

# **Infrastructure Development in Korea**

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## **I. Introduction**

With Korea's rapid industrialization since the 1960s, the relationship between its infrastructure and its economy has always been an important issue. Korea's infrastructure, which has certainly contributed to its economic development, is currently at an advanced level compared to other emerging industrial economies. However, when compared to the advanced economies, Korea's infrastructure lags far behind. This is evident in the appearance of major infrastructure bottlenecks since the mid-1990s, with the continued expansion of the economy. Also, with the achievement of higher living standards and greater democracy, Korean's expectations regarding infrastructure are swiftly rising. Providing infrastructure for better quality of life (for example, information infrastructure, urban public transportation, pollution control, and high-speed rail, etc.) has also become an important policy objective for the government. Yet, many of the urgently needed infrastructure programs and projects (either for better quality of life or economic purposes) have been delayed by various obstacles, such as resistance from determined environmentalists and other interest groups, sharply divided political opinions, calls for radical policy changes, exposure of contract-related scandals, and unprecedented budgetary requirements.

Considering these issues in the context of the new era of the information and knowledge-based economy, Korea needs new development goals focused on

restructuring, liberalization, and private sector development. This paper reviews how Korea built its infrastructure base to foster its transformation into an industrial power, emphasizing the functional dimensions: policy making, institutional, regulatory, and financing. And briefly touches upon the issues of information and knowledge economy. In Section 2, Korea's infrastructure development during the last four decades is reviewed. Section 3 provides updated information on Korea's infrastructure development in areas such as power, transportation, telecommunications, education, and social services and also deals with the participation of the private sector.. Section 4 touches upon the macroeconomic aspects of infrastructure in Korea and suggests conceptual candidates for new infrastructure that are relevant for the shift towards a knowledge-based economy. Finally, concluding remarks are presented in the last section.

## **II. Korea's Infrastructure Development: Brief History**

Since the early 1960s, Korea has demonstrated an impressive record of economic performance. Much of its success stems from a commitment to infrastructure development. In the period between the early 1960s and the late 1980s, several factors enabled Korea to realize sizable economic benefits from infrastructure investments. Strong leadership and efficient coordination for installing the infrastructure necessary to spur economic performance, a well-defined focus and priorities on infrastructure

development, and willingness and flexibility were the critical factors (Reinfeld, 1997).

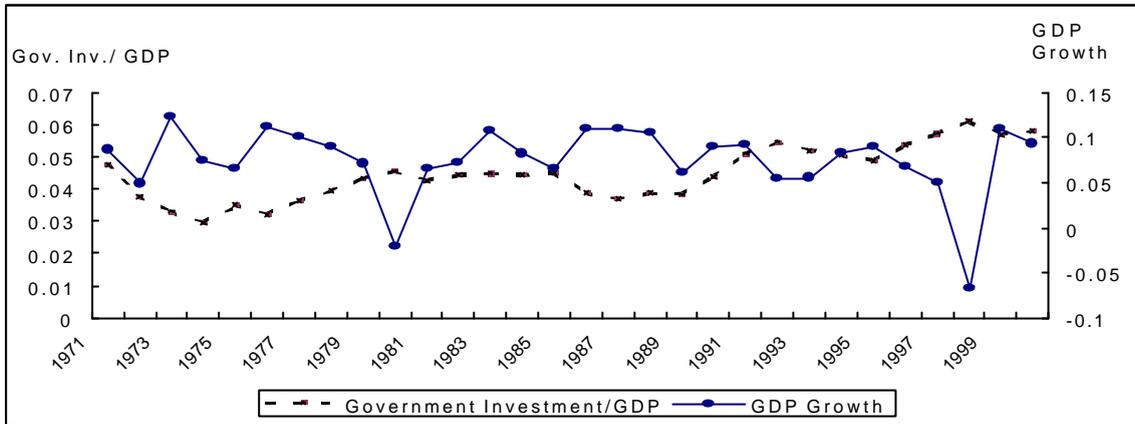
Immediately after the Korean War, Korea began making a solid recovery, largely with the support of foreign aid, which remained the primary source of funds during the 1960s. Korea's first Five-Year Development Plan (1962-66) focused on developing the light industries and the country's import substitution capacity. Infrastructure to support these activities included the construction of 275 kilometers of railways and several small highway projects. The second Five-Year Development Plan (1967-71) sought to stimulate exports, which grew by nearly 50 percent per year during this period. Investment in railways continued, and highway construction was accelerated. Korea's first major highway project was to connect the country's two largest cities, Seoul in the northwest and Pusan in the southeast. This project was particularly momentous because not only did it establish a vital industrial corridor in Korea, it also served as a symbol of Korea's emerging self-confidence.

Nevertheless, Korea's investment in infrastructure during the 1960s was certainly not enough. As the economy approached full employment in the early 1970s, the country began experiencing major bottlenecks. Moreover, finding it increasingly difficult to remain competitive in labor-intensive light industries, Korea shifted its focus to heavy and chemical industries, which require sufficient infrastructure for development. Beginning with the third Five-Year Development Plan (1972-76), the government

identified new priorities, policies, and infrastructure needed for petrochemicals, steel, and shipbuilding. Comprehensive programs were planned to develop the country's airports, seaports, highways, railways, and telecommunications systems to support these industries. With the first Ten-Year Comprehensive National Physical Plan in 1972, the government also decided to develop major industrial estates with new deepwater harbors, primarily along the southeastern coast near the ports of Pohang, Ulsan, and Masan. These areas experienced rapid growth during the 1970s. In addition, the authorities initiated major port projects in Inchon and Pusan, added 487 kilometers of highways in the south, and built a subway system in Seoul.

