation policies of note are (1) a policy to lower service charges, (2) education policies and (3) emphasis on competition, which have been mutually reinforcing. First, in terms of policy to lower service charges, for example in the initial stages of the KII, the government insisted upon an extremely low price for the public sector and free service for schools (Choi, 2008). This allowed the creation of initial demand, and a signalling effect which in turn led to the informatisation of the general public in tandem with the education policy. The demand in turn allowed for the lowering of prices.[23] Second, the government put in place strong education polices which aimed to increase the extent of ICT literacy both in the youth sector and the other sectors. While the pricing policy towards the education sector made ICT education available on a widespread scale, this opened the path for a widespread increase in the ICT population. Third, the government instituted a number of policies to ensure a level playing field for late comers providing mobile phone services to encourage competition among service operators which included the introduction of number portability in 2004. This led to the number of consumers switching carriers jumped from 3 million users in 2004 to 16.8 million in 2006. These informatisation policies in tandem has jointly contributed to the explosive increase in demand for ICT goods and services in the domestic market.

(5) Policies to develop foreign markets

45. The Korean government has also put in place some policies to help and encourage the development of foreign markets focus on two major areas: activities to increase the Korean IT firms' exposure, and supports for SMEs (small-to-medium sized enterprises) to develop foreign markets.[24] First, Korea Agency for Digital Opportunity and Promotion's Information Access Center (IAC)[25] and National Computerization Agency's Information Technology Cooperation Center (ITCC) are the facilities established in emerging countries where local people get computer training and access internet through products and services provided by Korean firms. Also the government officials from emerging countries have been invited to Korea for IT-related training (184 official in 2006 and 261 in 2007). These are the measures to indirectly help Korean firms enter foreign markets. Second, various agencies including KIICA (Korea IT International Cooperation Agency), KOTRA (Korea Trade-Investment Promotion Agency), and SBC (Small & Medium Business Corporation) provide assistance to SMEs to develop foreign markets. Databases on the firms and foreign market information have been constructed and open to the SMEs that possess competitive products but lack capabilities to develop foreign markets.

IV. Samsung – Star of the Korean ICT industry

46. Korean chaebols, in particular Samsung, Lucky Goldstar and Daewoo among others have played a central role in the evolution of Korea's innovation system. While the government has provided the framework conditions for innovation, and also played a significant supporting role, it was ultimately the

22 . See for example ITU (2003) and Choi (2008) for further discussion on the demand side policies.

23 . As a result of these measures, the price for broadband internet access for example dropped from 1,720 won per megabyte in 2002 to 1,280 won per megabyte in 2006; the cost of making calls from mobile phones decreased by 3.7% in 2004; the cost for transferring data over mobile handsets reduced by 30% in 2007.

24 Ministry of Information and Communication

25 IACs opened in such countries as Cambodia, Vietnam, Philippine, Egypt, Romania, and Bulgaria.

business sector that has introduced and commercialised innovations. Samsung, in particular, has played a major role in the transformation of the Korean economy and Korea's innovation system, especially in the past two decades.[26] The company has had an important effect on Korean exports, GDP, and gross domestic R&D expenditure.

47. This section does not aim to provide an in-depth analysis of Samsung's business strategy and its success factors. Instead it examines how Samsung has transformed itself by taking advantage of the increasingly liberal global trade and investment environment to become one of Korea's most innovative companies and one of the global leaders in the ICT industry. The section starts with a brief account of the company's evolution and then focuses on Samsung's strategies in international R&D, manufacturing, sourcing, supply chain management, sales and distribution. (Other key determinants of Samsung's success include its strong branding and marketing strategy, its investment strategy of investing in large capacity when other companies are cautious, and effective human resource management. These elements will however not be examined in the framework of this study).

