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# An economic analysis of the US wireless telephone industry: responses to new technologies<sup>☆</sup>

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## Abstract

The wireless telephone industry has seen dramatic changes. In the United States, for example, cellular demand continues to increase with high annual growth rates. In order to help meet this demand and to promote competition in the duopolistic wireless telephone industry, the Federal Communications Commission (FCC) supplemented the existing cellular industry capacity by auctioning spectrum for personal communications service (PCS). This paper analyzed the changing wireless telephone industry in terms of the emergence of new PCS providers. More specifically, this paper focused on the potential economic impacts of PCS providers on the traditional market structure of the wireless telephone industry by using industrial organization (IO) model and the concept of strategic groups. Because there are key strategic dimensions for grouping, the notions of strategic groups and mobility barriers seem to work well in the wireless telephone industry. Also, it is found that market concentration and conglomeration are more prominent than vertical integration in this fast growing, segmented and competitive industry. © 1999 Elsevier Science Ltd. All rights reserved.

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## 1. Introduction

Over the past several years, the wireless telecommunications industry has seen dramatic changes. In the United States, for example, wireless telephone demand

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continues to increase with high annual growth rates of 40–60%. Today there are over 69 million wireless telephone customers in the United States (CTIA, 1999). In order to help meet this demand and to promote competition in the duopolistic wireless telephone industry, the Federal Communications Commission (FCC) supplemented the existing cellular industry capacity by auctioning billions dollars of spectrum for personal communications service (PCS). A wide diversity of companies are making significant investments to participate in this exciting marketplace. This fundamental structural change will have a substantial impact on fast growing wireless telephone industry. According to economic theory, added competition will expand the service choices available to the public and put downward pressure on the prices of existing cellular services.

Many scholars have expressed concerns regarding the influence of new generation of wireless technologies such as PCS. However, in spite of its importance, there are few economic studies designed to analyze this significant industry within an economic framework. Thus, this article will attempt to give economic insight to the new developments in the wireless telephone industry, by focusing on the potential economic impacts of PCS providers on the traditional market structure of the wireless telephone industry, using the IO model and the concept of strategic groups.

## **2. Brief history of the US wireless telephone industry**

For the past decade, commercial wireless telephone service has been synonymous with cellular service. Cellular service was introduced into the United States in 1984. After years of industry debate in the late 1970s and early 1980s, the FCC decided that cellular should be competitive and issued two licenses in each service area. Two licenses would serve each of the 306 urban areas deemed Metropolitan Statistical Areas (MSAs) and each of the 428 Rural Service Areas (RSAs). One license was initially assigned to the incumbent local exchange carrier (ILEC) or to a coalition of ILECs. The other license in each area was assigned by lottery among the qualified non-LEC applicants. By the end of 1990, construction permits had been issued for at least one system in every market in the United States, and by the end of 1995, the cellular subscriber count topped 33 million (CTIA, 1997).

Because of the increased demand, the FCC auctioned six new PCS licenses, for a total 120 MHz (6 blocks), to expand the availability of wireless telephone services to the public and to provide more competition to both the cellular and LEC industries. PCS is a term encompassing a wide range of wireless technologies, chiefly two-way paging (narrowband PCS) and cellular-like telephone services (broadband PCS) that are transmitted at lower power and higher frequencies than cellular services. The FCC adopted a combination of 51 Major Trading Areas (MTAs) and 493 Basic Trading Areas (BTAs), which was designed by Rand McNally and based on natural flow of commerce, to auction total 2074 licenses (see Table 1). The new PCS

Table 1  
Spectrum location and license structure<sup>a</sup>

License	Cellular	New PCS (broadband)					
Spectrum (MHz)	824–849 869–894	1850–1990					
Bandwidth for license (MHz)	25	30	30	10	10	10	30
		A block	B block	C block	D block	E block	F block
Territory	MSA/RSA	MTA			BTA		
Way of licensing	Lottery	Auctions					
# of licenses	1468	2074					

<sup>a</sup> Source: FCC.

providers are expected to compete with existing cellular services, thereby yielding lower prices and developing a wide range of advanced services.

### 3. Background theories

#### 3.1. Industrial organization (IO) theory

In trying to explain structural problems of media industry, the industrial organization theory is uniquely helpful. The general methodological approach suggested by IO model focuses on three concepts: industry structure, industry conduct or behavior, and industry performance. The three concepts are interrelated: industry structure influences the behavior of firms, whose joint conduct then determines the collective performance of the marketplace (Scherer, 1990). However, this approach is a better analytical framework for strategically homogeneous industries such as broadcasting industry than for heterogeneous industries (Chan-Olmsted, 1997). Thus its traditional emphasis on industry as a unit of analysis may be no longer realistic for analyzing heterogeneous wireless providers based on different technologies and licenses. This paper needs to use the modified IO approach to improve the explanatory power of the structure–conduct–performance paradigm.

