Mobile Phone Industry: A Microcosm of Deregulation, Globalization, and Technological Change in the Japanese Economy.

By

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1. Introduction

The interaction between deregulation, globalization, and technological change is a major issue in the economics and management literatures[i]. For example, the forces of deregulation and globalization accelerated the international diffusion of the Internet. Deregulation began in the telecommunication sector in the early 1980s and it and the globalization of finance, corporate governance and trade had become powerful forces by the 1990s. Nevertheless, the extent to which the Internet pierced borders depended on the national specificities of law and regulation, business networks, competition, and technological legacies[ii].

Multinational corporations have played key roles in the globalization of the Internet and other industries. U.S. investment banks, consulting companies, venture capitalists, content providers, and technology providers have played this role in the Internet[iii], GM, Ford, and Toyota have done this in the automobile industry, and Nokia, Ericsson, and Motorola have played this role in the mobile phone industry[iv].

The interaction between globalization and deregulation has also been a major issue in the literature on the Japanese economy and other aspects of Japanese politics. The literature on Japanese economics and politics often uses the term Gaiatsu, which literally means foreign pressure, to describe the impact of foreign political pressure on decisions by the Japanese government. Japanese politicians and individual ministries also use Gaiatsu to strengthen their own domestic agendas. Many observers have argued that deregulation and globalization would have and will not proceed in Japan without Gaiatsu[v].

This chapter discusses the interaction between deregulation, globalization, and technological change in the Japanese mobile phone industry. A key aspect of Gaiatsu in

the mobile phone industry has been the gradual realization by Japanese firms and government agencies that globalizing and working with foreign firms is a necessary tool for competition in the Japanese domestic market. Without the early emergence of this realization, it is likely that globalization and deregulation would have proceeded much more slowly than it actually did in the Japanese market. Furthermore, without globalization and deregulation, it is unlikely that Japanese firms such as NTT DoCoMo and KDDI would have been able to transform themselves into global players.

This chapter is largely based on the author's previous books and articles on the mobile phone industry. These include an historical analysis of competition in the global market[vi], the Japanese mobile Internet[vii], and more specific analyses of global competition between mobile phone standards, phones[viii] and mobile Internet services[ix]. These publications provide information on the original sources, which include Japanese (e.g., the Nikkei Economic Journal) and English published sources and interviews with more than 200 managers from firms in Japan, Europe, and the U.S. between 1996 and 2004.

This chapter first discusses models of technological change and the application of these models to the mobile phone industry, which includes an historical overview of the Japanese-mobile phone industry. This is followed by separate discussions of each generation of technology including analog, digital, PHS, 3G, and the mobile Internet.

2. Technological change and mobile phones

Technological discontinuities lead to a period of ferment in which alternative product forms compete for dominance[x]. This competition between alternative product forms may occur in committees or in the marketplace where one result is the emergence

of one or at the most a limited number of standards or dominant designs. The choice of the standard or dominant design, which can include domestic and foreign ones, has a strong effect on the competition between firms in local and global markets[xi].

The mobile phone industry has experienced three major technological discontinuities and these discontinuities have led to the adoption of different standards; the most important is the air-interface standard, which defines how signals are transmitted between phones and base stations. Roughly speaking, dividing an area into cells, reusing the frequency spectrum in each cell, and using analog signals to make calls was the first technological discontinuity. The use of digital signals and the combination of digital and broadband are usually defined as the second and third technological discontinuities. In each generation of phones there have also been rapid reductions in the size, weight, and cost of the phones through improvements in discrete components and integrated circuits[xii].

Table 1 summarizes the evolution of the major mobile phone service providers in Japan, their names, and their operating regions. NTT (it spun off NTT DoCoMo in 1992) started services in 1979 and by the mid-1980s it was operating a national service. DDI Cellular and IDO started services in 1988 and 1989 respectively in different regions of Japan thus resulting in two service providers per region. Digital Phone and Tsuka Cellular started services in 1994 in Japan's three major metropolitan areas (Tokyo, Osaka, Nagoya). Although they are not shown in Table 1, the major investors in these service providers also started digital services that are based on a "low mobility" technology called Japan's personal handyphone system (PHS) in 1995 (See Table 2).

Table 1. Evolution of Service Provider Names and Their Operating Regions

Year	Names of Service Providers at Time of Formation					
	NTT	DDI Cellular	IDO	Digital Phone	Digital Tsuka	Tsuka Cellular
1979	Tokyo, Osaka					
1985	Nationwide					
1988 1989		Regions outside of Tokyo and Nagoya	Tokyo, Nagoya			
1992	Name changed to NTT DoCoMo					
1994				Tokyo, Nagoya, Osaka	Regions outside of Tokyo, Osaka, Nagoya	Tokyo, Nagoya, Osaka
1999				Merger and name changed to J-Phone		Acquired by DDI
2000		Merger between DDI, IDO, and KDD to form KDDI				
2001		Adoption of au brand name in mobile business		Becomes part of the Vodafone group		
2003				Name changed to Vodafone		

Source: Home pages of firms and author's analysis

NTT: Nihon Telegraph and Telephone

Returning to the major mobile phone service providers in Table 1, Digital Tsuka (combination of investors in Digital Phone and Tsuka Cellular) began providing services in the regions outside of Tokyo, Osaka, and Nagoya and providing roaming services for Digital Phone and Tsuka Cellular in 1997. After changing its name from Digital Phone, J-Phone acquired Digital Tsuka in 1998 and it was acquired by Vodafone in 2001. DDI Cellular, IDO, and KDD, which is a provider of international wireline

services, merged in 2000 to become KDDI; KDDI also acquired Tsuka Cellular in 2000. Since KDDI and Tsuka Cellular use different air-interface standards, there is very little integration of services. As of late 2004, there are four major service providers and three PHS service providers.

Table 2 summarizes the air-interface standards that Japanese service providers adopted in the three generations of mobile phone services. NTT and IDO used NTT's analog system while DDI Cellular adopted TACS, which is a derivative of the U.S. AMPS and British TACS. NTT DoCoMo began digital services in 1993 based on PDC (Personal Digital Cellular) as did Vodafone, Tsuka Cellular, and DDI Cellular in 1994, and Digital Tsuka in 1997. DDI Cellular started services based on cdmaOne in 1998 followed by IDO in 1999[xiii]. After they merged in 2000 to form KDDI, they renamed the mobile phone service "Au" and started cdma20001x services in April 2002. NTT DoCoMo started FOMA services in January 2002 and Vodafone did so in 2003.

Figures 1 and 2 summarize the growth in subscribers (including PHS) and the evolution in shares (cumulative data) for the non-PHS service providers. The entry of new service providers stimulated the growth in subscribers in 1994 and to a lesser extent in 1989; the former is hard to discern in Figure 1 due to the much lower number of subscribers in 1989 than now. As shown in Figure 2, the entry of new service providers has also had an impact on the share of subscribers.