During the first half of the 1980s, Korea introduced policies that emphasized stabilization, private sector development, and deregulation. The government placed less emphasis on the heavy and chemical industries program and paid more attention to high quality consumer goods while containing government spending. Infrastructure investment remained fairly high, however, to reach 8 percent of GNP in 1983. In 1985, confident that inflation was under control, the government initiated several measures to stimulate the economy and established a supplementary budget to stimulate demand and increase investment in infrastructure. These measures, along with the economic windfall from the Seoul Olympics, pushed the economic growth rate to unprecedented double-digit levels. Although the share of infrastructure in GNP fell to about 5 percent, absolute amounts of spending on infrastructure rose briskly.

<Figure 1> Government Investment Ratio (to GDP) and GDP Growth



Source: Bank of Korea

In the mid-1990s, major bottlenecks started to negatively affect Korea's economic performance, particularly in road and highway transportation. Because of the unusually fast growth in automobile use, which was the result of the government promotion supporting the domestic automobile industry, Korea faced a serious traffic problem causing high logistical costs. In fact, one study estimated that total highway congestion costs have reached US\$6.5 billion, or about 20 percent of total highway user costs. A special commission on social overhead capital has recommended that railroads be used more extensively to relieve the pressures on the highways (Cha, 1993). In response, during the 1990s, Korea planned to spend about US\$100 billion on transportation infrastructure alone, about half of it on roads, 40 percent on rail (including a high-speed rail from Seoul to Pusan), and the rest on airports and seaports.

Korea's infrastructure was encountering other problems as well: rapidly rising costs (particularly for land acquisition and domestic labor) and greater concern about budget deficits. For instance, a speculative bubble on land prices increased the cost of adding to the highway network from US\$4 million a kilometer in 1985 to roughly US\$26 million a kilometer by 1990.

The 1993-1997 Five-Year Economic Development Plan mapped out an ambitious program targeted at improved living standards (housing, the environment, urban traffic) and expanded social overhead capital (transportation and distribution, including the development of communications standards) in an attempt to address society's infrastructure needs.

Because of the continuous efforts of the government, the increase rate of investment in infrastructure has recorded more than 20% every year, and recently even exceeded the growth rate of the national budget. Notably, in 1997, the size of the government budget for infrastructure exceeded KRW 10 billion for the first time. In 2001, the percentage of infrastructure expenditures in the national budget reached 14.6%, from 11.2% in 1993 and 14.2% in 1997.

However, it should be noted that, despite the impressive growth, the nation's

accumulation rate of infrastructure facilities is still less than those of Singapore, Hong Kong, and Taiwan. The Korean government, along with the focus on supply expansion, is also concentrating on policies for reducing investment demand for infrastructure facilities through the more effective use of existing infrastructure like logistics information systems and highway traffic information systems.

### **III. Microeconomic Aspects**

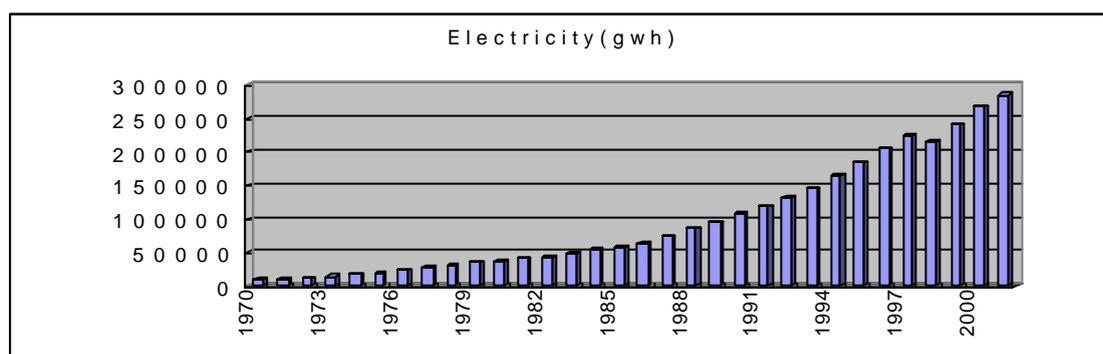
In this section, the time-series data and analysis of the development of major sectors in Korea are discussed. The major sectors covered here are power, transportation, telecommunications, education, and social services. Obviously, most of the infrastructure development follows a path similar to that of economic growth. Additionally, the institutional weaknesses are discussed.

#### ***A. Achievements and Current Status***

***Power & Energy.*** Securing adequate power was one of the government's most urgent tasks. In the 1960s, the power generation facilities were unevenly distributed regionally, resulting in unstable supplies. Many electric power facilities were destroyed during the Korean War, resulting in chronic power shortages. The Korean government merged three existing electric companies (Chosun, Kyungseong, and Namsun) on July 1, 1961 to establish the Korea Electric Company (KECO) to secure electric power before

implementing the economic development plan. As shown in <Figure 2>, the level of power generation reached 285,223.8 gwh (giga watt hour) in 2001 from 9167.4 gwh in 1970. And also as shown in <Table 1>, nuclear power provides a considerable portion of the nation's power supply in the late 1990s. However, it should also be noted that even with exceptional growth, Korea still imports more energy than it produces. In fact, as the economy expands, imports increase even more.

