The Growth of Broadband Internet Connections in South Korea: Contributing Factors

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Abstract

In recent years, Korea has seen a remarkable diffusion in broadband Internet connections. This paper explores the actions and factors contributing to this diffusion from three viewpoints: public sector, private sector, and social. We suggest that the matching of demand and supply is the most important factor in the fast diffusion of broadband in Korea. In particular, fierce infrastructure competition has led to quality services at a low fixed price. We also consider two challenges that lie ahead: take-up of retail e-commerce applications, and the need to bridge the digital divide.

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1. Introduction

In recent years, successful deployment of broadband Internet connections has become an important policy goal for many countries (Department of Commerce, 2002; BSG, 2001; Office of the e-Envoy, 2001a, 2001b). Building a nationwide broadband network infrastructure and making people "always" connected to "high-speed" Internet is viewed as the first step toward a transition into the new "information society." The development of a broadband network is a key element to empowering competitiveness in many nations (PIU, 1999; 2000). Thus, the deployment and use of broadband capabilities is high on the current political agenda in many developed and developing countries (BSG, 2001; Office of the e-Envoy, 2001a; 2001b).

Present broadband Internet deployment varies greatly across nations. This is so not only because of different levels of information technology (IT) and network infrastructure, but also because each nation has a complex set of economic, social, and policy considerations (Fowler, 2000). According to an OECD report (OECD, 2001), as of June 2001, South Korea had nearly 14 connections per 100 inhabitants, followed by Canada with 6.2, and Sweden with 4.5. As of December 2001, Korea has approximately 8 million households connected to the broadband Internet, more than half of all households. Korea can therefore be viewed as an effective case of broadband diffusion.

This paper examines the diffusion of broadband Internet in Korea. It investigates the actions and factors that contributed to rapid diffusion, and questions the extent to which this

has led to e-commerce. After a brief introduction to broadband technology and the "last mile" problem, our paper tracks the development of broadband Internet in Korea. It then provides an analysis of the actions taken by the public and private sectors to aid diffusion, plus the social and environmental factors that helped diffusion in this case. We also discuss distinctive features of the Korean market with respect to infrastructure and demand. Finally, we consider major challenges facing the government and related industries.

2. The Last Mile and Broadband Internet Connections

As the Internet moves beyond exchange of e-mail and the content being delivered becomes increasingly sophisticated—audio and video streams, for example—faster and more reliable connections are needed. A major bottleneck is what is metaphorically called "the last mile": the final stretch of connection that carries voice, data, and video into customers' homes and offices. In telephony, local loops "cover the distance between the network termination point at the customer's house and the subscriber main distribution frame" (Gabelmann, 2001, p. 730), in a local exchange.

The last mile constrains the development of the Internet and e-commerce. Service providers have for some time attempted to tackle this problem. High-speed fiber networks are an option, but installing fiber connections to every home or office building seems unrealistic, at least in the short term, because of its cost. To connect an enormous number of households and small companies, it is more economical and realistic to build on existing infrastructure.

Solutions for relatively low cost, high-speed Internet connection include ADSL (Asymmetric Digital Subscriber Lines), cable modems, fixed wireless, and satellite. These are generically called broadband Internet connections. The term broadband has no established definition, but is generally used to describe a wide range of bandwidth and technology. In current discourse, broadband is identified as covering bandwidth from 384 Kbps to over 10 Mbps (Office of the e-Envoy, 2001a).[1] Among broadband Internet connections, ADSL and cable modems are the most readily available to residential users. Table 1 compares the key technologies.

Table 1: ADSL and Cable Modems

	Characteristics	Downsides
ADSL	• Utilizes existing infrastructure of telephone lines (twisted copper line) • "Always on" connection • Asymmetric bandwidth: up to 8 Mbps down/1.5 Mbps up (dedicated access) • Simultaneous use of phone calls and Internet access	• Only works within a certain distance from a local exchange • Slower upload rates than download rates • Limited video capability
Cable modem	• Utilizes existing infrastructure of cable TV (hybrid fiber coaxial) • Bandwidth: 10 Mbps (shared access) • "Always on" connection • Simultaneous use of cable TV and Internet access	• Speed dependent on traffic • Difficulties of voice telephony service

ADSL uses existing twisted copper wire phone lines to provide broadband access. Thus, in theory, any house with a telephone line can be provided with a broadband connection. However, ADSL is hampered by a distance problem; speed of access drops substantially as the distance from the local exchange increases beyond about 4 kilometers. Cable modems are designed to take advantage of the existing cable infrastructure used to provide cable television services. A disadvantage is the relationship between speed and the volume of traffic across all connected to the cable relay; speed can drop dramatically at peak hours. In addition, since ADSL and cable modems use network infrastructures, which have evolved from telecommunications and broadcasting industries respectively, they have different technological and economic characteristics. For example, they are under different regulatory regimes (Yun and Lim, 2002). Fixed wireless and satellite connections are other possible alternatives, but their penetration is still too small to be reported in most areas (OECD, 2001; ITU, 2001a).

3. The Korean Broadband Internet Access Market

3.1 Background: South Korea

South Korea is noted for its rapid economic development over recent decades, joining the OECD in 1996. Table 2 provides some summary data. Until the mid-1990s, Korea's economic growth was based primarily on traditional manufacturing industries such as shipbuilding and the automobile industry. Recently, however, the IT industry (IT equipment, telecommunications services, and software) has played a greater role in the Korean economy. Since the financial crisis in 1997, the Korean government has not only invested in the IT industry, but also promoted further investment in it. The government views IT as an area of growth that will help the rest of the Korean economy to recover. The government underscored the importance of a knowledge-based society by producing the program "Cyber Korea 21" in 1999 (MIC, 1999), which accelerated IT development. The amount of value-added for the IT industry grew at an average annual rate of 18.9 percent from 1996 to 2000, exceeding the GDP growth rate by a large margin. As a result, the IT industry grew from 8.6 percent of GDP in 1997 to 13 percent in 2000, the highest proportion among OECD countries (KISDI, 2002).[2]

Table 2: Basic Facts about South Korea (as of 2000)

Population and Household (National Statistical Office, 2001)	
Population (A)	46.1 million
Population density	462
Urban population	80 percent
No. of households	14.3 million
Average no. per household	3.1
National Accounts (EIU, 2002)	
Currency WON (W)	W1,131:US$1 (average)
GDP (B)	US$ 456.5 bn
GDP growth	8.6 percent
GDP per head (B/A)	US$9,902

3.2 Telecommunications Policy and Infrastructure

The Korean government has consistently pursued telecommunications policies for competition, based on deregulation and market principles. South Korea is considered to have one of the most liberalized telecommunications sectors in Asia. It offers an example of a steadily privatized and liberalized market (Singh, 2000). This liberalization traces back to the early 1980s, when the government decided to take its hands off the business sectors that the government itself had operated. In line with this policy, Korea Telecom, DACOM, and Korea Mobile Telecommunications (now SK Telecom) were established to provide voice, data, and mobile telecommunications services respectively. However, it was not until the early 1990s that competition policy was introduced in each service area. In order to actively cope with rapidly changing environments in the telecommunications sector, the government implemented structural reforms in July 1990, in which competition was allowed in basic telecommunications services incrementally, and the market for value-added services was fully opened (KISDI, 2001).