Table 2. Service Start Dates by Operator and Technology

Technology	Operator	Air Interface Standard	Service Start Dates (some regions had later start dates)

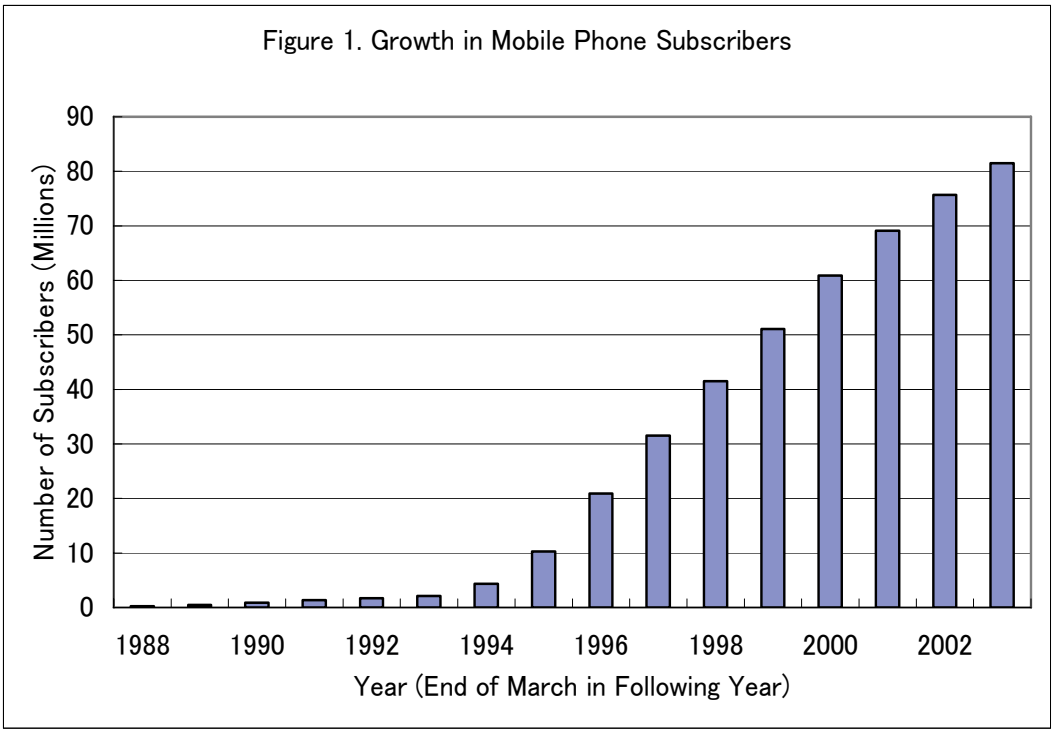
1G: Analog	NTT DoCoMo	NTT	1979
	IDO	NTT	1988
	DDI Cellular	TACS	1989
	IDO	TACS	1991
2G: Digital	NTT DoCoMo	PDC	1993
	J-Phone, Tsuka Cellular, DDI Cellular	PDC	1994
	IDO	PDC	1995
	NTT Personal, DDI Pocket, Astel	PHS	1995
	Digital Tsuka	PDC	1997
	DDI Cellular	cdmaOne	1998
	IDO	cdmaOne	1999
3G	KDDI	cdma20001x	2002
	NTT DoCoMo	W-CDMA	2002
	Vodafone	W-CDMA	2003

Source: Home pages of firms and author's analysis

Abbreviations used in Table 2: TACS (Total Access Control System), PDC (Personal Digital Cellular), PHS (Personal Handyphone System), cdma (code division multiple access), W-CDMA (Wide-band code division multiple access)

3. Analog: the first wave of gaiatsu

NTT started the first mobile phone services in the world in 1979. NTT used a proprietary system that it and a small number of Japanese suppliers had developed. In spite of Japan's two year lead in these services, other factors prevented the adoption of the standard by other countries: these include the closed nature of the standard, the small number of participating manufacturers, which were all Japanese, and the lack of growth in subscribers[xiv].

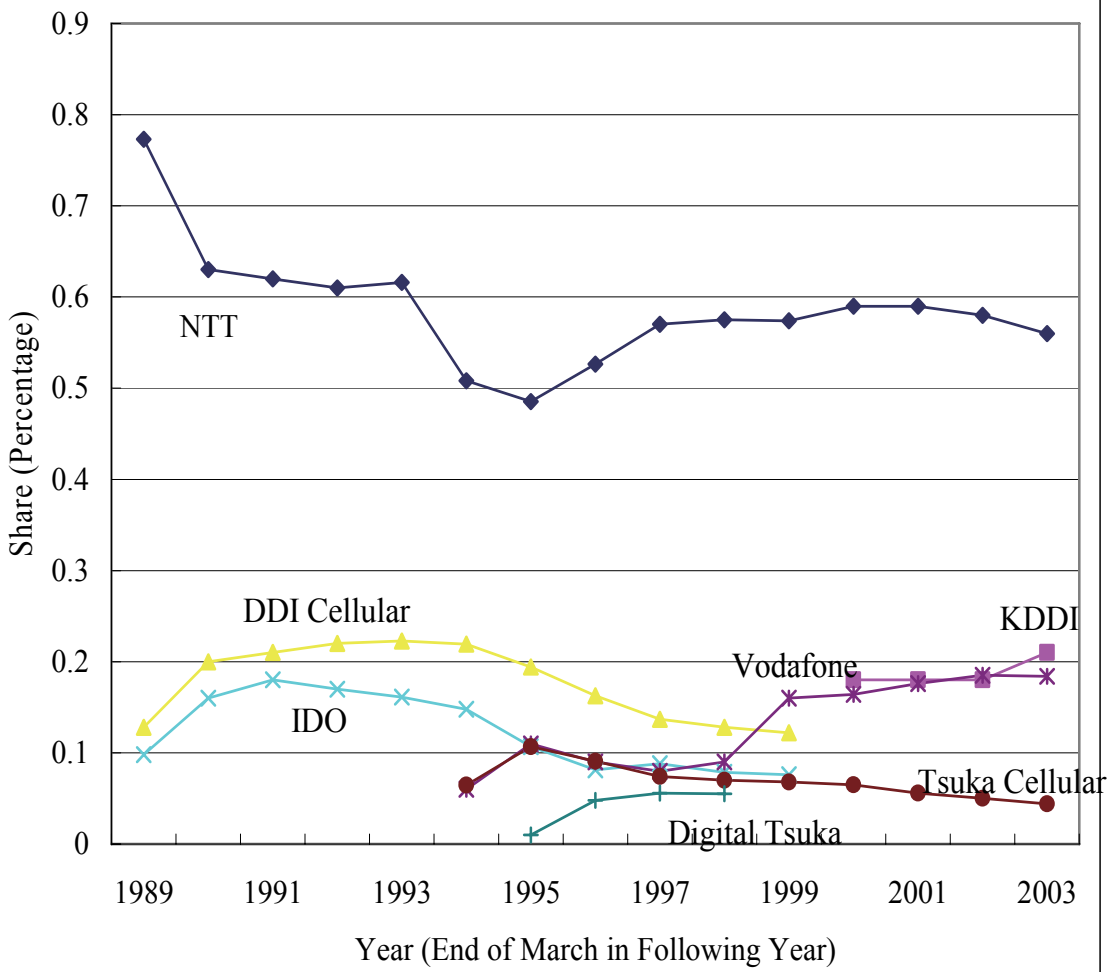


Source: Japan's Telecommunication Carriers Association and author's analysis

NTT's monopoly in services, the rental as opposed to sale of phones, and the high price of the services led to very slow growth in subscribers. Neither the MPT nor NTT believed there was a large market for mobile communication services in Japan and thus NTT did not install many base stations and both the MPT and NTT agreed to set user fees at high levels. The MPT wanted to set high fees high in order to minimize the number of complaints and prevent people from subscribing who could not afford the service, and it rented the phones because it thought the purchase of phones would confuse users[xv]. The MPT was apparently influenced by the Ministry of Transportation whose offices were adjacent to the MPT at the time. The MPT controlled the renting of phones and the awarding of spectrums like the Ministry of Transportation controlled

vehicle licenses. In spite of having less than 1/5 the population of Japan, there were more mobile phone subscribers in Scandinavia than in Japan by the end of 1983[xvi].