<Figure 2> Electricity Generation



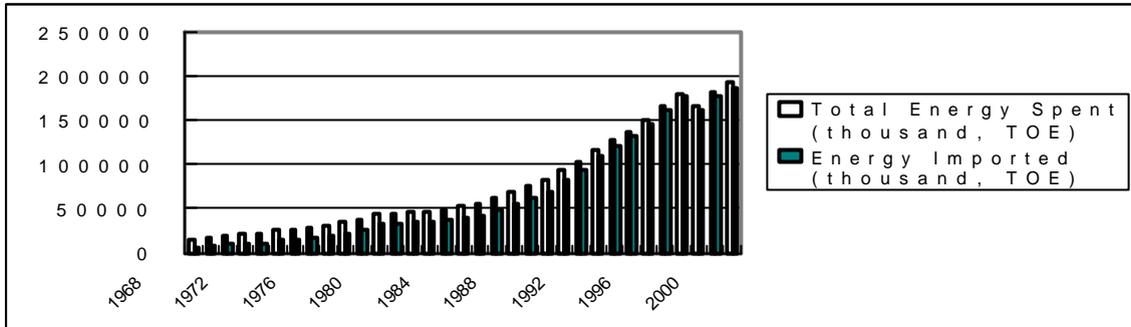
Source: KEPCO

<Table 1> Power Sources (gwh)

Item	1980	1997	1998	1999	2000	2001	
Hydro	1,984	5,404	6,099	6,066	5,610	4,151	
Thermal	Coal (Domestic)	2,481	4,112	4,572	4,833	5,285	5,235
	Coal (Bituminuos)	-	63,078	70,927	76,711	92,253	105,098
	Oil (Heavy)	28,876	36,620	16,430	17,365	25,485	27,770
	Oil (Diesel)	421	6,323	1,282	1,162	657	386
	Gas	-	31,823	26,302	30,124	28,146	30,451
Nuclear	3,477	77,086	89,689	103,064	108,964	112,133	
<b>TOTAL</b>	<b>37,239</b>	<b>224,445</b>	<b>215,300</b>	<b>239,325</b>	<b>266,400</b>	<b>285,224</b>	

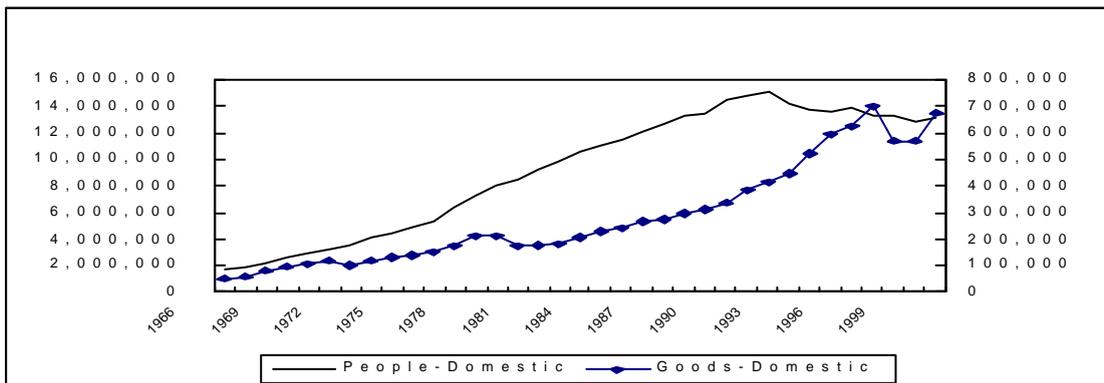
Source: KEPCO

<Figure 3> Import of Energy



Source: Korea Statistical Information System

**Transportation.** The nation's capacity to transport people and goods (domestic and international) has increased rapidly with the growth of the Korean economy. While there is a steady increase in the international transportation of people and goods with a higher slope in the 1990s (see Figure 5) due to deregulation, the domestic transportation of people and goods is decreasing (see Figure 4).

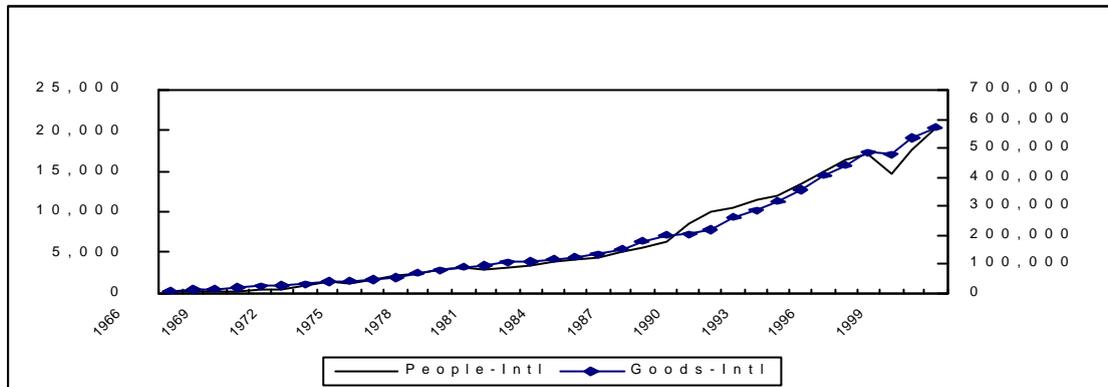


<Figure 4> Domestic Transportation (People and Goods)

Source: Korea Statistical Information System

Note: Left-hand axis indicates one thousand people transported, while the right axis indicates one thousand tons of goods transported.