4.1 Evolution of Samsung to the early 1990s[27]

48. The Samsung Group is today the largest chaebol in Korea, which has businesses spanning from electronics and electro-mechanics, shipbuilding and engineering, petrochemicals and fine chemicals, life insurance and securities to trading and constructions. Samsung Electronics is its largest company with 2006 consolidated sales of $92 billion and net income of $8.5 billion. It employs 128,000 people in more than 120 offices in 57 countries, and is organized into five major businesses: (1) semiconductors (memory chips, system LSI devices and hard disc drives), (2) LCDs (TFT-LCD products in various applications), (3) telecommunication networks (mobile phones, telecommunication systems), (4) digital appliances (washing machines, refrigerators, air conditioners and system cooking) and (5) digital media (TVs, audio/video products, PCs and computer peripherals) (Samsung, 2006). It is among the global leaders in semiconductor such as DRAM, SRAM chips, and flash memory, CDMA mobile handsets, and digital media technologies such as Liquid Crystal Displays (LCDs), and has fast become a truly global multinational company. For example, value of the Samsung brand was US$16.1 billion in 2006 in the Brand Value Survey conducted by *Business week* magazine and Interbrand, or 20th among all corporations in the world and 7th in the IT sector. Samsung Electronics is also ranked 27th in the world on *Fortune* magazine's list of Global Most Admired Companies.

49. Samsung's success in particularly noteworthy in light of two factors: first, the company's medium sized domestic market (Korea has a population of 48 million) and, second, its origins and recent history. Samsung started off in 1938 as a trading company, and while it entered two manufacturing sectors (i.e. sugar and textiles) in the mid-1950s, it was not until 1969 that the firm entered the electronics industry with the incorporation of Samsung Electronics Co.

50. One major characteristic of Samsung's entry into the electronics industry was its reliance on foreign technology.[28] Table 21 provides a brief overview of Samsung's evolution to the 1990s.

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26 This is in contrast with limited role of business start-ups and venture capital financing.

27 . This section draws extensively on Kim (1997).

28 . Kim (1997) refers three other characteristics: (1) emphasis on mass production, (2) a follow-the-leader strategy, and (3) government support, which we do not go into detail here. The emphasis on mass production stems from its experiences in the sugar and textiles: this knowledge on mass-production was of great benefit especially in DRAMs. The follow-the-leader strategy refers to the fact that Samsung entered the electronics industry after Goldstar Electrical who had already started assembling vacuum tube radios

Table 21. Samsung's technological capabilities and features of international production

	1970s	1980s	1990s	2000s
Key activities	Conglomerate diversification	Entry into DRAM market	Organisational reform, internationalisation	Transformation into a global company.
Main sources of capabilities	J/V partners, Original Equipment Manufacturer (OEM) buyers and overseas training	OEM buyers, foreign licensing, reverse ebngineering	Acquisitions, strategic alliances, in-house R&D	In-house R&D, strategic alliances and increasing emphasis on intellectual property.
Level of technological capabilities	Capabilities in mass production (TVs)	Broader product range (VCR, MWO, DRAM, components) but very weak in ability to introduce a major change of product	Continued weakness in product development	Strengthened R&D and design capabilities, with a core competency in product development.
International production and scope of interaction		US & EC for low-end markets (limited success). Centralised intra-firm interaction	International production of low-end items in peripheral regions. Moving toward decentralised intra- and inter-firm interaction	Creation of a global production network mainly in the Asian region but also in other parts of the globe as well.

Source : Kim (1994) for 1970s – 1990s.

(1) 1970s – Dependence on foreign technology

51. Given its lack of experience in electronics, Samsung had no choice but to turn to foreign sources of technology in management, production in marketing and Samsung established a close relationship with Japanese and US firms. It created several joint ventures with foreign technology suppliers such as NEC, Sanyo, Corning Glass Works and other companies.[29] It reached numerous agreements to assemble electronic products for foreign original equipment manufacturer (OEM) buyers, who provided it with design and engineering support as well as with an international market. Samsung also relied extensively on outside suppliers for the purchase of core components. However, Samsung and its affiliated partners have increased its capabilities for parts supply and for some parts even began to ship parts to Korean and Japanese customers.

52. Samsung electronics expanded and improved its assembling capacity, producing 10 million black and white TV sets by the end of the 1970s. Most sales were through OEM channels. OEM buyers provided Samsung with product design, quality control and engineering support, leaving Samsung to increase its manufacturing capability. Samsung continued to increase access to other international distributors and was able to renegotiate and ease initial geographical restrictions imposed by its joint venture partners.[30]

53. Samsung expanded its OEM channels and capabilities by adding two new products – VCRs and microwave ovens. As Samsung was unable to gain foreign licensing for these products, it used "reverse engineering", and succeeded in developing its own microwave in 1978 and a VCR in 1979. Samsung further diversified into the telecommunication sector through a 1977 JV with GTE of the US. In 1974, Samsung acquired Korea Semiconductor Co. (KSC), a joint venture between Korea Engineering & Manufacturing Co. and Integrated Circuit International, a US firm, which manufactured simple integrated

for a US firm in 1959.Government support refers to the fact that Samsung's entry into electronics followed the introduction of the Electronics Industry Promotion Law in 1968.