Figure 2. Shares of Mobile Phone Subscribers



Source: Japan's Telecommunication Carriers Association and author's analysis

Gaiatsu, in combination with domestic interest in deregulation, ended NTT's

monopoly on mobile phone services by allowing the entry of two new service providers, one of which used foreign technology. Pressure in the mid-1980s from the U.S. government is one reason why Japan's Ministry of Posts and Telecommunications (MPT) agreed to give one license to a firm that promised to implement a foreign standard and buy from a US company[xvii]. IDO, whose major investor was Toyota, adopted the NTT standard and started services in Nagoya and Tokyo in late 1988. Toyota believed that it was safer to adopt a Japanese standard than a foreign one even if the standard was provided by its major competitor (Shigetaka, 1995). DDI Cellular, whose major investor was Kyocera, adopted TACS, which is a derivative of the U.S. AMPS standard, purchased the equipment from Motorola, and started services in the other regions of Japan in early 1989.

DDI Cellular's use of an open foreign standard enabled it to obtain 48% of the subscribers in its regions (versus 52% for NTT DoCoMo) as compared to 31% for IDO (versus 69% for NTT DoCoMo) in its regions of operation between the date of their service starts and March 1994. In particular, the large installed base of the AMPS and TACS standard in the US and elsewhere enabled DDI Cellular to offer handsets that were smaller and cheaper than NTT DoCoMo's handsets. On the other hand, IDO paid NTT a licensing for the use of the NTT standard, it did not receive phones until six months after NTT DoCoMo had received the phones, and few suppliers developed handsets based on NTT DoCoMo's analog standard due to the small market and high licensing fees[xviii].

Motorola, the U.S. government, and DDI Cellular continued to argue that the lack of a nationwide service represented a disadvantage to DDI Cellular and thus IDO should also adopt the TACS standard in order to provide roaming services for DDI Cellular.

IDO's main investor, Toyota, did not strongly oppose these arguments partly since it did not want to anger the government of its second largest market. As a result, IDO adopted and gradually implemented TACS equipment in the early 1990s as it simultaneously implemented digital base stations[xix].

4. Digital: the second wave of gaiatsu

Gaiatsu also played a role in the choice of service providers, standards, and suppliers for digital services, which were started in the early 1990s in Japan, Europe, and the U.S. Partly as a result of Gaiatsu, the Japanese government awarded two new licenses and allowed foreign firms to invest in the new entrants. The largest investment was made by Vodafone albeit more than 10 other foreign companies made investments in Digital Phone, Tsuka Cellular, and later in the PHS service providers. Vodafone's investment in Digital Phone eventually led to its acquisition of this firm (then called J-Phone) in 1999.

In terms of standards, the U.S. government pressure probably played a role in NTT's design change from frequency division (FDMA) to time division multiple access (TDMA) in the late 1980s. Both U.S. and European firms had been focusing on the latter since the mid-1980s. Although NTT claims that the decision to adopt TDMA and also Motorola's coding and decoding technology in 1990 was based solely on technical reasons, it is likely that political factors also played a role and may have played the largest role[xx].

In addition to the successful use of foreign technology by DDI Cellular in analog cellular, both political and technical factors probably also played roles in the choice of suppliers for NTT DoCoMo's digital services. As part of the US-Japanese

Telecommunications Agreement in 1985, the NTT Procurement Agreement required NTT to purchase 20% of its equipment from foreign suppliers. The decision to change to technology in which foreign firms had greater capabilities than domestic firms and NTT's falling share in the analog market probably also encouraged NTT to work with foreign suppliers. Ericsson and to a lesser extent Motorola became suppliers of infrastructure while Nokia became a supplier of handsets[xxi].

Partly through pressure from the U.S. government, the Japanese government also required service providers to sell rather than rent phones and required NTT to publish a set of specifications for the air interface and freely license this technology to the other service providers. The much faster subscriber growth in countries like the U.S., Great Britain, and Scandinavia, which sold phones and adopted open standards, made it hard for the Japanese government to resist these arguments. As part of publishing the specifications for the air interface, NTT was required to obtain approval for the standards in the Japanese Association for Radio Industry Businesses or ARIB[xxii].