Since the mid-1990s, the Ministry of Information and Communications (MIC) has pursued a policy of high-speed telecommunications infrastructure as a foundation for building the knowledge-based society. The government started work on an initial plan for the Korea Information Infrastructure (KII) in 1993 and set up a comprehensive plan in March 1995. In August 1995, the "Framework Act on Informatization Promotion" was enacted to drive the nationwide KII project and the "Informatization Planning Office" was set up in the Ministry of Information and Communication.

The goal of KII was to construct an advanced nationwide information infrastructure consisting of communications networks, Internet services, application software, computers, and information products and services. All information and communications services in voice, data, and video were to be provided easily, reliably, securely, and cost-effectively, in a timely manner (Jeong and King, 1997). The plan consisted of three sectors: KII-Government, KII-Public, KII-Tested called KOREN (Korea Advanced Research Network) and it has been running in three phases, as summarized in Table 3.

Table 3: KII Sectors and Phases

	KII-Government	**KII-Public**	**KII-Testbed**
Main user	Government	Domestic and business	Research institutes and universities
Investor	Government	Private sector	Government and private
Main objective	Backbone	Access	Testbed
Phase 1 (1995–1997)	Connect 80 call zones	Fiber to the big buildings	2.5 Gbps between Seoul and Taejon
Phase 2 (1998–2000)	All 144 call zones with ATM service	30 percent of the total households with ADSL or CATV	GigaPoPs
Phase 3 (2001–2005)	Upgrade to Tera bps	Over 80 percent of the households with 20 Mbps access	All optical net

Source: Kim, 2001

3.3 Broadband Connections and Internet Use

In the burgeoning world market and with its impact on the shape of the international telecommunications landscape, Korea presents a unique case with the rapid deployment of broadband, fast Internet penetration, and very high amount of time its people spend online (ITU, 2001a; OECD, 2001). It has been widely reported that South Korea is the most wired country in terms of broadband (Financial Times, 2000; *Business Week*, 2000; Time, 2000).

According to the OECD report (OECD, 2001), as of June 2001, Korea's broadband penetration exceeded 14 subscribers per 100 inhabitants. This figure more than doubles the next best performing country, Canada (Figure 1). In December 2001, Digital Subscriber Line (DSL) subscribers increased to 4.5 million and cable modem subscribers to 2.7 million in Korea. This lifted the broadband penetration rate to 17 subscribers per 100 inhabitants. A survey by NetValue (a French-based Internet measurement company) reveals a detailed picture of Korean Internet usage; the aggregate data for users is broadly in line with the OECD studies. NetValue (2001a) shows Korea to have the highest broadband penetration in the world. In February 2001, 57.3 percent of Korean Internet home users accessed via broadband connections, whereas in the second country (the United States) this was only 11.1 percent (Figure 2). Pricing was lower than in many countries; in summer 2001, broadband Internet connections were available at the rate of about US$25 per month for a "24 hours per day" connection.

Figure 1: Broadband Penetration in OECD Countries (as of June 2001)

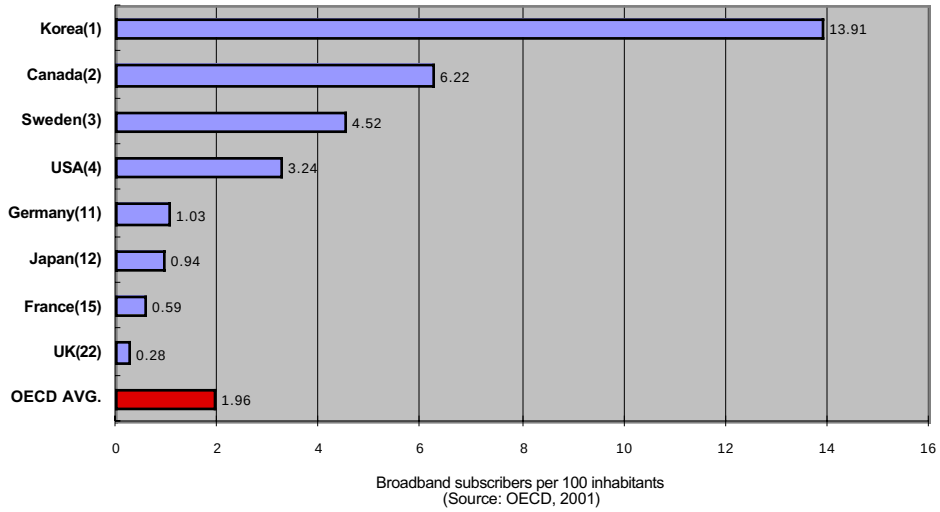
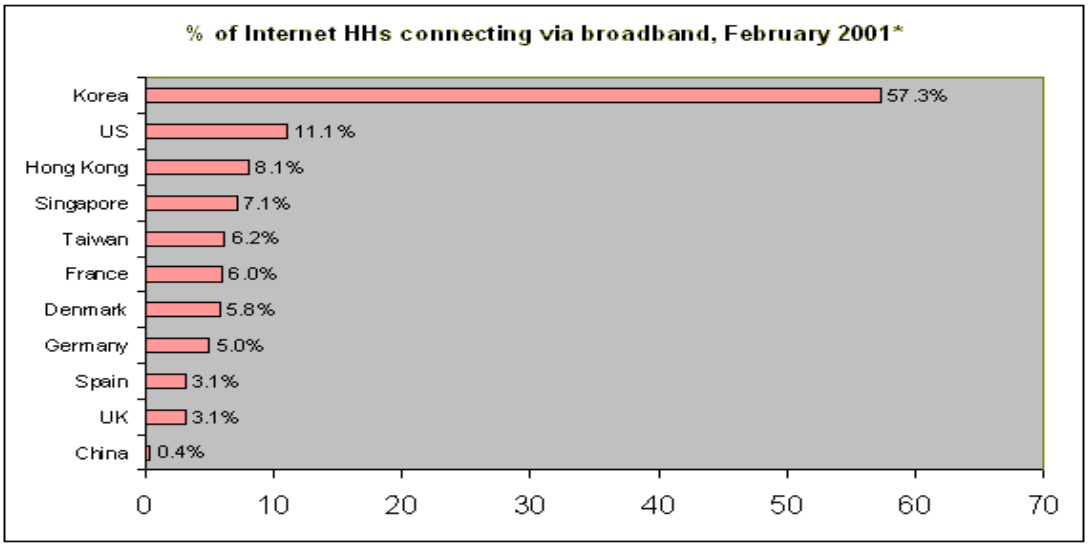