29 . Samsung-Sanyo was established in 1969 and. Samsung-NEC was established in 1970 and produced. Samsung-Sanyo Parts was established in 1973 for the production of parts for televisions, including tuners, deflection yokes, transformers and condensers. Samsung-Corning established in 1973 produced glass bulbs for the production of cathode ray tubes (CRTs).

30 . Joint venture agreements often included clauses which restricted Samsung's sale of its products in overseas markets.

circuits for electronic watches, which formed the basis for Samsung's entry into the dynamic random access memories (DRAMs) business.

(2) 1980s and early 1990s– Upgrading of technology – entry into DRAMs

54. The 1980s was the period of expansion and diversification for Samsung. As Samsung began to experience limitations on growth in the CTV and VCR markets due to lack of component availability, Samsung made a decision to enter the IC business. To achieve its objective, Samsung once again tried to learn foreign technology through a broad range of formal and informal contacts, and decided to enter the DRAM market which was considered more suitable for Samsung which had familiarity with incremental process innovation and large scale manufacturing efficiency both of which could become sources of competitive advantage in this sector. In 1983, Samsung licensed a DRAM design from Micron Technology, a US company, and entered the merchant market for DRAMs which require the most advanced manufacturing technologies and huge capital outlays. In 1983, Samsung successfully developed a 64K-DRAM, followed by a 256K in 1984, and a 1M DRAM in 1986. Samsung continued to upgrade its technology and decreased its reliance on outside technology, except for capital equipment and thus rose from a virtually zero share in memory chips in 1984 to be the world market leader in DRAMs by 1992. Table 22 shows how Samsung has gradually caught up with technology leaders: Samsung kept closing the gap between itself and the technology leaders, and has been the leader in DRAM development since 1992 when it the first company in the world to develop 64 Mbit DRAM.

Table 22. Samsung's technology gap in DRAM

	64Kbit[1]	256Kbit	1Mbit	4Mbit[2]	16Mbit	64Mbit	256Mbit	1Gbit	4Gbit
First Development Company	Intel	NEC	Toshiba	Hitachi	Samsung/ NEC	Samsung	Samsung	Samsung	Samsung
Development Date By Leader	06/1979	01/1981	07/1984	08/1987	4/1990	08/1992	08/1994	11/1996	12/2000
Development Date By Samsung	12/1983	01/1984	06/1986	02/1988	7/1990	08/1992	08/1994	11/1996	12/2000
Gap b/w Leader and Samsung	4 years -	3 years	2 years	6 months	3 months	-	-	-	-

[1] Design licensing from Micron Technology; Process technology from Sharp
[2] Samsung with two Korean partners
Source: Kim (1997), Siegel and Chang (2006), Samsung website (http://www.samsung.com).

55. By the late 1980s, Samsung was able to produce a wide variety of semiconductors for use in phone sets, computers, private automatic branch exchanges (PABXs), facsimile machines, and VCRs (Kim, 1997). As a result, it was able to reduce dependency on Japanese suppliers for core components. Nonetheless the majority of the DRAMs produced in Korea were exported to foreign countries and the other non-memory chips required (i.e. microprocessors) continued to be imported from other countries (Kim, 1998). The strong resource shift to semiconductors meant that development of other capabilities suffered to some extent. While SEC had a minor change capability, it remained weak in major change capability (Kim, 1997). As a result, it continued to use license technology from foreign companies even for its main export products in this period.[31] OEM channels remained dominant in the company sales at over 65% of total sales even in 1988, and Samsung maintained close relationships with OEM buyers such as JC Penney, Sears Roebuck, GTE, Toshiba, IBM, Hewlett Packard, RCA and Crown Corporation (Kim, 1997).

31 . For example, Licensing from Toshiba for Hi-fi VCRs over three years (1987), Sanyo for microwave oven technology over five years (1984), Matsushita for magnetron production technology over five years (1985), and Sony for VHS-VCRs over five years (1989) (Kim, 1997).