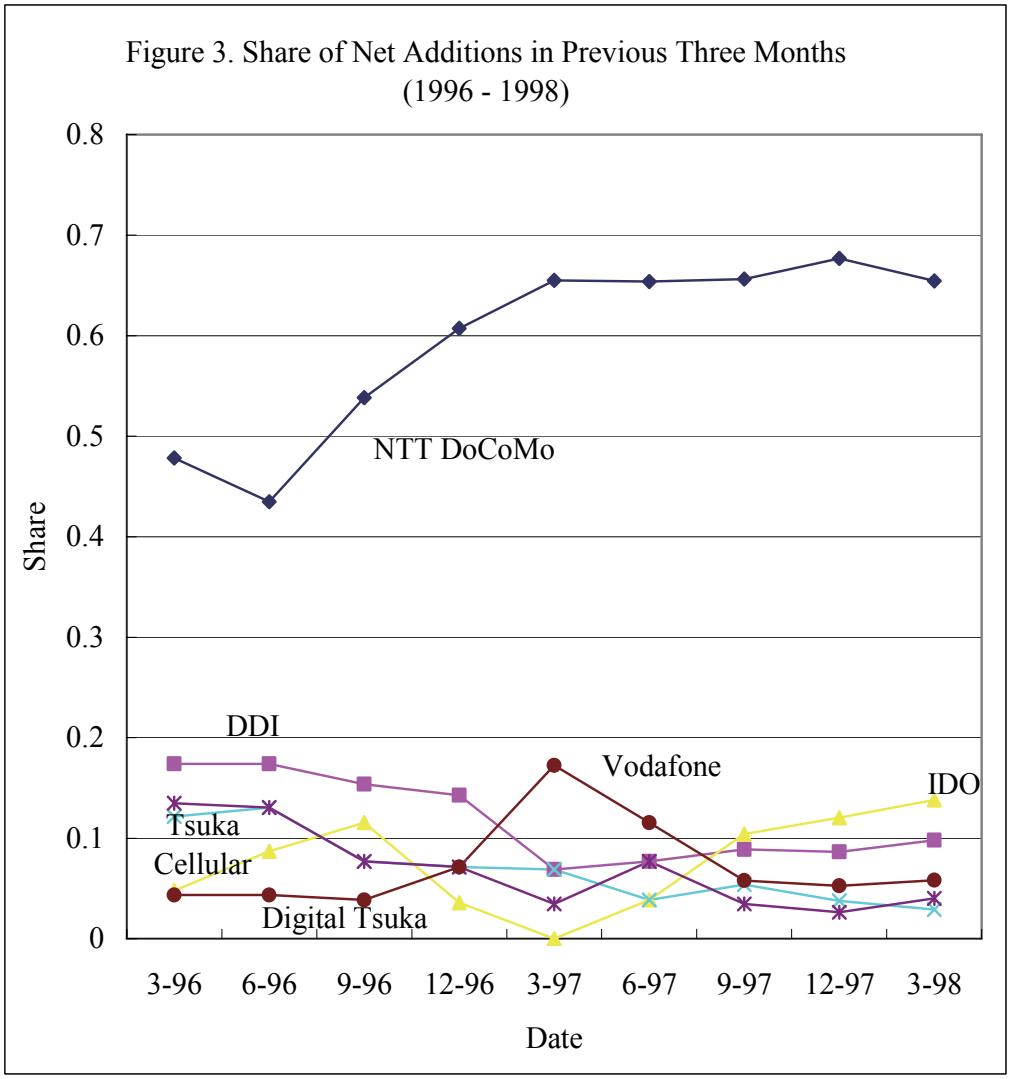
4.1 NTT DoCoMo's Revival

In spite of the government's requirements to publish the specifications for the digital standard, however, NTT DoCoMo's used it superior financial resources to control the digital standard and it used this control to obtain smaller and lighter handsets from phone manufacturers than its competitors during the early years of digital services. NTT DoCoMo was the only service provider to develop proposals and test the equipment with a select set of manufacturers. Thus, its competitors have had little choice but to rubber stamp NTT DoCoMo's proposals, many times just as NTT DoCoMo was implementing them. This standard-setting process is very similar to the ones used in

Europe in both wireline and most analog mobile phone services. The success of the Scandinavian NMT standard-setting process convinced Western European firms to change from this rather closed to a more open standard setting process for GSM[xxiii].

NTT DoCoMo used its control of the PDC standard and its close relationships with its handset suppliers to obtain better handsets than its competitors. It provided its four suppliers (Matsushita, NEC, Fujitsu, Mitsubishi) with preferential information about the PDC standard and its planned services in return for preferential access to phones. These suppliers used this preferential information to make better design decisions and to receive preferential treatment from part suppliers. The phone suppliers agreed not to deliver the handsets to other service providers until six months after DoCoMo received them[xxiv].

NTT DoCoMo's advantages in handsets became very apparent to users upon the release of the first sub-100 gram phone in late 1996, which coincided with a reduction in activation commissions (phone subsidies) by the other service providers due to their relatively high cancellation rates. The combination of the sub-100 gram phone and reduced activation commissions caused DoCoMo's share of all new subscribers to rise dramatically in late 1996 (See Figure 3). On a monthly basis, DoCoMo's share of new subscriber's rose from 48% in August to over 60% in October and it stayed over 60% throughout 1997 including a high of 71% in January, 1997. Furthermore, NTT DoCoMo's phone suppliers also experienced rising shares due to the success of NTT DoCoMo and the demand for their phones from the other service providers[xxv].



Source: Japan's Telecommunication Carriers Association and author's analysis

4.2 Importing another Foreign Standard

The falling shares of DDI Cellular and IDO caused them to begin services that are based on a second foreign technology called cdma (code division multiple access) in 1998 and 1999 respectively. DDI Cellular had succeeded with a foreign analog technology and it wanted to return to a situation where it used a superior technology to NTT DoCoMo. Both DDI Cellular and IDO's success with TACS convinced IDO that it should also implement cdmaOne services. Both service providers had been slow to

realize that Japanese consumers perceived that digital was superior to analog services and that NTT DoCoMo's control of PDC prevented them from effectively competing in the market[xxvi].

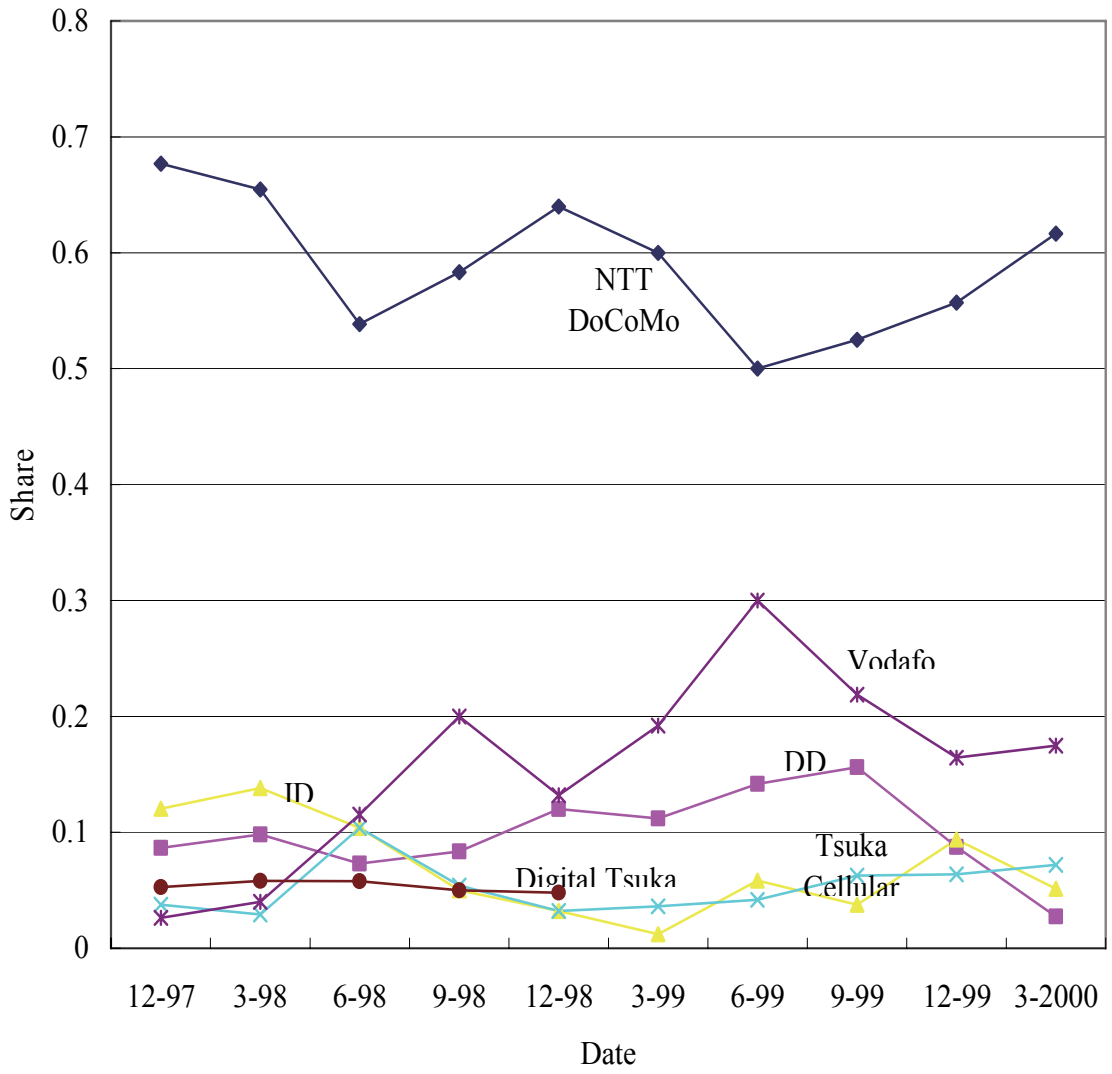
DDI Cellular started cdmaOne services in Kansai, Kyushu, and Okinawa in July 1998 and achieved a nationwide service when IDO started services in Tokai and Tokyo in April 1999. Interestingly, the same month that Kansai Cellular started its cdmaOne services, Kyocera released the smallest PDC phone (69 grams) in the Japanese market thus eliminating one of the reasons for changing to cdmaOne[xxvii].