<Figure 5> International Transportation (People and Goods)

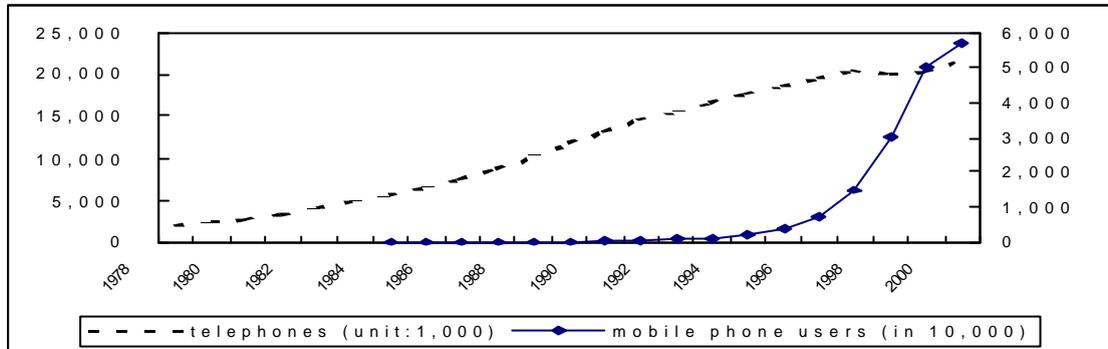


Source: Korea Statistical Information System

Note: Left-hand axis indicates one thousand people transported, while the right axis indicates one thousand tons of goods transported.

**Telecommunications.** While new information technology such as mobile phones and the Internet is showing unprecedented growth, the number of registered telephone users is not yet decreasing, indicating that Korea's telecommunication network is still expanding. Telecommunications has been the backbone of Korea's economic development. Also notice that Internet and mobile phone users are increasing at the fastest pace in the world. This is due to the government's appropriate deregulation and competition policy.

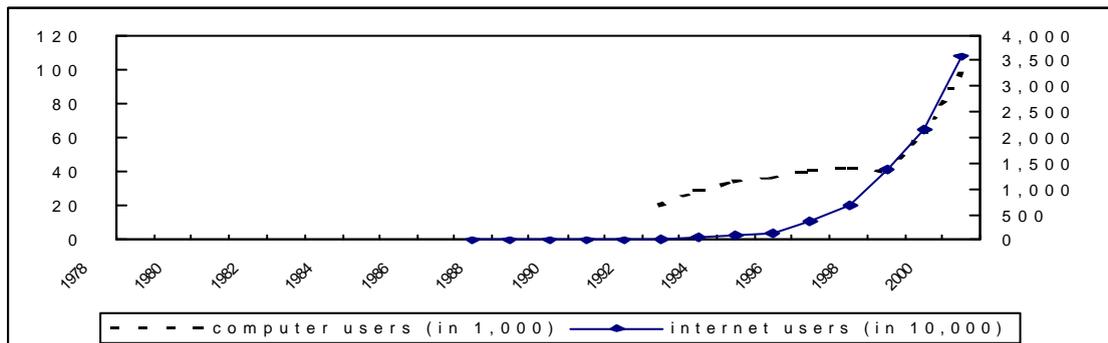
<Figure 6> Number of Telephone Users and Mobile Phone Users



Source: Korea Statistical Information System

Note: Left-hand axis indicates telephone users, and the right axis indicates mobile phone users.

<Figure 7> Number of Computer and Internet Users

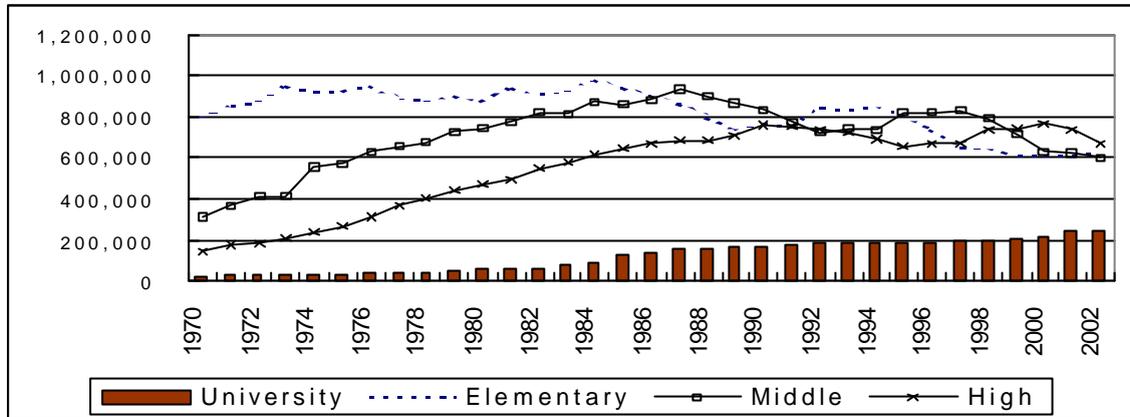


Source: Korea Statistical Information System

Note: Left-hand axis indicates telephone users, and the right axis indicates mobile phone users.

**Education.** As in most of the newly industrialized economies, education played an important role for Korea's industrialization. <Figure 8> shows the number of graduates from elementary school to university. It is interesting to note that while the number of elementary, middle, and high school graduates is decreasing because of the decreasing population, the number of university graduates is increasing.