56. It was toward the end of the 1980s that Samsung slowly started to build its own technological capability with the acquisition of Micro Five Corporation, a US company in 1988 and establishment of Samsung Information Systems America Inc. (SISA) in the Silicon Valley to support export activities and gather information on ICT products. It was also in this period that Samsung began its search for foreign talent as a means to compensate for its lack of internal expertise (Box 3). It was also in the 1980s that Samsung started to internationalise its production for certain products such as colour TVs, audio products and microwave ovens. Samsung also sowed the seeds of its telecom business at this time, acquiring Korea Telecommunications in 1980 and started production of a cellular phone in 1986.

Box 3. Technology transfer through hiring

One of the ways Samsung has overcome its lack of technical capabilities has been through recruiting top level engineers from world leading competitors.[32] In early days, Samsung focused on recruiting Korean engineers working at foreign companies. Hwang Chang-gyu, a former president of Samsung Electronics, was recruited from Intel, and Chin Daeje, another former president, worked at IBM's Watson Research Center before being hired by Samsung, to name just a few. These people have significantly contributed to the transformation of Samsung from a me-too memory producer to the world leader by bringing cutting-edge technical knowledge and managerial skills.

Samsung also hired foreigners in order to fill the gap it identifies to upgrade its technical capabilities. It is widely known that Shigeo Fukuda, who was hired from Kyocera, played a critical role in the Samsung's new initiative in 1993 known as "New Management." It is believed that his critical comments on Samsung during the 1980s pushed the company to enhance its product development processes and design capabilities. More recently hiring has become increasingly diverse from all over the world including David Still (US), David Henri (France), Roman Sepeda (US), Nelson Allen (US), Hao In (China), and Tung Wang (China).

4.2 Transformation into a global company – 1993 and onwards

57. Several changes in the business environment faced Samsung in the early 1990s. First, lower trade barriers and transportation costs and enhanced ICT from the latter 1980s and the 1990s resulted in greater fragmentation of the ICT industry. In the late 1980s, Japanese producers rapidly increased overseas production in response to increased competition from Korean competitors and the rapid appreciation of the yen, which led to greater competition at the lower end of the market. Secondly, Korea's domestic electronics market which had long been protected from foreign competition was gradually liberalised as Korea prepared to join the ranks of industrial nations.[33] In 1989, import quotas on consumer electronics were removed. By 1993 there was a plan to cut the average tariff rate below 10% for all imported electronics goods. The number of items subject to the import diversification programme which shielded the Korean market from Japanese competitors was steadily decreased with a schedule put in place for abolition in 1999. Thirdly, on the export side, the generalised system of preferences privileges were withdrawn from Korean electronics goods by the US and EC in 1988. The Won also started to appreciate against the dollar making exports from Korea less attractive.

58. The above changes in the business environment led to a strong initiative headed by the Chairman Kun-Hee-Lee in 1993 to become a truly global company.[34] Under this new initiative, Samsung began its transformation from a successful company to one of the global leaders in the industry. There was a renewed emphasis placed on quality, and several new products were subsequently introduced such as the TFT-LCD and CDMA mobile handsets. The Asian financial crisis presented a further challenge as the

32 This "learning-by-hiring" is a well established medium of technology transfer (e.g., Song et al 2003).

33 . Korea joined the OECD in 1996.

34 . Chairman Lee initiated the "New Management Initiative" which placed a renewed emphasis on quality, and a goal of achieving global recognition as a maker of top-class products.

domestic market plunged, and Samsung had to undergo a fundamental restructuring of its activities, exiting from numerous businesses, cutting 30% of its workforce and cutting its debt-to-equity ratio from 300% to 30%. However, the Asian crisis also presented an opportunity for Samsung to consolidate its domestic market as competitors weakened their positions, while shifting more of its resources to the LCD (Liquid Crystal Display) and mobile phone businesses which has allowed it to diversify its revenues. The growth has been particularly strong in the CDMA mobile handset market, where Samsung has leapt from almost a negligible share in the global market to number one in CDMA phones with a share of about 30%, and number two in the global market overall behind Nokia.

59. Below we focus on three main strategic responses of Samsung: greater emphasis on technology, global productions and sourcing, and international sales and distribution.