It has taken DDI Cellular and IDO many years to obtain a higher share of new subscribers via the advantages of cdmaOne services. Although the superior voice quality of cdmaOne had led many people to believe that DDI Cellular and IDO would quickly take share away from NTT DoCoMo, this did not happen until KDDI introduced cdma2001x and Chaku Uta services in 2002. Initial problems included heavy and expensive phones with shorter battery times than the PDC phones and less than expected benefits from the superior voice quality. While the voice quality of cdmaOne was superior to PDC in fixed-line to mobile phone calls, it was similar to mobile calls made between PDC phones or between PDC and cdmaOne calls. And by the time DDI Cellular and IDO had introduced cdmaOne, the mobile to mobile calls had already become more frequent than the fixed-line to mobile calls and due to the wide use of PDC by the other service providers, most mobile-to mobile calls by KDDI users were PDC-to cdmaOne calls (or visa versa).

Interestingly, Vodafone (then called J-Phone) outperformed both DDI Cellular and IDO in 1999 through the success of its J-Sky messaging service. As shown in Figure 4, J-Phone had a higher share of new subscribers than both DDI Cellular and IDO between

early 1998 and early 2000. Furthermore, even if the shares for DDI Cellular and IDO are combined, J-Phone has had a higher share of new subscribers since the former started cdmaOne services in April 1999.

Figure 4. Net Additions in Previous Three Months (1997 - 2000)



Source: Japan's Telecommunication Carriers Association and author's analysis

5. PHS: a partial success in deregulation and a failure in globalization

While NTT DoCoMo was developing and implementing its PDC standard, the MPT and many Japanese manufacturers were also developing a low-mobility digital system called PHS (Personal Handyphone System). PHS is characterized as a low mobility digital system because calls were initially very difficult to handle in fast moving vehicles. Because of the very low penetration rate in the Japanese market as compared to many other countries in the early 1990s, many Japanese officials believed that the Japanese market would not experience growth unless a completely new kind of system was introduced. Thus, the Japanese MPT would only approve a system that was one-fourth as expensive as cellular technology and this directive required Japanese firms to take full advantage of the low cost potential of the small cell, small base station approach[xxviii].

These technical differences have enabled PHS to become moderately successful in developing countries with high-population densities. There were almost 60 million subscribers outside of Japan as of mid-2004[xxix] of which 54 million were in China (EMC, 2004). China's fixed-line carriers operate the PHS services. Interestingly there was more PHS than cdmaOne subscribers in China at this time. Other adopters include Taiwan and Thailand. Kyocera, which was the main investor when DDI Cellular was formed in the mid-1980s and Carlyle acquired the largest PHS service provider, DDI Pocket in June 2004 in order to promote further sales of equipment[xxx].

PHS would probably have been more successful if the standard-setting process had been open to international participation from the beginning. The openness of the standard setting process to all Japanese manufacturing firms and service providers from the beginning has caused a different service provider (DDI Pocket) and manufacturers

(not NTT DoCoMo's major suppliers) to become the market leaders in Japan. However, the MPT delayed the opening of the standard to foreign firms in order to give Japanese manufacturers an advantage. Similar to the behavior often attributed to Japan's Ministry of International Trade and Industry[xxxi], foreign firms were not invited to participate in the standard setting process and the system specifications were not made public until one year after service was started in July 1995. Quite naturally, most foreign manufacturers, including industry leaders such as Ericsson, Nokia, and Motorola have criticized PHS. This has made it difficult for Japanese manufacturers to convince foreign carriers to adopt PHS particularly when many of these foreign carriers are major customers of firms like Ericsson and Nokia[xxxii].

Domestically, perceptions about PHS rose and fell several times. The heavy media coverage during the service start in mid-1995 caused many Japanese to visit stores with the intention of subscribing to PHS but the initial poor coverage caused many of them to subscribe to PDC services. Improvements in coverage led to a short-term boom in subscribers in 1996 that also fueled heavy competition between PHS and PDC services. For example, the PDC service providers were spending more than 70,000 Yen ($580) to acquire a subscriber in the mid-1990s[xxxiii] levels that have never been reached in Europe or the US.

On the other hand, this competition led to lower PDC rates thus causing the price advantage of PHS to slowly disappear and the dependence on NTT's wireline system to become a major problem. The PHS systems depended not only on NTT for connections to fixed-line and PDC systems, but also for connecting base stations within a PHS-to PHS phone call. NTT, which had a monopoly on local telephone calls throughout the 1990s, set very high connection charges for the PHS service providers and there have

been constant battles between the NTT and the PHS services providers over these charges. For example, 40% of the revenues for the PHS carriers were being paid to NTT in the first two years of the PHS service (only 9% for cellular firms) while these connection charges have represented a significant fraction of NTT's profits[xxxiv].

Furthermore, the PHS carriers depended on NTT for fundamental changes in PHS and NTT has implemented these changes very slowly. For example, as the penetration rate for non-PHS mobile phones grew from about 3% in April, 1994 when PHS was being designed to over 20% by late 1997, the number of people making calls to or receiving calls from these non-mobile PHS phones increased sharply. However, calls between PHS and non-PHS mobile phones were not possible until mid-1996 and when they became possible they were 9 times more expensive than PHS-to PHS or PHS-to wireline calls and 3 times more expensive than calls made between non-PHS mobile phones. The reason for the delays in making the calls between non-PHS and PHS mobile phones possible and the reason why these calls are still very expensive is that NTT has been very slow to implement appropriate switching equipment and it is generally believed that the MPT has not set appropriate connection charges[xxxv].

The number of PHS subscribers had declined to a level of about 5 million by mid-2004 and it is losing a couple hundred thousand subscribers a year. If not for the superior data services of PHS, the decline would probably be much greater. The three PHS service providers offer 128,000 a-second-services with data cards that are widely used with laptops and PDAs. Flat rate plans are particularly popular. Furthermore, about one-tenth of NTT DoCoMo's (it acquired NTT Personal in 1998) PHS subscribers use the service to monitor the location of phones, e.g., parents monitor their children's location.