Figure 2: Internet Households Connecting via Broadband (Source: NetValue, 2001a)



The number of Internet users increased dramatically between 1998 and 2001. According to the Korea Network Information Center (KRNIC, 2002), an independent institute for domain administration and Internet statistics, 24 million Koreans users over the age of seven used the Internet more than once a month in December 2001, which is more than half the population. Using a more conservative criterion, of users over the age of sixteen connecting more than once a week, 48 percent of the population used the Internet more than once (Table 4).

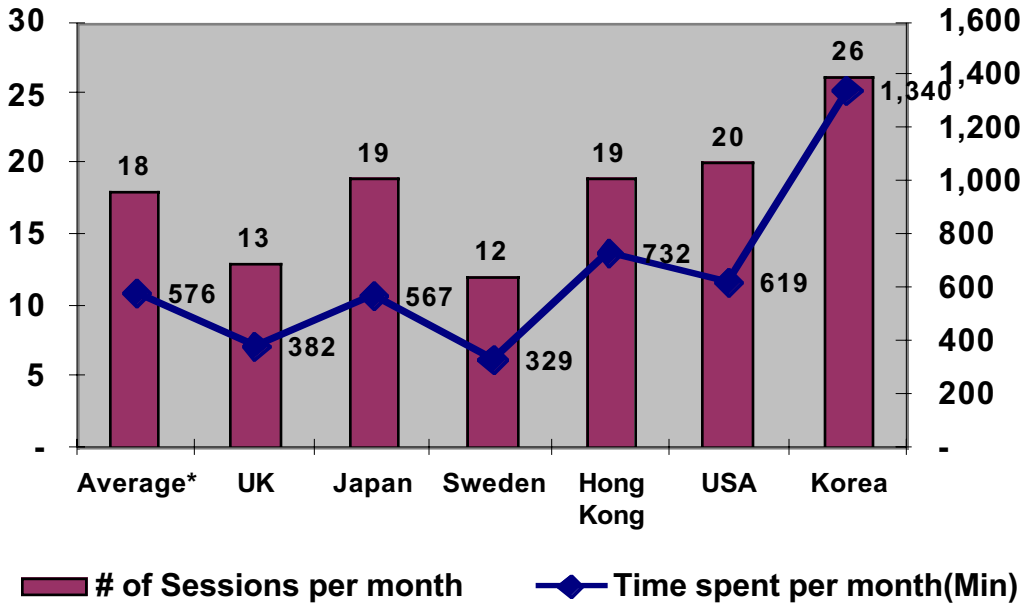
Table 4: The Number of Internet Users (KRNIC, 2000b, 2001, 2002)

Number of Users (unit: 10 thousands) *Ratio to the total population (percent)*						
Time **Measure**	**Oct. 1999**	**Mar. 2000**	**Aug. 2000**	**Dec. 2000**	**Jun. 2001**	**Dec. 2001**
A	943 *22.4*	1,393 *33.0*	1,640 *38.5*	1,904 *44.7*	2,223 *51.6*	2,438 *56.6*
B	786 *18.6*	1,276 *30.3*	1,474 *34.6*	1,811 *42.5*	2,093 *48.6*	2,317 *53.8*
C	786 *21.7*	1,168 *32.2*	1,299 *35.4*	1,519 *41.4*	1,726 *46.5*	1,867 *50.3*
D	665 *18.4*	1,080 *29.8*	1,178 *32.1*	1,453 *39.6*	1,615 *43.5*	1,771 *47.7*

Measure A: Internet user over the age of 7, using more than once a month
Measure B: Internet user over the age of 7, using more than once a week
Measure C: Internet user over the age of 16, using more than once a month
Measure D: Internet user over the age of 16, using more than once a week

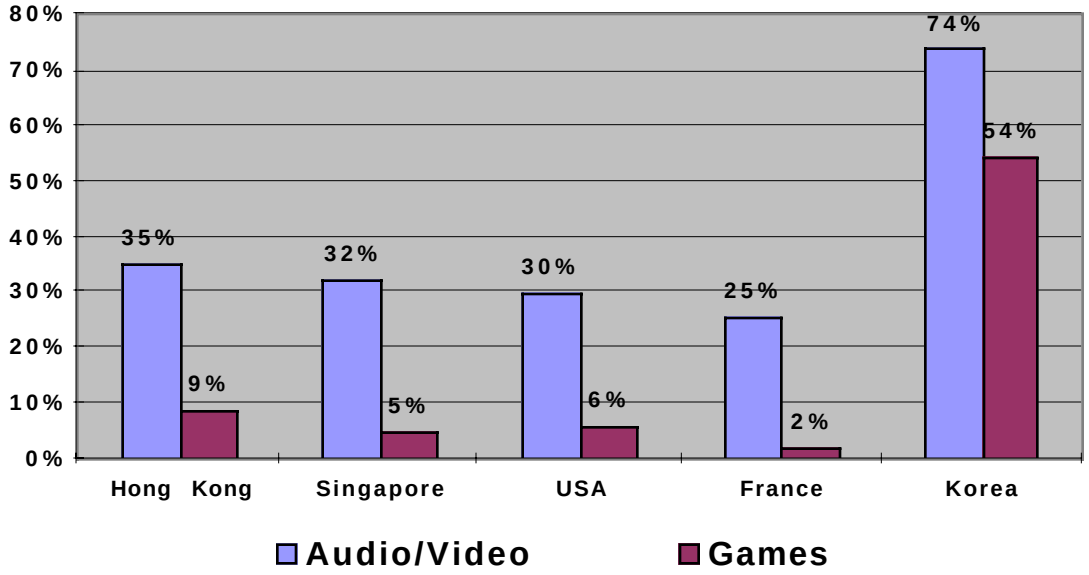
The increase in Internet users, as shown in Table 4, is remarkable. However, given the general increase worldwide, it does not show the peculiarities of the Korean phenomenon. Nielsen/NetRatings' report (2001) shows the most distinctive characteristics of Internet use in Korea. There is evidence that broadband connections are altering Koreans' surfing behavior and giving them a much richer online experience. In July 2001, Koreans spent longer surfing that any other nation: 1,340 minutes per user per month (Figure 3). This was longer than Americans (619 minutes) and more than three times the time spent by the British (382 minutes).