(1) Greater focus on technology (globalisation of R&D and strategic alliances)

60. Samsung's R&D expenditure in Korea has continuously increased both in terms of amount and as a percentage of sales, on average 18% annually from 2002 to 2006, and now approaches 10% of total sales (Figure 21).[35] The proportion of R&D staff has jumped from 16% in 1997 to 24% in 2006, and the company plans to push it up to 32% by 2010. The number of scientists and engineers at various research centers in Korea has increased by 70% since 2001. Table 23 indicates how Samsung has aggressively recruited scientists and engineers with graduate degrees: the number of Ph.D.'s is up by 50% and the number of Master's degree holders has been more than doubled.

61. Samsung has also changed its patenting activities since the early 1990s (Table 24). While Samsung only had 1704 patents for applications made before 1994, it was granted over 2600 patents for applications made in the three year period 1994-1996, and has consistently been granted over 1000 patents since then.[36] This shows how Samsung has become aggressive in the application of patents in the United States as part of its technology strategy.

35 "Samsung Electronics' R&D expenditure approaches 10% of sales," The Hankyoreh, April 25, 2007

36 . The number of patents by year of applications tapers in recent years as it typically takes a number of years for patents to be granted.

Figure 21. Samsung Electronics' R&D Expenditure

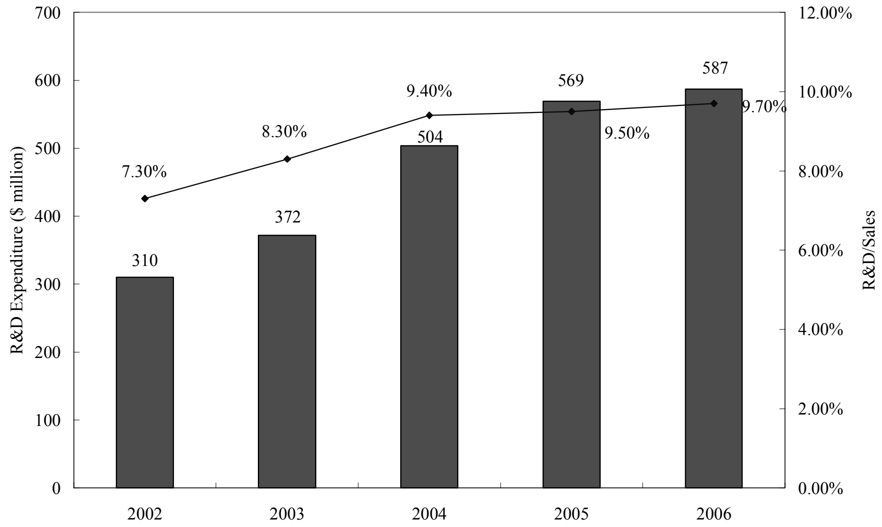

Table 23. Scientist and Engineers at Samsung's Research Labs

Period	Ph.D.	Master	Bachelor	Total
2001/2002	1,039	2,980	6,038	10,057
2003/2004	873	3,453	6,815	11,141
2005/2006	1,537	8,320	7,363	17,220

Source: KOITA, Directory of Korean R&D Institutes

Table 24. Samsung's patents in the United States

	Pre1994	1994	1995	1996	1997	1998	1999	2000
Patents by year of grant	850	412	423	485	584	1305	1542	1437
Patents by application year	1704	498	656	1532	1613	1845	1470	1336

	2001	2002	2003	2004	2005	2006	2007	Total
Patents by year of grant (contd)	1446	1328	1313	1604	1641	2451	2723	19544
Patents by application year (contd)	1550	1804	2412	2005	890	216	13	19544

Source : Based on US Patent and Trademark Office (2007)

62. Samsung's efforts to strengthen its research capabilities have not been limited to Korea. In order to improve responsiveness to the local demand conditions and tap into the pool of cutting edge scientists and engineers, the company established R&D centres in various parts of the world (Table 24). Samsung started by setting up Samsung Information Systems America (SISA) in Silicon Valley in 1988, followed by Samsung Electronics Research Institute in London in 1991. These two research facilities are typical examples of R&D facilities set up to monitor abroad as is the case with the Dallas and Yokohama facilities in 1997. More interestingly, the company has rapidly expanded its global network of research centres with the objective of utilising the foreign pool of research talent starting with Russia (1993), India (1996) and the three recently added research centres in China focusing on semiconductor, mobile telecommunications, and electronics. Samsung has also seriously increased the size and capabilities of the foreign research

centres: its research centre in Moscow had only 1 Ph.D. and 7 Masters in 2001 and now has 10 Ph.D.'s and 29 Masters; its Bangalore software facility had no Ph.D., 17 Masters, and 37 Bachelors in 2001 and now hires 4 Ph.D.'s, 179 Masters, and 164 Bachelors.