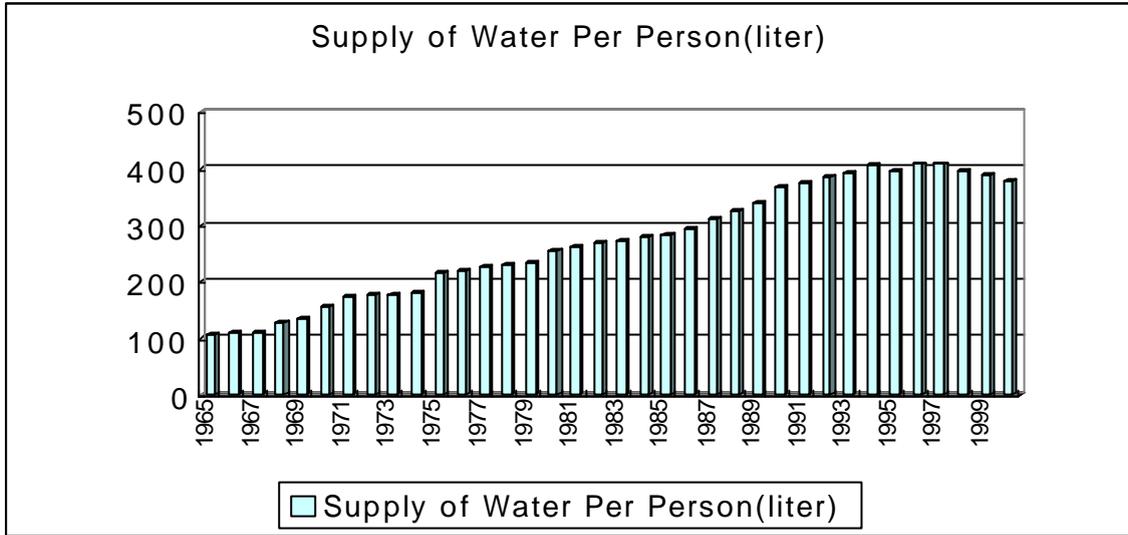
<Figure 8> Number of Graduates from Elementary, Middle, High School, and University



Source: Ministry of Education and Human Resources Development

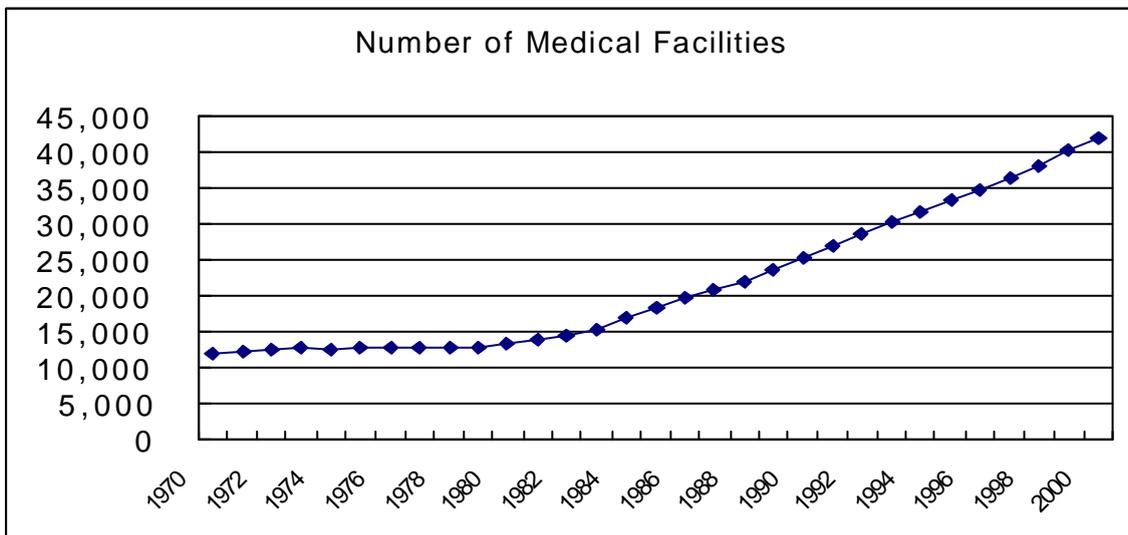
**Social Services.** Infrastructure in the social service area, such as medical facilities and water supply have had relatively low priority in Korea. The development of such infrastructure picked up only after the 1980s when the economy had accumulated some capital (see Figure 9 and 10).

<Figure 9> Supply of Water



Source: Korea Statistical Information System

<Figure 10> Medical Facilities

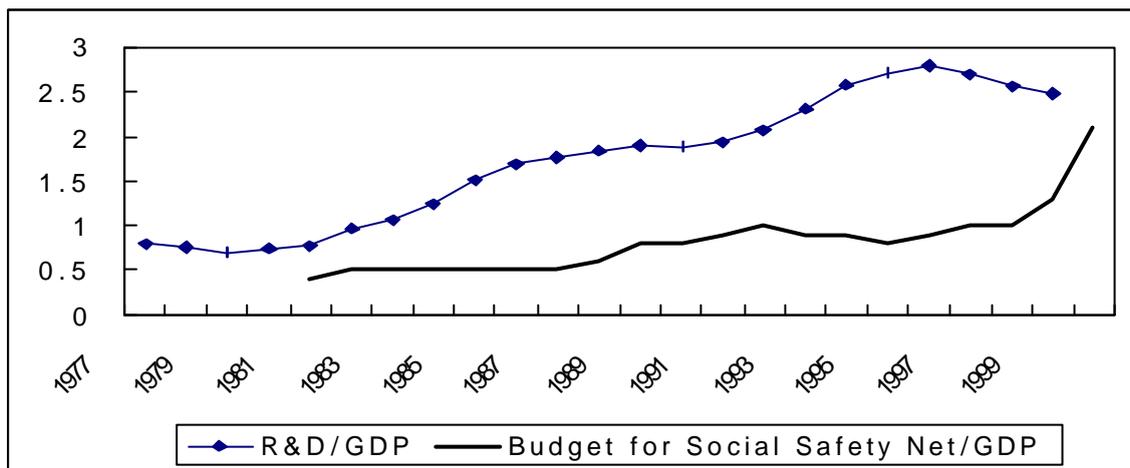


Source: Korea Statistical Information System

Infrastructure development in the social service area heavily depends on economic and

social conditions. As shown in <Figure 11>, R&D expenditures dropped, while expenditures for the social safety net increased.