Figure 3: Internet Usage (Source: Nielsen/NetRatings, 2001)



A related aspect of Internet use in Korea is audio and video streaming. Koreans are over twice more engaged in audio and video usage than Americans (Figure 4). In February 2001, this figure reached 74 percent (NetValue, 2001a). The high penetration of broadband is likely to account for this high audio and video usage. Moreover, online games are major activities for Korean Internet users; 54 percent were playing games in February 2001. The popularity of online games[3] in Korea is particularly interesting when we consider that the game usage rate in the rest of Asia is less than 10 percent. This is likely due to Korea's high-speed Internet access, which allows multiple users to simultaneously play games requiring high resolution and high processing capacity.

Figure 4: Audio/Video and Game Usage (Source: NetValue, 2001a)



In sum, it can be said that the rapid growth of the Internet population and the changing behavior of this population can be attributed to the high penetration of broadband access at an exponential rate, and within a short period of time. Table 5 shows the details of the penetration by various broadband technologies. As of June 2002, the penetration rate of high-speed Internet services has reached 62 percent of the total households and 18 percent of the total population. There are 8.7 million broadband Internet subscribers, mainly consisting of 5 million ADSL users and 3 million cable modem users. This substantial growth can be attributed largely to falling equipment prices and competitive marketing activities by service providers.[4] We will explore this in more detail later.

Table 5: Broadband Internet Penetration. Units: 1,000.

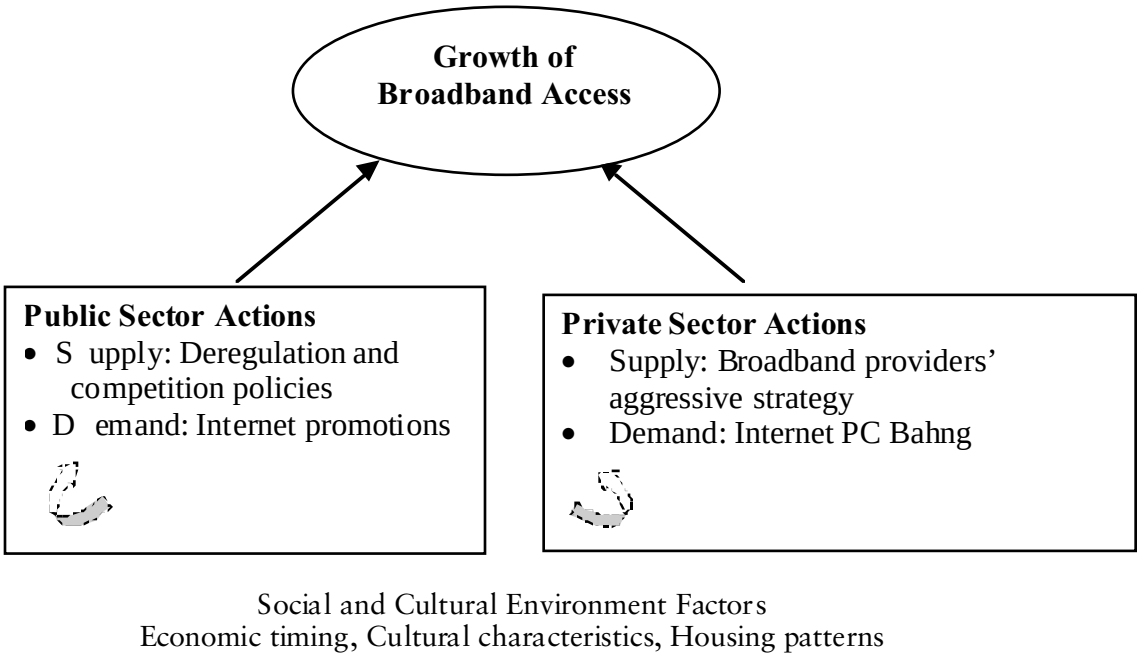
Method	1998	1999	2000	2001	Jun. 2002
ADSL	-	74	2,074	4,453	5,021
CATV	13	156	1,386	2,723	3,017
Others	-	6	557	630	680
Total subscribers	13	236	4,017	7,806	8,718
Percentage of the total household	0.1 percent	1.7 percent	28.7 percent	55.8 percent	62.3 percent
Percentage of the total population	0.03 percent	0.5 percent	8.7 percent	17.0 percent	18.4 percent

Source: MIC, 2002.

4. Analysis

In this section, we analyze the actions and factors that contributed to the rapid penetration of broadband access in Korea. We trace them, as shown in Figure 5, from three different viewpoints: public sector, private sector, and social and cultural environment factors. In each sector, we consider demand for broadband and supply of broadband.

Figure 5: Contributing Factors to the Broadband Development in Korea



4.1 Public Sector Actions

4.1.1 Supply: Deregulation and Competition in the Internet Market

In line with the deregulation and competition policies in the telecommunications sector, the Internet market was led by the same principle. Before broadband Internet emerged, the government introduced competition in the local and long distance call sectors by giving licenses to multiple carriers. In this process, for instance, the Ministry of Information and Communication granted Hanaro Telecom Inc. a license for a local call carrier to compete against Korea Telecom. This promoted the development of high-speed Internet access infrastructure, and facilitated open competition in the high-speed Internet market. The intense competition led to a relatively low price, and subsequently a rapid increase in demand.

There has been little entry regulation for Internet services, whereas the government has kept entry regulation for voice telephone services. The government's "hands-off policy" (Park and Lee, 2002) allowed any businesses which wanted to provide high-speed Internet access to start and provide a variety of services following a simple registration procedure. The

government also ignited service competition by monitoring and announcing the services (e.g., actual connection speed, days taking for installation, etc.) provided by the companies. On the downside, this deregulated environment has produced too many service providers for the market size, causing overlapping investment; it is expected an industry restructuring will take place.