Table 25. Samsung's R&D facilities

Research Centre	Location	Est.	Core Tasks
Samsung Information Systems America	San Jose, CA, U.S.A.	1988	Strategic parts and components, core technologies
Samsung Electronics Research Institute	London, U.K.	1991	Mobile phones and digital TV software
Moscow Samsung Research Centre	Moscow, Russia	1993	Optics, software algorithms and other new technologies
Samsung Electronics India Software Operations	Bangalore, India	1996	System software for digital products, protocols for wired/wireless networks and handsets
Dallas Telecom Laboratory	Dallas, TX, U.S.A.	1997	Next generation telecommunications systems
Samsung Telecom Research Israel	Yakum, Israel	1997	Hebrew software for mobile phones
Samsung Yokohama Research Institute	Yokohama, Japan	1997	Core next-generation parts and components, digital technologies
Beijing Samsung Telecommunication	Beijing, China	2000	Mobile telecommunications standardization and commercialization for China
Samsung Semiconductor China R&D	Suzhou, China	2003	Semiconductor packages and solutions
Samsung Electronics China R&D	Nanjing, China	2004	Software, digital TVs and MP3 players for China

63. While, Samsung had already begun to use strategic alliances especially for acquiring technologies, the increasing R&D capabilities of Samsung is allowing it to benefit from strategic alliances in developing new cutting edge technologies (Table 26). Because there is an increasing convergence of technologies, for example between telecommunications and broadcasting, mobile phones and personal computers, telecommunication equipment and household appliances, it is becoming increasingly difficult and expensive to conduct the research and development necessary to cover all technology areas in one company. Samsung, therefore, has been using its technology base to conduct strategic alliances to build new strategic capabilities.

Table 26. Selection of recent strategic alliances

Partners	Date	Areas of Cooperation
Nokia	Apr. 2007	Co-develop technology for handsets and DVB-H standardisation solutions
Limo	Jan. 2007	Establish a joint venture for developing a Linux platform (SAMSUNG Electronics, Vodafone, DoCoMo, Motorola and NEC)
Alcatel	Oct. 2006	Cooperate on satellite DVB-H
Sony (S-LCD)	Jul. 2006	Jointly invest in 8th-generation LCD line (2200mm x 2500mm motherglass)
IBM	Mar. 2006	Co-develop and market technologies for industrial printer solutions
Intel & Microsoft	Mar. 2006	Co-develop UMPCs
Discovery	Sept. 2005	Cooperate on high-definition contents
Salvarani	Jul. 2005	Co-develop new built-in products combining household electronics and furniture
Sun Microsystems	Jul. 2005	Cooperation in solution business and next-generation business computing systems
VDL	Feb. 2005	Cooperate in commercialisation of terrestrial DMB
Charter	Jan. 2005	Co-develop cable broadcasting receiver and set-top box for digital TV Full-Duplex service
Bang & Olufsen	Nov. 2004	Partner in home theatre business
Kent State University	Oct. 2004	Co-develop display technologies
Qualcomm	Jul. 2004	Cooperation in MDDI (Mobile Display Data Interface) technology
Toshiba (TSST)	Apr. 2004	Develop and market optical storage devices
Sony (S-LCD)	Mar. 2004	Establish joint venture for 7th generation LCD (1870 x 2200 mm) line
IBM	Mar. 2004	Co-develop nano-logic process technologies

Partners	Date	Areas of Cooperation
Dell	Jan. 2004	Supply multi-functional laser printers
Hewlett-Packard	Sept. 2003	Share technology for ink-jet printers
Disney	Sept. 2003	Supply "Movie Beam" set-top box for VOD
Napster	Sept. 2003	Co-develop and market SAMSUNG-Napster player
Sony	Aug. 2003	Expand and consolidate memory stick business
NEC	Jul. 2003	Cooperate in high-end business computer systems
Matsushita	Jan. 2003	Standardise technology, co-produce and jointly market DVD recorders
Microsoft	Nov. 2001	Co-develop digital household electronics