6. 3G Standard Setting: NTT DoCoMo Becomes a Global Participant

Continued pressure from the MPT and Europe's slow moves to develop cdma technology provided NTT DoCoMo with the opportunity to create a global 3G standard. Japan's MPT pressured NTT DoCoMo to either create or adopt a worldwide standard due to the pressure it was receiving from domestic and international manufacturers. Although Japanese phone manufacturers had initially done well in the global analog market in the 1980s, their shares had subsequently dropped due to their own mistakes[xxxvi], differences in market structure[xxxvii], and the use of non-global standards in the Japanese market.

NTT DoCoMo had little interest in adopting another firm's standard, particularly since it had been working on 3G systems, including cdma-based ones, since the early 1990s. These factors caused NTT DoCoMo to focus on creating a global standard through a much more open approach than it had done with PDC and to eventually create an alliance with Nokia and Ericsson and thus with Europe's GSM community. The Japanese government also pushed for an early start date, which NTT DoCoMo also wanted due to its desire for additional frequency spectrum. Due to the high population densities in Japan and the large share for NTT DoCoMo, NTT DoCoMo has experienced shortages of frequency spectrum since the mid-1990s. For example, it was the first service provider in the world to adopt a so-called "half-rate" for voice, which substantially reduced the quality of voice calls[xxxviii].

European firms were very slow to recognize the superiority of cdma. In the competition between European and U.S. firms, in particular between Ericsson and Qualcomm, European firms had continuously argued that GSM was superior to cdma.

However, as cdmaOne began to diffuse in the U.S. and elsewhere in 1995 and 1996, the possibility that cdmaOne would be chosen by the newly formed UMTS became a large concern to Ericsson and Nokia who had previously decided not to participate in the cdmaOne infrastructure market. Their late entry would have made it difficult for them to become competitive partly since they would be paying higher license fees than the early entrants. Ericsson was the largest supplier of GSM and mobile communication infrastructure overall while Nokia was the second-largest supplier of GSM infrastructure in the mid-1990s[xxxix].

Ericsson and Nokia used their influence in Europe and Europe's plan to choose a single standard in late 1997 to negotiate with NTT DoCoMo. They convinced NTT DoCoMo to adopt the evolution path of the GSM network interface in place of Docomo's proposed ISDN interface, which would enable GSM infrastructure suppliers and service providers to utilize some of their existing technology in third generation systems. NTT DoCoMo announced the adoption of this technology in March, 1997 and Ericsson and Nokia announce their support for NTT DoCoMo's W-CDMA system ("W" stands for wide band) in May 1997. After more than a month of negotiations between Ericsson, Nokia, and other manufacturers, the European Technology and Standards Institute (ETSI) selected a combination of W-CDMA and TD-CDMA for the 3G standard. The former would be used for outdoor applications and the latter would be used for indoor applications[xl].

ETSI's selection of W-CDMA also led to changes within Japan. It caused Vodafone to acquire a controlling interest in J-Phone since as it became clear that Japan would probably be the first country to implement W-CDMA on a wide-scale. As part of their implementation of cdmaOne and their desire to obtain 3G licenses and frequency

spectrum, DDI Cellular, IDO, and KDD merged. KDD (international calls) had planned to apply for a 3G license due to the expected international roaming capability of 3G. All three firms concluded that it would be better to jointly apply rather than compete for a 3G license. For similar reasons, KDDI acquired Tsuka Cellular.

7. Mobile Internet: NTT DoCoMo Begins Foreign Expansion

The success of NTT DoCoMo's i-mode service enabled NTT DoCoMo to further increase its share of the Japanese market and to also expand its global presence beyond 3G standard setting. Although it did not adopt WAP, which was the perceived global mobile Internet standard at the time, it did use other global standards and foreign technology. It developed compact HTML (c-HTML) and compact MIDI (Music Instrument Digital Interface), which were mobile versions of the global standards for markup languages (HTML) and karaoke music at the time. It also purchased servers, data base equipment, and routers from leading U.S. firms.

Key elements of the initial i-mode service included a micro-payment system, packet service, and Internet mail[xli]. Although KDDI introduced mobile Internet services in April 1999, only two months after NTT DoCoMo did, KDDI did not introduce packet services until December 1999 and more importantly a micro-payment system and Internet mail until April 2000. The lack of a micro-payment system delayed the creation of entertainment content and there were many technical problems to be solved with WAP. While the overall failure of WAP in Western countries allowed individual mobile service providers to move slowly with WAP, KDDI was forced to solve many problems before they were addressed in the various WAP committees. Like NTT DoCoMo and Vodafone, KDDI was helped by its close relationships with phone manufacturers[xlii].

Vodafone introduced its mobile Internet services, which were based on MML, in December 1999 including micro-payment services. Many people believe that the similarities between MML and c-HTML simplified the introduction of Vodafone's services. Although Vodafone did not introduce a packet system until 2001, it charged by the packet. Thus users did not see large disadvantages in comparison to the KDDI system. In fact, Vodafone and KDDI experienced very similar levels of growth in their mobile Internet services in 2000 and 2001.

Network effects[xliii] and its early lead enabled NTT DoCoMo to begin building a network of content providers, mobile Internet subscribers, and mobile Internet-compatible phones before the other service providers could do this. Within one year of the start of services, there were more than 3 million subscribers, 300 content providers on the official menu (4 times as many as when the services had started), and more than 5000 content sites that could be accessed via the input of a URL address. The success of entertainment contents, particularly images, ringing tones, and horoscopes caused phone manufacturers to release phones with color displays and MIDP capabilities in late 1999 (2 phones) and early 2000 (2 phones). The high activation commissions paid by NTT DoCoMo and the other service providers contributed to this growth in mobile Internet subscribers since they reduced the cost of technologically sophisticated phones to the final users[xliv].

However, technological change appears to have at least partially negated NTT DoCoMo's advantage in network effects. For example, NTT DoCoMo initially turned down Sharp's proposal to produce camera phones. Instead, Vodafone was the first service provider to offer camera phones and a service for attaching pictures to e-mail called Sha-mail. Camera phones were a huge hit in spite of the fact that few people

actually takes photos with them or attach photos to mail messages. Nevertheless, the success of Sha-mail enabled Vodafone to increase its share of new subscribers in 2001 (See Figure 5).