<Figure 11> R&D, Social Safety Net Expenditure



Source: Korea Statistical Information System

### ***B. Institutional Aspects***

Much of the impetus for infrastructure investments came early on because of strong political leaders who had considerable autonomy in formulating and implementing policy. At the time, such a scheme was effective and was efficiently deployed. However, as time passed, these institutional structures and decision-making processes appear to be less effective.

Now, the Korean government faces problems of financing for new infrastructure investments on top of the inefficiency of the old institutions.

*Traditional Planning Institutions Are No Longer Adequate.* The Economic Planning Bureau (EPB) was the coordinating agency in the infrastructure decision making process. Its responsibilities covered a wide range of activities in infrastructure development and operations, including coordinating ministerial plans, making policy recommendations, and allocating budgets. Several other ministries were also responsible for planning and managing infrastructure, namely, the Ministry of Transportation for rail and ports; the Ministry of Construction for highways, housing, dams, and water; the Ministry of Industry, Energy, and Resources for electricity and gas; the Ministry of Communications for telecommunications; and the Ministry of Environment. Local governments were responsible for local and urban transportation. However, the president's office - the core of the government's power base - is where some of the most important decisions were made. Although this extensive set of institutions served Korea well in the past, now it appears to suffer from several significant weaknesses:

- No individual or group is now assuming the strong leadership role that was important during the early periods of infrastructure development.
- Planning is frequently too theoretical (as the economy has become complex).
- Coordination among and within the institutions has been ineffective.
- Performance evaluation is limited and data are generally spotty.
- Institutions have tended to avoid assigning priorities to activities.

*Enormous Investment Needs Will Require New Financing Sources.* Current and projected financial needs for infrastructure in Korea are enormous. They are projected to be US\$100 billion over the next three years, excluding telecommunications and some other programs outside the scope of the government's budget. Thus, financing, along with the financing environment and institutions responsible for infrastructure services, must change accordingly. Korea has proposed creative strategies in financing for infrastructure, improving the performance of service delivery organizations, and attracting private funds, but none of these efforts will succeed unless the authorities implement appropriate reforms and restructuring initiatives.

In the past, the government has used a variety of public funding methods, but now it is shifting to private finance. Currently, the government budget consists of two categories: the general account and special accounts. Special accounts are targeted for special projects and financial operations; the general account is the source for the government's overall fiscal activities. Of the seventeen special accounts that existed at the end of 1990, several were applied directly to infrastructure development, including the railway special account, the communication service special account, and the highway special account. The main sources of funding for Korea's infrastructure development include the following: taxation, designated funds, public pension funds, and private funds.

Given that many of the proposed infrastructure projects are potentially profitable, private financing is a promising way to fund them. Good candidates for private funding include industrial estates, freight depots, wastewater and municipal waste treatment facilities, and local toll roads. Incentives for attracting private funding include allowing public agencies to acquire land, pairing marginal projects with profitable projects, arranging long-term financing from public funds, and allowing tax exemptions.

***Private Participation in Infrastructure in Korea.***<sup>1</sup> Korea has made significant strides in increasing private participation in infrastructure (PPI) by reforming infrastructure sectors from the early 1990s. But some of the reform programs that have been implemented are limited in size and limited to a particular sector. Most reform activities have been in the telecommunications sector, with other infrastructure sectors yet to take off.

In 1994, the Private Capital Inducement Promotion Act was introduced to encourage private participation in infrastructure, primarily for greenfield investments in transportation. The government targeted 40 primary infrastructure facilities for private participation. But because of a number of weaknesses in the act and the opaque selection process, only five of the targeted transportation projects went into the

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<sup>1</sup> This section draws heavily on Baietti (2001)'s Annex country profile on South Korea.

construction phase. But all have been on hold since the East Asian crisis erupted in 1997.

In July 1998 the Planning and Budget Committee announced policies to:

- privatize 11 state enterprises, including Korea Telecom, the Korea Electric Power Corporation, and the Korea Gas Corporation;
- create a regulatory framework for private participation;
- promote competition in the market;
- address labor issues; and
- find optimal privatization techniques.

Lack of private investment interest has led to more lucrative clauses being embedded in new acts. To further improve the private investment environment, The Private Investment Act of 1999 (effective on April 4) replaced the Private Capital Inducement Promotion Act of 1994. The main objective of the new act is to encourage more private participation in all infrastructure sectors - power, gas, transportation, airports, ports, telecommunications, water and sewage facilities, by providing tax and other incentives to private investors, and improving the investment selection processes. The act includes new incentives for foreign investors such as 1) exemption of 10 percent value-added tax upon completion of target facilities; 2) a government guarantee of up to 90 percent of operating revenue; 3) a bonus for early completion and permission for excess profit

resulting from lower than expected construction costs; 4) compensation for losses due to exchange rates movements; 5) acceptance of diversified development modes (BOT, BTO, BLT, ROT); 6) an increase of the profit level approved by the government from 10 percent to 18 percent; 7) a buy-out option in the event of franchiser bankruptcy; 8) exclusion of the debt portion related to private infrastructure investment when the franchiser's overall debt-equity ratio is computed.

*A possible solution to the problems that Korea is facing regarding infrastructure development is private sector participation, which can be achieved by deregulation and a well functioning market economy that is open to the world. Latter part of the next section deals with this issue.*

<Box 1> Ownership/Management: Sector-by-Sector Overview.