Source : Based on Samsung homepage

(2) Globalisation of the Production Network and global sourcing

64. Samsung Electronics began to build its global production network in the early 1980s when it established its first manufacturing facilities in the U.S. and Portugal. It went on to establish a subsidiary in the UK (1987), Mexico (1988) and Thailand in 1988. Since then, the company has continued to expand the network by adding new countries to the network as well as setting up new facilities in countries where it has already established its production facility. In 1989, Samsung further set up production subsidiaries in Spain, China, Hungary and Turkey. Table 27 lists the countries where the company has its production facilities and illustrates that the company has been selectively expanding its global production network. Table 28 shows how overseas production is gradually increasing in recent years reaching 35.9% in 2007. It should be noted that while this figure is a measurable increase from the levels in the early 1990s, it remains considerably smaller than comparable figures for Japanese electronics companies which exceeded 70% as of the early 1990s (Table 8).

65. The major products manufactured in overseas facilities are consumer electronics products such as TV, VCR, refrigerator, and microwave ovens. The company's Mexican production subsidiaries produce flat-screen TVs and LCD TVs and export them to the U.S. and other Latin American countries. As Mexico is a member country of NAFTA, Samsung's exports to the U.S. from Mexican plants are exempt of the import tariffs. Samsung Electronics Hungarian Co. Ltd., established in 1989, produces 3.2 million TVs annually and exports them to Western Europe, Eastern Europe, and Central Asia.[37]

66. Recently, Samsung announced to increase its production capacity of the mobile phone manufacturing plant in Haryana, India from one million to three million units per year. In addition to the importance of the local market, India is considered as a strategic alternative to China to hedge the uncertainty from relying heavily on Chinese operations.[38] In the semiconductor sector, Samsung pursues a triad strategy: Giheung complex in Korea as the R&D and frontier semiconductor manufacturing hub, the American facilities in Austin, Texas as strategic manufacturing hub for the Americas, and the Suzhou complex in China as the global testing and packaging hub.[39]

[37] From Yeonhab News (2007)

[38] From Seoul Kyungje (2007)

[39] From Chosun Ilbo (2007)

Table 27. Samsung Electronics' Global Production Network*

	2000	2006
Korea	Six Facilities	Eight Facilities
North America	Mexico, U.S.A.	*Canada*, *Mexico(2),* U.S.A.
Asia Pacific	China(7), India, Indonesia(2), Malaysia(2), Thailand, Vietnam	*China(13), India(2)*, Indonesia, Malaysia(2), *Philippines*, Thailand, Vietnam
Europe	Hungary, Spain, U.K.	Hungary, *Slovakia*
South America	Brazil	None
Middle East and Africa	None	None
CIS	Uzbekistan	None

* The number in parentheses is the number of subsidiaries in the country; Countries in italics are those newly added to the list between 2000 and 2006.
Source: Samsung Electronics' website (www.samsung.com/us)

Table 28. Samsung Production Network
(unit million won)

	2003	2004	2005	2006	2007
Total	64,817,456	81,963,009	80,629,510	85,834,604	98,507,817
	100%	100%	100%	100%	100%
Domestic Production	43,582,016	57,632,359	57,457,670	58,972,765	63,175,968
	67.2%	70.3%	71.3%	68.7%	64.1%
Overseas Production	21,235,440	24,330,650	23,171,840	26,861,839	35,331,849
	32.8%	29.7%	28.7%	31.3%	35.9%

Source : Korean Government

(3) International sales and distribution

67. Samsung's initial expansion of international sales was through Samsung Corporation, the group affiliate involved in general overseas trading in the early 1970s. While this may have aided Samsung initially, it blocked Samsung Electronics' further expansion and in 1978, Samsung established its own sales affiliate in the United States for the first time. Since then, Samsung Electronics has continuously expanded its sales and distribution network around the world (Table 29). In 2000, the company had a network of 32 sales organizations in 23 countries and its primary emphasis was on North American and European markets. However, the company doubled its sales subsidiaries to 60 in 48 countries over six years, and it is now paying more attention to emerging markets, including Asia Pacific, Middle East, Africa, CIS, and South America. According to Samsung Electronics' homepage as of 2008, Samsung had a total of 53 sales subsidiaries and branch offices in 36 countries.[40] Samsung has achieved over three quarters of its sales overseas in recent years (Table 30).