7.1 NTT DoCoMo's foreign expansion

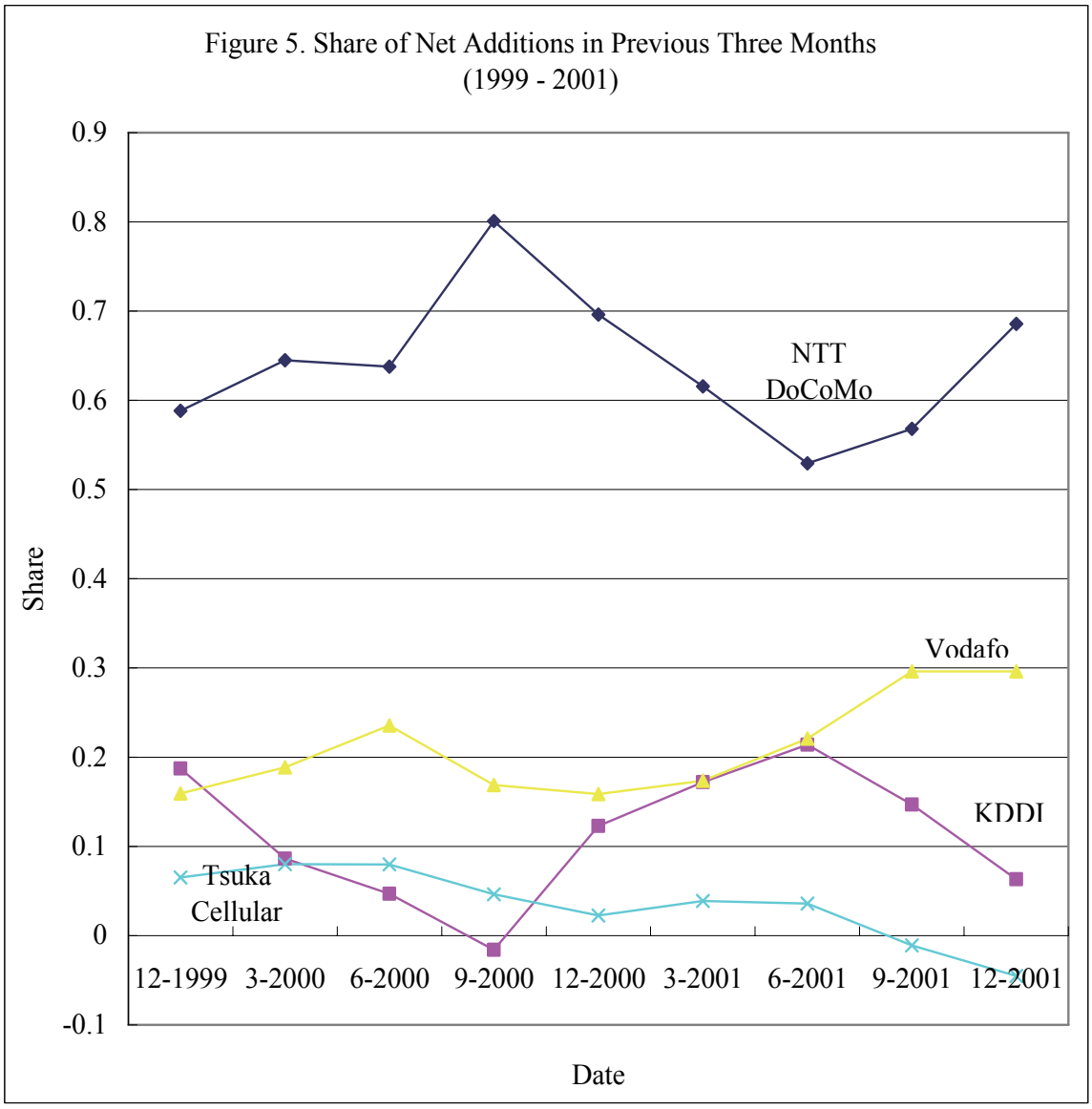
The success of i-mode and the failure of WAP outside of Japan and Korea provided NTT DoCoMo with a global opportunity. While phones for European WAP services were incapable of displaying content in a consistent manner across different phones, NTT DoCoMo's close relationships with phone manufacturers and its close control over the i-mode standard resulted in consistent and high quality content. The i-mode service also included Internet mail, which is superior to SMS services, and was still not available in most services outside of Japan as of late 2004 (some in the U.S.). The use of c-HTML and Internet mail services facilitated not only the entry of content providers but also many other firms like retailers, restaurants, manufacturers, and many other firms[xlv].

By early 2000, NTT DoCoMo was actively selling i-mode overseas. Although it initially attempted to profit from i-mode via investments in foreign carriers like KPN and AT&T Wireless, the collapse of the Internet bubble and NTT DoCoMo's lack of foreign experience has caused it to focus on licensing i-mode. The first services were launched by KPN mobile in the Netherlands and Belgium and KPN Mobile's subsidiary E-Plus in Germany in 2002. Via licenses, i-mode was launched by Bouygues Telecom in France and Far EasTone in Taiwan in 2002, by Telefónica Móviles in Spain and Wind in Italy in 2003, and by COSMOTE in Greece in June 2004. These i-mode services had acquired 3 million subscribers by the end of June 2004.Telefónica Móviles, which is the

largest service provider to adopt i-mode, plans to offer services in South America and Cosmote plans to offer the services in Bulgaria. Extrapolating from the recent growth, the number of subscribers may pass the 10 million mark before the end of 2005.

The biggest challenge facing i-mode outside of Japan is network effects. Since Europe uses GSM and not NTT DoCoMo's proprietary PDC standard, different phones have to be created for the European i-mode market, which are also different from regular GSM phones. There were only two phones available at the end of 2003 and although four new phones were released in 2004, this number is still far less than the number of phones available with regular GSM services. The lack of phones is said to be one of the main reasons why AT&T Wireless has pushed m-mode in the U.S., which requires fewer changes to the basic GSM phones and thus are easier to obtain than i-mode phones. Furthermore, the incompatibilities between Internet mail and SMS make it difficult for i-mode users from benefiting from the existing network of SMS users.

It is interesting to speculate on what would have happened if NTT DoCoMo had adopted GSM in the early 1990s. Not only would this have provided Japan's manufacturers with greater global opportunities[xlvi], it would have also have made it easier for NTT DoCoMo to license i-mode. Of course, the adoption of GSM would have completely changed the competitive dynamics of the Japanese market thus raising the possibility that i-mode would not have emerged or would have emerged in a completely different context.