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### **Ownership/Management: Sector-by-Sector Overview**

a) *Power generation and distribution.* Korea Electric Power Corporation (KEPCO) - the largest state-owned enterprise in Korea- has been a dominant monopoly in power generation (94 percent), transmission (100 percent) and distribution (100 percent). The government has a direct 58.2 percent stake in KEPCO. Foreign ownership in KEPCO was authorized in 1994, but initially limited to 8 percent of total equity. Foreign investors now own 16.3 percent. While foreign ownership of KEPCO is restricted to a 30 percent cap, the sale of individual generation and distribution assets are considered private investments and foreign investors can purchase up to 100 percent of them.

According to the 'Power Sector Restructuring Plan' recently prepared by the Ministry of Commerce, Industry and Energy's (MOCIE), KEPCO's generating assets will be split into several subsidiaries by the end of 1999 and by 2002, KEPCO will separate its distribution assets into subsidiaries and gradually sell off these assets. The target is to open up the distribution market by 2009.

b) *Oil & gas.* Korea imports almost all supplies of oil and natural gas. The government is encouraging the use of liquefied natural gas (LNG) to reduce dependence on oil and nuclear power. Korea Gas Corporation (KGC) – which is owned by the central government, KEPCO, and local governments - has monopolized the import and wholesaling of LNG, while 32 general city gas suppliers, which exclusively supply LNG, have monopolized resale. KGC has been a target of the Korean Privatization Program since

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1993. However, the privatization of KGC has been postponed until after the national gas pipeline is completed.

*c) Transportation.* Transportation services are delivered largely by the private or quasi-private sectors, except for rail transport and subways. The transportation services run by the private sector operate in a fairly competitive environment, and are considered to be efficient. However, transport services are greatly limited in their ability to improve their service because of restrictive price controls.

*d) Roads.* The roads network is the sector in which most infrastructure projects have been lined up. Korea believes that the main cause of its heavy logistic costs (about 17 percent of GDP) is a direct result of poor road facilities. This sector is the core area in which Korea is most interested in drawing foreign investment.

*e) Port.* Construction and management of ports is administered by the Ministry of Maritime Affairs and Fisheries (MMAF). Each regional office is directly under the supervision of the Minister. The Ministry is very much interested in private participation in ports. Nevertheless, due to national security concerns, privatization remains a distant possibility.

*f) Railway.* High Speed Rail projects are administered by the Ministry of Construction and Transportation, while all other railways are run by the Korea National Railroad. Korea's High Speed Railway project has been one of the most problematic projects and suffers from a serious shortage in funds.

*g) Subway.* Construction of Korea's subway system is handled by local city governments. The most troublesome case is the Seoul Metropolitan Subway Corporation (SMSC). Tariffs do not cover construction costs, and attempts to adjust tariffs have not been successful in the past. SMSC's known overseas borrowings amount to over \$409 million and 60 billion yen.

*h) Light rail transit.* Currently, 3 projects are being administered by local governments. No private participation attracted because the projects lack profitability.

*i) Airports.* Privatization of airports is not an urgent issue in Korea for national security reasons. The government's representatives here are the Civil Aviation Authority of the Ministry of Construction and Transport, and the Ministry of Defense. Incheon International Airport, located near Seoul, was built under the BOOT method with large significant amounts of private capital. The airport project, constructed between 1997 and 2001, includes a comprehensive business complex with hotels, offices, exhibition and conference centers, and a shopping mall.

*j) Telecommunications.* The Korean telecommunications industry underwent serious changes in the 1990s. The monopoly by state-owned Korea Telecom (KT) was broken up when international and long distance service liberalization took place in 1991. Dacom, the second primary telecommunications business operator, entered these two markets in 1991 and 1996, respectively and now competes with KT. In 1997, local calls were liberalized and a second operator entered the market.

The mobile phone segment (18 million mobile phone subscribers) has attracted considerable FDI in spite of the economic crisis of 1997. Major foreign investments in this sector includes a \$396 million stake in LG Telecom by British Telecom. The most important issue preventing greater private involvement in this sector is regulatory independence and the creation of a more level playing field.

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## **IV. Macroeconomic Aspects**

### ***A. Effects of infrastructure Investment on Economic Growth***

Many studies have empirically proved the positive relationship between infrastructure and economic growth in Korea. Yang (1992) and Kwack (1987) used a regression model to show that manufacturing competitiveness was weakened by insufficient infrastructure investment. Kim and Kim (1997) and Kim (1995) also investigated the economic impacts of infrastructure with a structural VAR model and CGE model respectively. They both found the positive effects of infrastructure and the CGE model suggested that public infrastructure of 1 trillion won in 1993 would generate GDP and export growth of 1.6636 trillion won in the period between 1993 and 1997.

Here, I present a simple Granger Causality Test between Gross Domestic Product (GDP), Government Investment (GINV), and Government Construction (GCON). As expected, government investment and government Granger caused GDP growth. The significance was greatest at lag 3 (3 years) in the Granger Causality Test (this was also supported by the Schwartz Bayesian Criterion).

<Table 2> Granger Causality Test

Null Hypothesis	Lags				
	1	2	3	4	5
GINV $\rightarrow$ GCON	1.96	0.51	0.34	1.21	0.79
GCON $\rightarrow$ GINV	0.00	4.09	3.50	3.80	2.02
GDP $\rightarrow$ GCON	2.86	1.79	6.75*	5.48	1.99
GCON $\rightarrow$ GDP	2.05	9.29*	5.64*	2.18	1.56
GDP $\rightarrow$ GINV	25.11*	10.11*	4.32	3.64	3.62
GINV $\rightarrow$ GDP	0.31	1.65	15.01*	12.42*	11.14*

\* indicates significance at 1% level

Although the strong relationship between government construction investment and economic growth is still valid, we should now consider testing information and knowledge infrastructure. With the accumulation of data in such areas, our next task will be to test the relationship between economic growth and information and knowledge infrastructure.