40. Sales subsidiaries can be found in the US, Canada, UK, Germany, France, Italy, Sweden, Poland, Portugal, Netherlands, Spain, Austria, China, Singapore, Australia, the Philippines, Malaysia, Japan, Russia, Ukraine, South Africa, Dubai, Panama, Colombia, Chile, Peru. In addition, branch offices can be found in Kazakhstan, Uzbekistan, Jordan, Saudi Arabia, Iran, Turkey, Morocco, Algeria, Tunisia, and Kenya.

Table 29. Samsung Electronics' Global Network of Sales Subsidiaries*

	2000	2006
North America	Canada, Mexico, U.S.A.(6)	Canada, Mexico, U.S.A.(4)
Asia Pacific	Australia, Hong Kong, India, Japan, Philippines, Singapore, Taiwan	Australia, *China(6)*, Hong Kong, *India(2)*, *Indonesia*, Japan, *Malaysia*, *Pakistan*, Philippines, Singapore, Taiwan, *Thailand*, *Vietnam*
Europe	France, Germany(2), Italy, Poland, Portugal, Sweden, The Netherlands(2), U.K.(2)	*Austria*, France, Germany(2), *Greece*, *Hungary*, Italy, Poland, Portugal, *Spain*, Sweden, The Netherlands, U.K.(2)
South America	Argentina, Colombia, Panama	Argentina, *Brazil*, *Chile*, Colombia, Panama, *Peru*
Middle East and Africa	South Africa, U.A.E.	*Algeria, Iran, Jordan, Kenya, Morocco, Nigeria, Saudi Arabia*, South Africa, *Tunisia*, *Turkey*, U.A.E.
CIS	Russia	*Kazakhstan*, Russia, *Ukraine*, *Uzbekistan*

* The number in parentheses is the number of subsidiaries in the country; Countries in italics are those newly added to the list between 2000 and 2006.
Source: Samsung Electronics' website (www.samsung.com/us)

Table 30. Samsung Sales Network

	2003	2004	2005	2006	2007
Domestic sales	19,981,696	18,648,908	17,805,911	19,255,849	21,139,278
Overseas sales	44,835,760	63,314,101	62,823,599	66,578,755	77,368,539
% of overseas sales to total	69.2%	77.2%	77.9%	77.6%	78.5%

Source : Korean Government

V. Conclusions

68. To conclude, trade and investment has played an extremely important role in innovation in the Korean ICT sector. Initially, Korean industry needed to import technology in the form of capital goods, components, licensing, EM contracts etc. It also depended on exports for the market necessary to make the investment to upgrade its industry. Public policy played an important role in the nurturing of absorptive capacity in Korea at this early stage of development. Public R&D played an important role in acquiring and diffusing technology. Trade and investment policy in this initial stage was restrictive. For a time it may have alleviated the investment related risks by providing an assured domestic market, while industrial policy in the form of tax incentives and access to low interest policy loans further provided strong incentives to invest resources in technology absorption, innovation and new export activities. It is worth noting however that imports were restricted but not prohibited: to the contrary Korean industry was reliant on imported capital goods and components. Also there likely were costs to the restrictive trade and investment policies: competition in the domestic market was lower leading to a decrease in the incentives for innovation, there were some restrictions to the free access of foreign technology and such policies were becoming an obstacle to Korea's integration into production networks.

69. The transformation of Korea into a knowledge-based economy and its strengthening innovative capacity in the recent decade on the other hand has been based on a much more liberal trade and investment policy. Freer trade and investment policies have led to greater incentives towards R&D and innovation in the ICT industry. The introduction of international standards and deregulation of the telecommunication services market and introduction of effective competition was also important for the growth of the ICT sector. As a result of such developments and the mutually reinforcing effects with other

policies such as industrial policy, informatisation policy, R&D policy and IPR policy, Korea's innovation system has become increasingly innovative but also more deeply integrated with the global innovation system at various levels from R&D, production, and sales.

70. The current success of Korea's ICT industry may not have been possible under a more restrictive trade and investment regime, as incentives for innovation would have been much weaker and access to technology would have been more limited. Looking to the future, this would suggest that Korea should continue to ensure that a stable trade and investment environment and competitive regulatory policies will maintain the incentives for innovation and facilitate the international division of labour. From this point of view, Korea should continue to promote freer trade through multilateral trade liberalisation through the Doha Development Round as well as the Information Technology Agreement. Korea should also strive to further promote the strengthening of intellectual property rights with a view to promoting domestic innovations as well as ensuring that standards do not constitute unnecessary barriers to trade.

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