#### 3.2. Strategic groups and mobility barriers

The notion of strategic groups suggest that firms within an industry can be clustered into different groups according to their strategic conduct. Porter (1985) defined a strategic group as a cluster of firms that follow similar strategies in terms of key decision variables. The contention has been that members of the same groups will have similar endowments of resources, which will lead them to act and react to competitive disturbances in similar way. Such firms will be better able to predict the

actions and reactions of each other and recognize mutual dependence (Scherer, 1990). Finally, firms with similar resource endowments will likely have common suppliers and customers, which can enhance communication and coordination in an industry (Peteraf, 1993).

At the same time, there is a case for strong rivalry between groups. Differences between groups imply heterogeneous resources and varying patterns of competitive behavior, which will make it difficult to predict and coordinate actions with rivals across groups (Porter, 1980).

Oster (1982) argues that at the heart of strategic group theory is the idea that there are rigidities associated with change, and the concept that explains these rigidities is mobility barriers. Mobility barriers are the structural and behavioral forces that deter or impede firms from freely changing their strategic positions. Mobility barriers, which mean each group's distinct entry conditions, can be compared to conventional entry barriers because they rest on the same theoretical propositions as barriers to a market from the outside (Chan-Olmsted, 1997). Mobility barriers not only protect firms in a strategic group from entry by outside firms, but also create barriers to current members from easily shifting their strategic position to another group (McGee and Thomas, 1986).

Therefore, according to Chan-Olmsted, it is essential to consider a group-industry bilevel analytical framework when firms within an industry can be clustered into different strategic groups. In the meantime, in the wireless telephone industry, we can define strategic groups easily in terms of existing cellular providers versus new PCS entrants or different technology standards adopters. Thus it is necessary to use not only the IO theory (Caves, 1982; Scherer, 1990) but also the group-industry competition model (Chan-Olmsted, 1997) in order to understand the complex nature of the wireless telephone industry.

#### **4. Strategic grouping of wireless telephone industry**

##### *4.1. Technology and standard competition*

The wireless telecommunication industry display a complex structure of levels of competition (Lindmark and Granstrand, 1995). To begin with, technology competition seems more intense compared to many other industries. For example, cellular technology competes successfully with other wireless technologies (e.g., Specialized mobile radio, cordless and PCS technologies). Cellular technology is also competing with fixed network technology for customer access. All these existing and future technologies could be and are involved in a technological struggle aimed for future wireless telephone system.

In addition, the competition between the different technological standards (e.g., CDMA, TDMA and GSM in digital wireless telephone system) can be another level of competition. For example, digital cellular provider must choose between three

digital standards. For PCS, there may be currently seven competing standards based on three basic digital standards.

Therefore, the decision-making regarding specific technology (e.g., cellular or PCS) and technological standard (e.g., CDMA, TDMA or GSM) is one of the key variables in the wireless telephone industry. Thus the firms in the wireless industry can be clustered into different strategic groups according to their strategic choice of technology and standard (Chan-Olmsted, 1997).

#### *4.2. Cellular group versus PCS group*

In the wireless telephone industry, strategic groups can be defined easily in terms of existing cellular providers versus new entrants based on PCS technology. Also, because the FCC issues the wireless license on specific technology, cellular group and PCS group can be divided in terms of type of technology or license.

PCS can be defined as a new set of digital wireless telephone services personalized to the individual. Although there is not a major difference between the fundamental technology of cellular and PCS, PCS has several unique characteristics:

- Telephone number will belong to a person.
- Types and features of service will be customized to his or her unique needs.
- Better service quality and lower price through digital technology.
- Enhanced service features (e.g., messaging, voice-mail, caller-ID).
- More secured network (encryption capability).
- Stronger signal and lower power (cell sites are smaller and closer).
- Faster construction requirements.
- More complex interconnection and roaming procedure (Lera, 1996).

The cellular group has been planning to replace analog systems with new digital technology for most of the past decade. However, the emphasis on digital capacity has only recently indicated the necessity for them to switch over to effectively compete against the new PCS providers (Westerhold, 1996). Table 2 summarizes the key dimensions of two competing technologies in the wireless telephone market.