4.1.2 Demand: Internet Promotions

The government deployed a variety of promotion policies to boost Internet use among the population. They include IT literacy, and particularly Internet literacy programs targeted at "housewives", the elderly, military personnel, farmers and excluded social sectors such as low-income families, the disabled, and even prisoners. It set up the "Ten Million People Internet Education" project in June 2000, by which ten million people will have attended a variety of programs by the end of 2002 (MIC, 2000). This promotion was successful in generating the nationwide Internet boom, and 3.4 million people—including one million housewives—learned basic Internet skills in 2000. Among them, we present here one of the most original and successful promotion programs.

While setting up programs for computer and Internet literacy, MIC set "housewives" as its main target (defined as married females not in employment).[5] Government subsidies were granted to private IT/Internet training institutes for training housewives, allowing them to take Internet courses at an affordable price. The program was a success and created an Internet "boom" among housewives. Many portal sites targeting female users were created and some of them now boast of over million subscribers. The program was so successful that MIC increased its target number from one million to two million by the end of 2002 (KRNIC, 2000a). The success of this policy and the resulting Internet boom among housewives in Korea are demonstrated by comparing profiles of heavy and light computer users by occupation among some Asian countries. As seen in Table 6, the ratios of heavy and light users, among housewives, are remarkably high compared with those in four other countries. The gender gap of Internet users is also shrinking, with 56.8 percent of all Korean Internet users being male and 43.2 percent female in June 2001, from 66.9 percent and 33.1 percent respectively in October 1999 (KRNIC, 2001).

Table 6: Heavy and Light Users by Occupation

	Hong Kong		Taiwan		Singapore		Korea		China	
Occupation	**Heavy (%)**	**Light (%)**	**Heavy (%)**	**Light (%)**	**Heavy (%)**	**Light (%)**	**Heavy (%)**	**Light (%)**	**Heavy (%)**	**Light (%)**
Student	30	6	31	13	25	7	51	13	14	7
Housewife	5	23	4	19	4	23	11	41	0	1
Other	65	72	64	66	69	71	37	44	85	91

Base: individuals aged 15+ living in a household connected to the Internet.
Source: NetValue, 2000.

The program for "housewives" is considered a success partly because a housewife has actual purchasing power in running a household (especially in Korea). Although the actual Internet access fee is as low as about US$25 per month, diffusion still requires not only

decision-making by a householder, but also a computer with capacity for such high-speed Internet access costs a substantial amount of money. Policymakers thought that without housewives' commitment to the Internet, its diffusion among households in general could be retarded. Most importantly, the program spotted the shared feeling among housewives of "being left behind" or "being ignored by their own children", and it stimulated a hidden demand for the Internet. This demand is particularly conspicuous in the realm of education, about which Koreans are famously emphatic and enthusiastic. They want to contribute to their children's education at almost any cost, and at the very least, want to understand what their children are doing. A typical television commercial depicts mothers who are solemnly responding to their kids' pleas for high-speed Internet access.

The government also introduced the Cyber Building Certificate system in 1997. Under this system, the authority concerned issues a certificate to a building with high-speed telecommunications capacity. The government sets standards on domestic and business premises with three levels and grants the certificates to qualified buildings (Table 7). This certification gives builders a motivation to enhance the broadband access platform of apartments and buildings they are constructing, as most residents want to live in high capacity cyber apartments. The system also provides builders with a means for differentiating their products—a useful feature in so highly competitive an industry. Cyber Building Certificates have worked particularly well in the Korean housing pattern, in which apartments account for half of the total housing.

Table 7: Traffic Capacity Standards for Cyber Building Certificates (Kim, 2001)

	1st Class	2nd Class	3rd Class
Traffic capacity	More than 100 Mbps	10–100 Mbps	Up to 10 Mbps

4.2 Private Sector Actions

4.2.1 Supply: Strategies of Broadband Internet Providers

The broadband Internet provision business has grown rapidly in Korea since 1998. With more than half of all Korean households subscribing to broadband Internet, it has become a significant sector of the Korean telecommunications industry. Here we present how this happened from the perspective of one of the service providers, Hanaro Telecom Inc.

In June 1997, Hanaro Telecom procured a license to be the second local call carrier in Korea. Although it was licensed as a local call carrier, the company found it extremely difficult to compete against Korea Telecom (KT) in this sector due to KT's pre-eminence as the first local call carrier, as well as its high quality service, low prices, and the problem of number portability. However, Hanaro's surveys also revealed that KT's data services—including the Internet—were generating a lot of complaints from its customers due to low access speed and time-based high usage rates. Accordingly, Hanaro decided to focus on broadband Internet access. A commercial service using ADSL technology was launched at the monthly rate of about $40 in April 1999. Several months later, the rate was cut to about $25, with the purpose of pre-empting the market before KT aggressively started a similar service. At that time, KT responded to Hanaro's ADSL launch with ISDN, and planned to expand its own ADSL service later because of high initial investment and estimated low demand. Immediately after Hanaro's launch proved to be a success, KT strengthened its ADSL service and

became the first market leader one year later in June 2000, exploiting its strong position in the telecommunications industry. In May 1999, Thrunet occupied 63 percent, Hanaro Telecom 35 percent, and Korea Telecom only 2 percent. Three years later, in June 2002, the market share of Thrunet and Hanaro dropped to 28 percent and 15 percent respectively, whereas KT's share leaped to 49 percent. Although new start-ups like Thrunet and Hanaro entered the market first with new technologies such as cable modems and ADSL, it did not take long for the major carrier, Korea Telecom, to overtake them with its existing networks and marketing capacity. In this process of overtaking, there was fierce competition, and all of the companies involved implemented aggressive strategies to increase their market share, which led to the low flat fee for quality services.

4.2.2 Demand: PC Bahngs

Internet PC Bahngs (meaning "room" in Korean) are similar to Internet cafés in other countries. However, PC Bahng is perhaps a unique Korean phenomenon in terms of its popularity.[6] It can be described as a business model in which constant access to the Internet is open to the pubic through leased lines (Park and Lee, 2002).

PC Bahngs are equipped with high-speed leased lines and multimedia computers, and offer high-speed access to the Internet at less than one dollar per hour. At first, online games brought young people to Internet PC Bahngs to enjoy the games at high speed and a low price. PC Bahngs have since evolved as places for Internet use among the population across age, region, and income to send e-mails, chat, trade stocks online, search information, and so on at any time of the day and night.

As high-speed Internet access has become a norm among ordinary households, Internet PC Bahngs are arguably losing the attractions (low cost and high speed) that once made them superior to dial-up access from home, and they are now facing challenges for survival. However, Internet PC Bahngs played an important role in generating the nationwide Internet boom. Most importantly, many Korean users were first exposed to high-speed access to the Internet in PC Bahngs. They became so accustomed to using high-speed services that they were not able to return to dial-up methods. This is an important factor that has made high-speed Internet access such as ADSL a norm among Korean people.