Source: Japan's Telecommunication Carriers Association and author's analysis

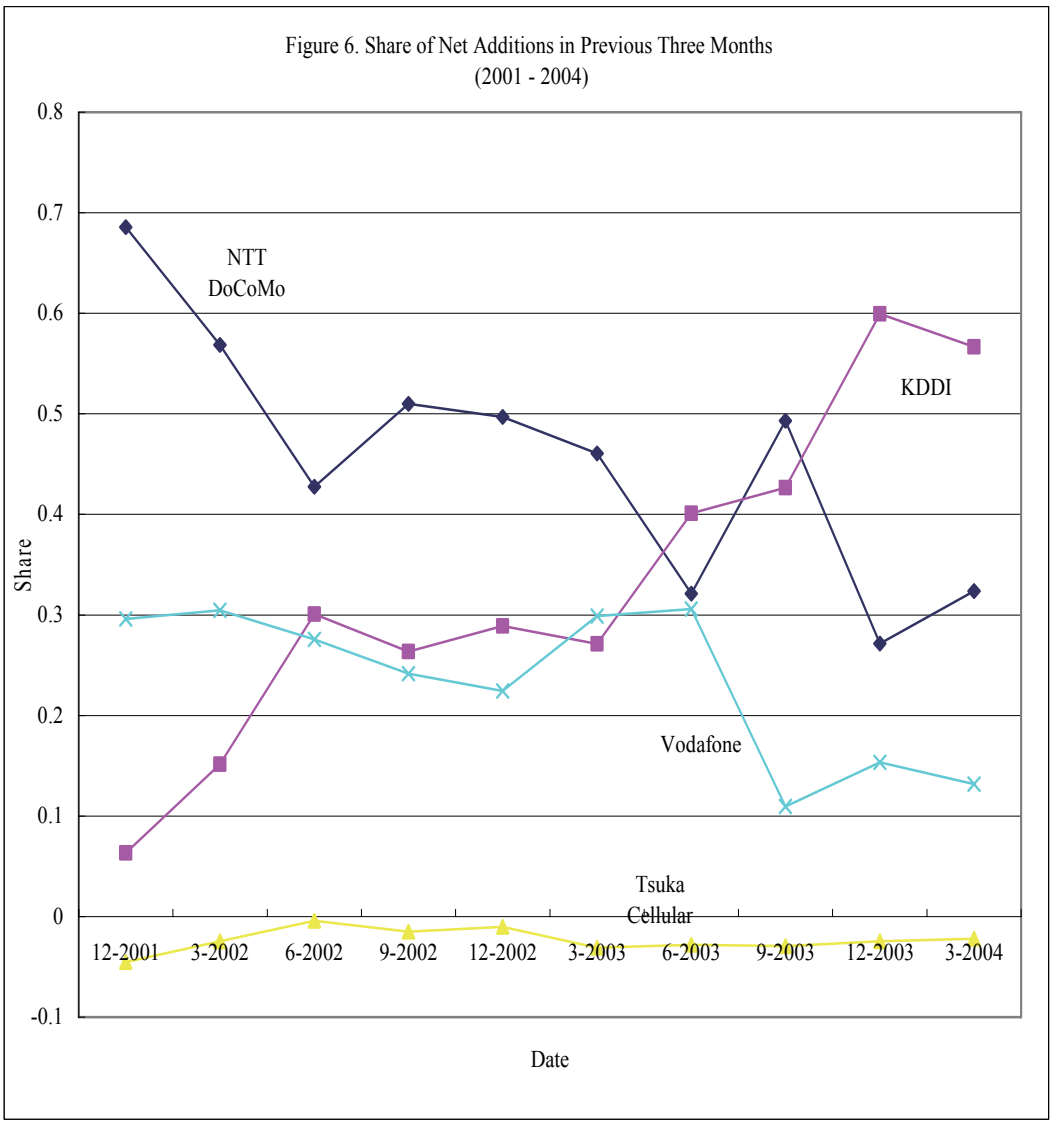
7.2 KDDI's Recovery

KDDI's faster diffusion of 3G phones and applications enabled it to obtain more than 50% of the new subscribers in 2003; this was the first time someone other than NTT DoCoMo had achieved this in Japan (See Figure 6). The reason for the faster

diffusion of 3G phones for KDDI is the backward compatibility of KDDI's 3G system. While NTT DoCoMo has had to introduce completely new base stations and handsets, KDDI has only had to make changes to the software in the base stations and phones. Thus, while KDDI had achieved more than 99% coverage by April 2002, or within a few months of starting services, NTT DoCoMo did not achieve this level of coverage until early 2004. Furthermore, FOMA handsets are more expensive to users than cdma2001x phones in spite of the fact that NTT DoCoMo has been spending about 55,000 Yen on handset subsidies or more than 20,000 Yen more than KDDI has done.

As shown in Figure 5, the first rise in KDDI's share came from the introduction of cdma20001x in April 2002. The faster data speeds and higher capacity of cdma20001x also enabled KDDI to introduce a new pricing plan called Packet Wari (Packet Discount). This plan offered 12,000 packets for 1200 Yen or 0.1 Yen per packet, which was half the price of the regular EZ Web Service and 1/3 the price of i-mode.

The introduction of Chaku Uta led to the second rise in KDDI's share of new subscribers. This new application is a major reason why KDDI's implementation of cdma20001x in 2001 has caused a long-term increase in subscriber shares while its implementation of cdmaOne in 1998 did not. The Chaku Uta service enables users to download a 15-30 second MP3 song, including lyrics, and use the song as a ringing tone in place of the MIDI files. The number of downloads jumped from 6 million songs in September 2003 to 50 million in the second quarter of 2004 or 13 million per month; interestingly this is similar to the number of global downloads with Apple's i-Tune service.



Source: Japan's Telecommunication Carriers Association and author's analysis

8. Conclusions

This paper has looked at the interaction between globalization, deregulation, and technological change in the Japanese mobile phone industry. Domestic concerns and both halves of globalization (foreign pressure and the desire to participate in the global market) have driven deregulation in the Japanese market. The U.S. government

pressurized the Japanese government to increase competition in the market through allowing the use of foreign technology and foreign investments. Results of this foreign pressure include DDI Cellular's adoption of TACS, DDI Cellular and IDO's adoption of Qualcomm's cdma technology, investments by many foreign firms in Japanese service providers, and NTT DoCoMo's steadily increasing purchases of foreign technology throughout the 1990s.

On the other hand, many firms' desire to participate in the global market has also encouraged the MPT to propose these changes. MPT created an open standard-setting process, at least from the domestic standpoint, for PHS in the hope that Japanese firms could export PHS to the rest of the world. The failure of PHS at the global level and the failure of Japanese manufacturers in the global phone market in general caused the MPT to require NTT DoCoMo to either create or adopt a 3G standard.

Technological change provided new entrants, which were the result of deregulation, with opportunities and encouraged domestic firms to use foreign technology (i.e., globalization). TACS provided DDI Cellular and digital technology provided Digital Phone and Tsuka Cellular with an opportunity to enter the market and compete with the incumbents on a "relatively" level playing field. While Toyota perceived that it was less risky to adopt its competitor's standard than adopt a global standard in IDO's service, the successful adoption of TACS by DDI Cellular in the late 1980s caused it to realize by 1995 that the opposite was true. Its merge with DDI Cellular and KDD has made KDDI one of the world's leading users of cdma technology.

DDI Cellular's success with foreign technology is also one reason why NTT DoCoMo began working with foreign firms and eventually learned to combine these technologies in unique ways. NTT DoCoMo has gradually moved from an internal to

external focus as it increased the use of global technology and it is now a provider of technology on the global level for the mobile Internet. On the other hand, the increasing strength of the Japanese market attracted the world's largest service provider Vodafone to the Japanese market. Vodafone's acquisition of J-Phone and the use of J-Phone's mobile Internet technology is one reason why Vodafone is now the leading providers of mobile Internet services outside of Japan and Korea with its Vodafone Live! services.

Further research should look at other Japanese industries and compare them to Japan's mobile phone industries. Understanding why some industries are able to change faster than others is an important subject to researchers of Japan and other countries.

9. About the author

Jeffrey Funk is Professor of Business at Hitotsubashi University's Institute for Innovation Research. He received his Ph.D. from Carnegie Mellon University in 1984 in the Department of Engineering and Public Policy. His research primarily focuses on managerial and economic issues associated with innovation. He was awarded the 2004 DoCoMo Mobile Science Award for lifetime contributions to the field of mobile communications.

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10. Notes

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