#### *4.3. CDMA, TDMA and GSM group*

The three technologies that seem to be gaining momentum in digital cellular and PCS industry are CDMA, TDMA, and GSM. Picking the ultimate winner technology can yield advantages in lower cost from economies of scale and make it easier to enter into roaming agreements. On the other hand, picking the wrong technology can leave the provider and customer stranded. Because this decision is critical and strategic, the cellular or PCS providers tend to enter into nationwide strategic alliances, and the strategic alliance may select a technological standard (Westerhold, 1996). Thus strategic groups can be defined in terms of choice of a technological standard in the wireless telephone industry. Table 3 shows that there are three strategic groups in North American wireless telephone industry.

Table 2  
Comparison between two wireless technologies

	Cellular		PCS
	Analog	Digital	
Concept	<ul style="list-style-type: none"> <li>• Reuse of spectrum by cell division</li> </ul>	<ul style="list-style-type: none"> <li>• Capacity expansion of existing analog cellular system</li> </ul>	<ul style="list-style-type: none"> <li>• Overcome the handicaps of cellular</li> </ul>
Service characteristics	<ul style="list-style-type: none"> <li>• Simple telephone</li> </ul>	<ul style="list-style-type: none"> <li>• Simple voice comm.</li> <li>• Try value-added service (VAS: data, fax...)</li> <li>• Analog cellular price</li> </ul>	<ul style="list-style-type: none"> <li>• Secure personal mobility</li> <li>• Advanced intelligent network (AIN) service</li> <li>• VAS (Data, Fax, Video)</li> <li>• Low price</li> </ul>
Technical differences	<ul style="list-style-type: none"> <li>• AMPS Macro Cell</li> <li>• 825–890 MHz</li> </ul>	<ul style="list-style-type: none"> <li>• TDMA/CDMA/GSM</li> <li>• Macro Cell</li> <li>• Large power (0.6 W)</li> <li>• Big infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>• TDMA/CDMA/GSM</li> <li>• Micro Cell</li> <li>• Small power (0.2 W)</li> <li>• Small infrastructure</li> <li>• 1.8–2.3 GHz new spectrum</li> </ul>
Service environments	<ul style="list-style-type: none"> <li>• Car phone</li> </ul>	<ul style="list-style-type: none"> <li>• Specific area</li> <li>• Must stop to use</li> </ul>	<ul style="list-style-type: none"> <li>• Outdoor, Building, Home</li> <li>• Pedestrian</li> </ul>

Table 3  
Competing wireless standards

Country	Standard	Strategic group	Key members
North America	IS-136 Time division multiple access (TDMA)	Universal Wireless Communication (UWC) group	AT&T Wireless, BellSouth, SBC
	IS-95 Code division multiple access (CDMA)	CDG (CDMA Development Group)	PrimeCo, Sprint PCS, NextWave, AirTouch, Bell Atlantic
	PCS-1900 (GSM based)	North American GSM Alliance	PowerTel, Aerial, Omnipoint
Europe	Global system for mobile communication (GSM)/DCS-1800 (Digital cellular system at 1.8G)		One-2-one (UK), Deutsche Telecom
Japan	Personal Handy Phone Service (PHS)		NTT

In the US, there has been debate raging among CDMA, TDMA and GSM proponents to win over the next generation of wireless service to their point of view but it is likely that these multiple standards will co-exist in this country. It is because that the US government supports multiple standards for third generation (3G) wireless service and the ITU has recently given up the long-sought goal of a single,

global standard that would apply around the world for delivering “mobile multi-media” services.

## 5. Entry barriers for PCS group

If there is any barrier to entry for the PCS providers to enter wireless telephone market, it can be mobility barrier, which means each strategic group’s distinct entry condition (Chan-Olmsted, 1997).

### 5.1. High initial investment

There may be high barriers of exit because of the considerable amount of sunk costs including license fees, system investments and spectrum relocation costs.

In the first place, the PCS licensees spent around US\$20 billion in the FCC’s broadband PCS auctions (A/B block: US\$7.7 billion, C-block: US\$10.2 billion, and D/E/F block: US\$2.5 billion). However, some of the licensees, especially small firms participating in C-block auction are having difficulty in financing the funds to pay the license fees. Thus the FCC allowed the bidders in C-block to delay their payments. However, it is predicted that the PCS entrants who spent too much money for their licenses may not succeed in the competition against already settled cellular providers. Actually, some of the C-block licensees including Pocket Communications and NextWave have filed for the bankruptcy.

In addition, the PCS providers still must pay to relocate the licensed 1.8 GHz microwave incumbents to higher frequencies or alternative media (Shultz, 1996). It is because that the new PCS spectrum is currently assigned to various point-to-point microwave users. Thus the PCS providers must arrange to relocate these radio systems in their serving areas. According to the estimates of Columbia Spectrum Management, the relocation cost per link will be between US\$25,000 and US\$50,000. With more than 5000 microwave links nationwide, the total relocation cost would fall between \$1.2 billion and \$2.5 billion (PCS Week, 1995). Thus the PCS entrants should have “good-faith” negotiations with microwave incumbents who are attempting to extort excessive payments from them.