4.3 Social and Cultural Environment Factors

4.3.1 Economic Timing

It is arguable that timing was also critical for Internet diffusion in Korea. At the end of 1997, the financial crisis hit the Korean economy. In the following years, Koreans suffered unprecedented rates of unemployment and bankruptcies. This crisis forced the Korean economy to restructure itself.

Since 1998, some 7,700 new companies have started. The government has encouraged Internet ventures by offering tax benefits and low rate loans. Coupled with the previously discussed telecommunications deregulation, new Internet start-ups coincided with the deployment of infrastructure. Interestingly, "the transformation would have been much slower but for the 1998 financial trauma. The very event opened the way for radical changes that would have been unthinkable three years ago" (*Business Week*, 2000, p. 31).

4.3.2 Housing Patterns

Korea's housing pattern contributed to the deployment of broadband connections. The 2001 *Population and Housing Census* (National Statistical Office, 2001) states that apartments account for 47.8 percent of the total housing stock (11.5 million). The concentration of high density dwellings in urban areas made the installation of broadband services relatively easy. This is particularly important given that, as mentioned earlier, ADSL works best within about four kilometers of a local exchange; over 90 percent of the Korean households are within that radius (ITU, 2001b), and therefore, the last mile has been a less serious problem than in other countries.

4.3.3 Cultural Characteristics

Rapid Internet diffusion in Korea can in part be attributed to certain characteristics of Korean culture. Koreans are susceptible to a social pressure to keep up with their neighbors. This tendency is further fuelled by a competitive enthusiasm for children's education, which is considered to be the highest in the world (PCER, 1997). The kids begging for high-speed Internet access in the TV commercial mentioned above are shouting, "Mum, our house, too!" This strong emphasis on education and academic performance has prompted parents to turn to the Internet for educational goods and services.

5. Discussion

We have so far examined the actions and factors contributing to the rapid development of broadband Internet in Korea. Although several factors played a role in the growth, we suggest that the two most important ones are: (a) infrastructure competition, and (b) the high demand for broadband Internet. In effect, (a) is a key supply side action, and (b) is the demand side. The co-existence of these allowed for demand and supply to be quickly matched. This section explores these issues in more detail.

5.1 Infrastructure Competition between Technologies

From the preceding analysis, we note that the government has been playing an important role in creating a competitive market environment through various policy measures of deregulation. As a result, there has been fierce competition in the broadband market in Korea. There are two "pure" ways to promote competition in the network industry (Christodoulou and Vlahos, 2001; Michalis, 2001). In infrastructure competition, entrants have to build their own network; in service competition, entrants can use the incumbent's network and resell capacity on it. Healthy competition between both infrastructure networks and within each network technology (e.g., ADSL) plays a pivotal role in the deployment of broadband Internet (Guillen and Suarez, 2001; OECD, 2001).

In Korea, there has been a vigorous infrastructure competition within and between ADSL and cable modem networks, which in turn has played an important role in Korea's successful broadband Internet deployment (Yun and Lim, 2002). Infrastructure competition was ignited as new broadband Internet providers aggressively entered the market, posing serious challenges to the incumbent Internet service providers (ISPs). In July 1998, Thrunet, a major cable modem provider, launched its first commercial broadband access service by utilizing the existing cable TV network. In April 1999, Hanaro, the second local call carrier, joined the high-speed Internet market by launching its commercial DSL and cable modem services. Hanaro's DSL services were provided over its own fiber-optic networks for apartment resi-

dential areas, while it leased the cable networks mainly from Powercomm[7] for cable modem services. At that time, KT, the incumbent carrier, responded to Hanaro's launch with ISDN. However, immediately after Hanaro's launch proved to be a success, KT strengthened its DSL service, exploiting its strong position in the telecommunications industry, and regained the market leader position one year later in July 2000. Added to this, Dreamline, DACOM, Onse, and SKT entered the broadband Internet market one after another by leasing the cable networks, primarily from Powercomm.

This aggressive tug-of-war between facility-based service providers utilizing different access technologies has had the effect of lowering prices even during the early phase of market development. The low flat fee for a quality service, in turn, created a greater demand for high-speed Internet access among consumers, and thereby allowed the size of the market to grow exponentially. The resulting market figure shows an interesting difference between diffusion rates for each technology in Korea (Table 8).

Table 8: Residential Broadband Transport Subscribers in Korea and the United States

Nations	*South Korea* (as of Jun. 2002)		*United States* (as of Dec. 2001)	
Technologies	Subscriber	Market Share	Subscriber	Market Share
Cable Modem	3,017,262	37.5	7,050,709	66.1
DSL	5,020,539	62.5	3,615,989	33.9
Total	8,037,801	100.0	10,666,698	100.00

Source: MIC, 2002; FCC, 2002.

As shown in Table 8, the market outlook in Korea differs greatly from that of the United States. This disparity in market composition across Korea and the United States can be attributed to a number of factors, including technological features, housing patterns, and cultural differences between nations, as we have seen in the previous sections. Among these, the distinctive trajectory of broadband access market development in Korea owes much to the regulatory approach that its government has developed toward broadcasting and the common carrier industries. The current market bears the imprint of different regulatory heritages that evolved in different industry sectors. To understand how DSL became a market leader in the Korean broadband market, it is crucial to note that the cable modem market is entwined with the cable TV market, which is historically one of the most heavily regulated sectors in Korea's media industry. Unlike other nations, the Korean government took the initiative to launch the cable industry as part of a plan for "national digitalization." Before its launch, the blueprint of specifications for the cable TV market structure and conduct was laid out by policymakers, who worried about potential anticompetitive effects that might harm fair competition in the downstream market.[8]

In order to prevent the vertical foreclosure effects, the government came up with market structural remedies. The government separated the cable TV market into three vertical layers: Network Operator (NO), System Operator (SO), and Program Provider (PP).[9] Vertical and horizontal integrations across these layers were strictly prohibited. Due to the large investment to build the HFC (Hybrid Fiber Coaxial) infrastructure, the NO licenses were issued primarily to Powercomm and KT, both public corporations at the time.[10] Simultaneously, seventy-seven SO licenses were issued to local SOs divided based upon geographic distribution, and twenty-nine PP licenses to various channel providers.

Table 9: Cable Industry in Korea

Network Operators (NO)	System Operator (SO)	Program Provider (PP)
National—KT, KEPCO (2)	Divided by region (77)	29
Local NOs (20)		

Source: KISDI, 2001; ING Barings, 2000.