### ***B. New Infrastructure for the Knowledge-based Economy***

The use of knowledge is becoming more central than ever to economic and social development due to rapid technical progress, globalization and the development of information and communication technologies (ICTs). In this context, Korea is being confronted with the unprecedented challenge of transforming itself into a knowledge-based economy, defined as “an economy, which is directly based on the production, distribution and use of knowledge and information” (OECD, 1996; OECD & World Bank Institute (2000)).

Yet, knowledge is not something that can be bought in a store. Thus, for developed and developing countries alike, the ability to build a knowledge-based economy depends on their capacity to use the global system of the generation and transmission of knowledge (*e.g.* through the Internet). To develop such a capacity, the following elements are required:

(1) dynamic information infrastructure to facilitate the effective communication and processing of information; (2) educated population that can create and use knowledge; (3) system of research centers, universities, think tanks, firms and other organizations that can tap into the stock of global knowledge, adapt it to local needs, and create new knowledge; (4) an economic and institutional regime that provides incentives for the efficient use of existing knowledge, and the creation of new knowledge and entrepreneurship. The rationale for the focus on each of these factors is discussed below.

***A Dynamic Information Infrastructure.*** The rapid advances in ICTs are dramatically affecting economic and social activities, as well as the acquisition, creation, dissemination and use of knowledge. These advances affect the way in which manufacturers, service providers and governments are organized, and how they perform their functions. Increased access to ICTs is also affecting how people work, learn and communicate. Therefore, an adequate information infrastructure to handle these new

technologies is needed, as it reduces transaction costs and improves the efficiency of markets.

The information infrastructure is made up of telecommunications networks, strategic information systems, related policy and legal frameworks, as well as the skilled human resources needed to develop and use the infrastructure. Developing a powerful information infrastructure, therefore, requires the support of the many stakeholders involved in its use such as government, business, individual users, telecommunications and information service providers. They must collaborate on establishing an information infrastructure strategy that involves identifying the opportunities and needs for information and communication in the economy. This also involves assessing existing information systems to identify common difficulties, and formulating goals for the information infrastructure.

***Skilled and Creative Human Resources.*** Skilled and adaptive people play a crucial role in taking advantage of the potential offered by the explosion of new knowledge and technical change. Researchers and technicians are necessary, as is a workforce that can adopt the new technologies and a general population that can efficiently use electronic products and information services. Addressing these needs will require developing education and training policies to prepare the appropriate human resources. In this context, opportunities for life-long learning are essential. This should not be limited to

learning in the workplace, but must include other environments such as the home and school.

***An Effective Innovation System.*** An efficient national innovation system, consists of the networks of institutions, rules, and procedures that affect how a country acquires, creates, disseminates and uses knowledge.<sup>2</sup> Key components in this creative process include universities, research centers and policy think tanks. NGOs, private enterprises and the government are part of the innovation system as well.

The mere existence of all of these organizations is not sufficient. What counts is the extent to which they are efficiently organized to create, adapt and disseminate knowledge to the firms, government, organizations and people who put it to use.

***An Effective Institutional Infrastructure.*** A competitive environment induces firms and individuals to seek knowledge in order to produce goods or services more efficiently or to produce new goods and services – an effective institutional infrastructure. The creation of such an environment requires good macroeconomic competition and regulatory policies, and the existence of financial systems to allocate

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<sup>2</sup> Innovation and technical progress are the result of a complex set of relationships among actors producing, disseminating, acquiring and applying various kinds of knowledge. So the concept of a national innovation systems rests on the premise that understanding the linkages among the actors involved in innovation is the key to improving a country's technological performance. Linkages can take the form of joint research, personnel exchanges, cross-patenting, licensing of technology, purchase of equipment and a variety of other channels (OECD, 1998)

resources to promising new opportunities (including venture capital). The following should be considered for effective institutional infrastructure: 1) encouraging entrepreneurship and risk-taking, 2) the large number of small and medium enterprises, 3) an adequate exchange of information between science and industry, and 4) sufficiently flexible labor markets to ease the redeployment of labor.

Less obvious but also important for an effective institutional infrastructure are the rules and procedures in a society, which in turn determine how decisions are made and actions taken. These include the relationships between legal rules and procedures, social conventions, firms, government, non-government organizations and markets. Another important element is the legal system that protects intellectual property rights. The creation and dissemination of knowledge is strongly affected by the degree to which intellectual property is valued and protected.

## **V. Concluding Remarks**

The Korean economy -- one of the fastest in the world in achieving growth and demonstrating unbelievable recovery after the financial crisis -- is now facing new challenges: The challenges of democracy, market economy, technology, and globalization.

Rapidly developing technology, particularly information technology, is placing greater pressure on the Korean government to remove restrictions that block innovation in infrastructure development. Calls for liberalization and privatization are growing, demanding the renovation of obsolete infrastructure.

To cope with these challenges, the private sector must play a major role in infrastructure development and operations in the future. And the only way to attract private sector investment is for the government to deregulate, guarantee a market economy, and globalize. If the government provides a better business environment than in other parts of the world, private investments are sure to flow in. And in doing so, the government can use above challenges to its advantage.

In earlier part of this paper, I presented a view of the development path of Korea's infrastructure and the government's role. The Korean government played a critical role and demonstrated authoritative leadership in developing 'hard' infrastructure such as roads, transportation etc. However, as I suggested in the later part, the need to focus on 'soft' infrastructure such as information networks, since knowledge distribution is emerging as a new source of productivity. The government's role in this context should be something like a 'coach' to provide private businesses with the best environment to create and distribute knowledge.

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