This rigid and inflexible regulation of the market structure later turned out to be problematic.[11] It failed to provide the momentum that the cable TV industry needed during the initial stage of its development: the loss in efficiency as a result of negative vertical externalities (e.g., double marginalization) affected all the segments of market. Small sized local SOs did not have the strong marketing capacity to generate large subscriber bases, and the static market structure failed to bring viable competition into the market. Consequently, structural regulation was criticized as the main obstacle to cable TV's more rapid diffusion rate. The failure of the cable TV market to install a large subscriber base had a deleterious effect on the cable broadband access market, and protracted the cable Internet market's uptake.[12]

Under a different policy legacy of common carriers, telecommunications firms that promote DSL, like KT, have no market structural and behavioral regulation imposed upon them. Unlike cable TV, the government has adopted the competition policy in the telecommunications industry, under which new entrants have been licensed to provide the telecommunications services such as local, long distance, and international call services.

Table 10: Telecommunications Industry in Korea (as of June 2001)

Local Call	Long Distance/International Call	Leasing Service
2 (KT, Hanaro)	3 (KT, Dacom, Onse)	13 (KT, etc.)

Source: MIC, 2001.

The entrance regulation the government imposed upon voice telephone services does not apply to data services. Even during the introduction of competition, KT's vertically integrated structure remained intact. Therefore, KT could provide the Internet services over its own vertically integrated network without any kind of regulatory burden. Although the government is scheduled to implement open access for ISPs and unbundle the local loops of incumbent telecommunications operators (e.g. KT, its implementation is not foreseeable in the near future.

This overall broadband market shape shows a stark contrast with the U.S. case. In the United States, the regional Bell operating companies (RBOCs), the primary providers of DSL, have been under heavy regulatory codes, along the lines of common carrier regulatory model. By contrast, situated within the broadcasting model of regulation, cable TV services have not been tied to any strong regulation (Hausman et al., 2001). This is often referred to as "asymmetric regulation for the broadband technologies" pursued by the Federal Communications Commission (Noll, 2002).

5.2 Existing Demand and a Killer Application

As described above, low prices induced by fierce competition created remarkable demand for Internet access in Korea. At the same time, however, it must be noted that strong demand for the Internet, particularly for fast connections, existed prior to the commercial provision of broadband (Park and Lee, 2002). Access to the Internet diffused at a rapid pace from 1996, and many users who were connected by dial-up access began to demand 'faster speed'. PC Bahngs and online games played a particularly interesting role in this diffusion. As mentioned above, PC Bahngs introduced users to fast connections in the early stages of their Internet experience. We suggest that online games acted like a "killer application": an application which forces or urges users to buy or adopt the platform on which the application is running (Downes et al., 2000). For Korean users, and particularly younger generations, the speed provided in PC Bahngs was a strong incentive for them to obtain a home broadband connection.

The Korean case also shows that if the demand for high bandwidth Internet access can be matched by cultural expectations, such as the Korean emphasis on education and knowledge, then diffusion can be fast. When the MIC set up Internet promotion policies, they shrewdly spotted the cultural demand for the Internet, particularly among housewives. This case of fast Internet diffusion and usage in Korea shows the importance of culture in the diffusion of technology.

6. Challenges

In this section, we discuss challenges that lie ahead for the government as well as related industries. These challenges may also face other countries, currently and in the near future.

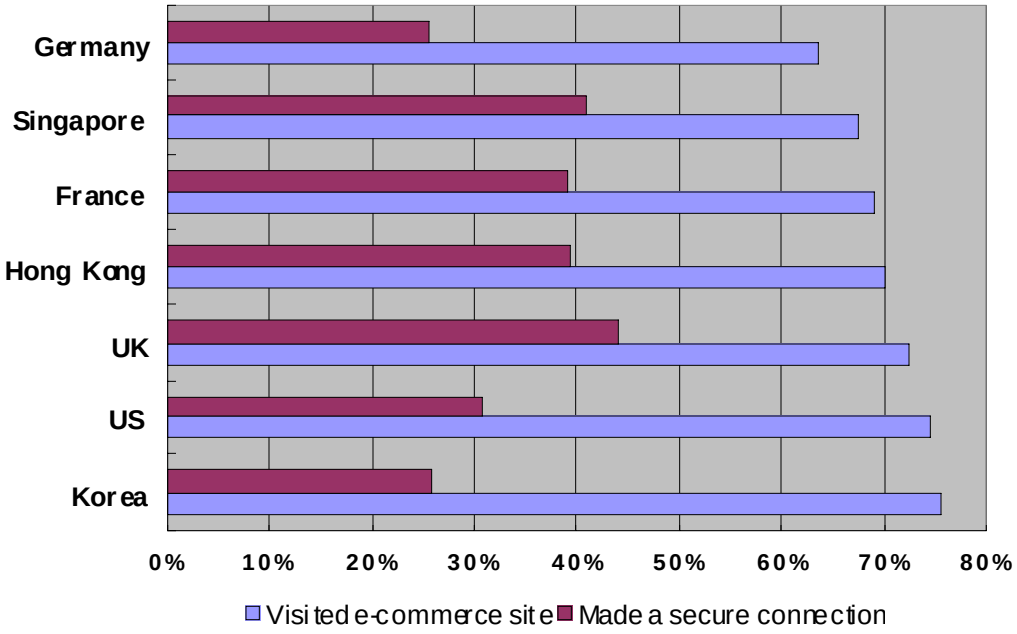
6.1 Electronic Commerce

Korea not only has the infrastructure, but also has a population that is willing and able to use the infrastructure. However, this high Internet usage needs to be converted to electronic commerce.

According to a survey of NetValue (NetValue, 2001b), 75.7 percent of Internet users in Korea visited e-commerce sites in June 2001, among which only 25.7 percent made secure connections. Secure connections are used to ensure the confidentiality of information exchanged, particularly when entering and transmitting credit card information, when accessing online bank accounts, and when trading online. Such connections are therefore often used as a measure of purchase intentions. These figures compare well to the United States (74.5 percent and 30.9 percent respectively), but are behind the United Kingdom (72.3 percent, 44.1 percent), Hong Kong (70.2 percent, 39.4 percent), and France (69.1 percent, 39.1 percent). A goal of approximately 40 percent for secure connections would place Korea favorably, at least on this measure. A recent survey of the Economist Intelligence Unit (EIU, 2002) also shows similar results to the NetValue's reports. As of July 2002, Korea was ranked as twenty-first in terms of e-readiness (as developed for the EIU e-business forum,) which is shorthand for the extent to which a country's business environment is conducive to Internet-based commercial opportunities.

In sum, it is still not clear that broadband diffusion in Korea has led to high adoption of e-commerce. Therefore, one of key challenges for policymakers and related industries' leaders will be to increase e-commerce activities on the basis of a well constructed broadband infrastructure.

Figure 6: Internet Use and E-Commerce (Source: NetValue, 2001b)



6.2 The Digital Divide

Despite widespread use of the Internet, particularly via broadband access, the Internet boom remains a largely urban phenomenon in Korea. For example, the provision of high-speed Internet access concentrates on metropolitan areas. Large parts of the country and its population remain excluded from the benefits that the Internet offers. Unless well managed and planned, broadband Internet connections will be yet another source of digital divide (Table 11). However, as subscription to broadband connections is currently expanding to rural areas, this gap is expected to shrink. To reduce the digital gap, the government needs to grant loans to service providers that construct broadband access network in rural areas. Such a scheme would help to reduce the digital divide between urban and rural areas.

Table 11: Internet Usage by Area Size*

	Metropolitan	Mid and small cities	Rural
Aug. 2000	41.3	38.4	27.3
Dec. 2000	47.5	44.7	33.3
June 2001	54.2	52.3	38.7

* percent of the total population over age 7.
Source: KRNIC, 2001.

Another worrying divide arises in differences by age and occupation. Only 7.3 percent of those aged 50 and above go online, compared with 87.6 percent of the 7–19 age group, the most active group. By occupation, 23.4 percent of production workers (including farmers and others) have Internet connections. The figure stands at 89.9 percent for students and

78.3 percent for office workers (KRNIC, 2001). However, this figure continues to increasw at a rapid pace; it was only 12.3 percent in December 2000.

7. Conclusions

We have examined how the phenomenal growth of the broadband Internet has been achieved in Korea. In particular, the interplay of the public and private sectors in promoting a wide deployment of the broadband Internet—according to demand and supply—has also been investigated. Government investment and promotion of the Internet, deregulation and the encouragement of competition, aggressive strategies by broadband providers, housing patterns, and enthusiasm for children's education have combined to produce an explosive growth in Korean broadband deployment and applications. The market structure of the broadband Internet access market has also been scrutinized, particularly with respect to how the policy regimes that govern related technologies (cable and telephone) have influenced the particular shape of the market. The paper further suggests regulatory measures that would treat both telecommunications and cable industries in a technology-neutral approach, resulting in a better environment for the two substitute technologies—cable modems and DSL—to compete. Finally, the paper considers the potential controversies that could arise with regard to the future development of the broadband Internet, such as electronic commerce and the digital divide.

There are two keys to any country's ability to exploit the potential of information and communication technologies (Mansell and Wehn, 1998; Van Audenhove et al., 1999): the availability of a network infrastructure, and the capacity to create and administer an enabling environment. The former is essential for the provision of applications. The latter includes the capacity to develop applications that exploit the infrastructure in ways that are consistent with need in the local environment. Although it has achieved an unprecedented level of broadband Internet infrastructure, Korea's capacity to exploit its telecommunications infrastructure has room to grow. This growth will be a primary goal for Korean policymakers and industry leaders, both now and in the future.

Notes

[1] Related organizations have adopted slightly different definitions depending on their reporting purposes: "downstream speed faster than 256 Kbps" (OECD, 2001), "faster than primary rate ISDN (that is, 1.5 or 2 Mbps)" (ITU, 1997), and "in excess of 200 Kbps in each direction' (FCC, 2000). Bandwidth over 2 Mbps is called current generation broadband. Bandwidth over 10 Mbps next generation broadband (Office of the e-Envoy, 2001a). While 560 Kbps is provided for residential users and called broadband access in the United Kingdom, broadband in South Korea is taken to mean over 2 Mbps. In this paper, we use the term broadband Internet to mean current generation broadband, which is in the range of speed provided by ADSL and cable modems in Korea.

[2] The IT industry share of GDP in the United States, the global leader in the IT industry, is only 8.3 percent (Department of Commerce, 2000).

[3] The most popular online games in Korea, such as Starcraft and Lineage, are MUD (Multi-

User Dungeon) games. They require high bandwidth for transmitting graphic data, and a better quality of interaction than board games such as online chess and Othello.

[4] For example, Korea Telecom has procured its ADSL equipment at a 50 percent discount from Samsung Electronics and Hanaro Telecom has expanded its reach in newly-built apartment complexes with a variety of promotions (*Korea Times*, 2001).

[5] "Housewife" is now perhaps a derogatory term in the West, but this is the direct translation of the term in use in Korea.

[6] According to the Ministry of Culture and Tourism, with which PC Bahngs are required to register, there were about 12,000 PC Bahngs as of November 1999. However, due to the difficulty in specifying the business and the resulting conflict of interests among the parties involved, there were many unregistered PC Bahngs. Given this, it is estimated that there were about 20,000 at that time.

[7] Powercomm is a firm spun off from Korean Electric Power Corporation (KEPCO), according to the government's privatization policy. KEPCO is the monopoly utility firm in Korea, which owns the vast telecommunications infrastructure measuring up to KT.

[8] The strategic effects of vertical mergers and their impact on consumer welfare in the cable TV industry have long been a source of debate in economics and antitrust. Vertically integrated cable operators may well have incentives to strategically exclude competing services, and consequent harmful effects of market foreclosure are often reported (Salinger, 1988; Hart and Tirole, 1990; Ordover et al., 1990). However, these are usually offset by the efficiency-enhancing effects of vertical integration (Williamson, 1979; Salinger, 1991).

[9] The role division for three main layers is as follows. NOs are in charge of construction and maintenance of a nationwide cable network infrastructure. SOs are responsible for providing the actual commodity of cable TV service to their local subscribers. PPs are licensed to supply program contents for cable TV channels.

[10] There are many small-sized local network operators, but they are not taken into account here because their network coverage is minimal compared to that of Powercomm and KT.

[11] A prescription for this problematic situation—a more conduct-oriented regulation approach that would provide a resilient, consistent foundation for cable market—soon surfaced. The "heavy-handed" regulation model toward cable industry failed to embrace flexibility in a fast-changing economic environment, which is more indicative of telecommunications than other industrial sectors.

[12] Recently, the ownership rules regarding NO, SO, and PP have been removed in the deregulation scheme introduced by the new Broadcasting Act of 2000. The triple-layered, vertically segregated market structure is no longer legally imposed. Even after the structural regulation was lifted, however, the original market structure remains unchanged.

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