Furthermore, new PCS providers face big capital expenditures for the network construction. For example, American Personal Communications, the pioneering PCS provider, estimated that it would spend approximately US\$100 million to construct some 300–400 base stations in the urban portion of the Washington/Baltimore MTA (Shultz, 1996). If this figure would hold up, the cost – US\$100 million times 102 MTA – would yield a total construction cost of more than US\$10 billion.

From 1983 to 1995, the cellular industry invested approximately US\$21 billion in the development of network infrastructure. In contrast, due to PCS network implementation and cellular firms’ digital upgrade, there was about US\$35.5 billion

new capital investment in the US wireless industry during 1996 and 1998 (see Table 6).

### *5.2. Economies of scale and scope*

Because of the high fixed costs, economies of scale will be as important for PCS as for cellular service. Especially, economies of scale in terms of multi-system operation (the decline in average costs as the provider serves additional local markets) will become significant. Furthermore, economies of scope (the decline in average costs as the carrier produces higher quantities of complimentary services) will be critical forms of barriers to entry. It is because that companies providing a full range of services like local, long distance, wireless telephone and data, TV, and internet access are likely to be more successful due to the ability to market a whole bundle of services.

### *5.3. Local regulation and community resistance*

There are local regulatory barriers to entry such as zoning and construction permit requirements for cell sites. As of June 1995, the wireless industry had constructed 22,663 cell sites nationwide. Since 1996, with PCS entrance, the number of wireless cell sites was significantly increased up to 65,887 (190% increase). It is expected that more new cell sites will be required for a complete PCS buildout because PCS systems use smaller cells than those of cellular systems (see Table 6).

In the meantime, many of the 38,000 local governments have restrictive zoning ordinances regarding tower or wireless facilities. Furthermore, some entities have tried to extort additional revenues from the PCS providers through a kind of local franchise fees. Table 4 shows that some examples of local regulatory barriers regarding wireless tower-siting. For example, Birmingham and Southfield in Michigan are enforcing a specifically defined policy for the wireless telephone industry.

In addition to the local regulatory barriers, other safety issue and natural environment issue are main community concerns for wireless tower-siting. The wireless industry is anxious to build networks quickly, and citizens want access to these new technologies. But citizens also are concerned about the impact of new antennas and towers on public health and safety, property values and community aesthetics (Tabin, 1997). Although some cases vary, the majority of these conflicts (Table 5) falls into one of four categories: setback requirements, aesthetics, property values or health concerns (Boney, 1998).

Actually, In many localities, tower construction is bogged down in a quagmire of community complaints and politically motivated governmental reviews. Thus, PCS providers are saddled with increasing demands of customers and federal licenses that require the PCS providers to provide adequate service in the face of increasing opposition to wireless facilities siting (Degnan et al., 1997).



Table 4  
Examples of local siting policies in State of Michigan<sup>a</sup>

Cities	Processing fees	Permission	Land use fees	Other charges
Birmingham	Plan review fees: US\$600	<ul style="list-style-type: none"> <li>• Takes 5–15 days</li> <li>• Published at newspaper</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly rent payment</li> <li>• Special land use: US\$500</li> <li>• Initial term annual fee: US\$7500</li> <li>• Second term annual fee: US\$8700</li> <li>• Third term annual fee: US\$9900</li> <li>• Fourth term annual fee: US\$11,100</li> <li>• Five term annual fee: US\$12,300</li> </ul>	<ul style="list-style-type: none"> <li>• Community impact review fee: US\$1500</li> <li>• All real estate and personal property taxes</li> <li>• All real estate and personal property taxes</li> </ul>
Southfield				

<sup>a</sup> Source: Kim and Muth (1998b), ITS paper.

Table 5  
Issues of tower disputes<sup>a</sup>

Issues	Description
Setback requirements	Many cities and municipalities have added setback requirements to their new zoning ordinances
Aesthetics	Concern for the aesthetics of a community drives many citizens to oppose new tower sites. Many communications ordinances contain provisions that attempt to mitigate aesthetic concerns by requiring property-line setbacks and landscaping around the site
Property values	Loss of property value is a standard argument against new towers. Citizens often claim that proposed sites degrade the property and decrease property values
Health and safety concerns	Many citizens also are concerned about health issues. They argue that wireless radiation could produce deadly rays as harmful as nuclear radiation, although scientific research has not shown this

<sup>a</sup> Source: Kim and Muth (1998a), TPRC paper.

## 6. Changes in industry structure

### 6.1. Nature of demand

The wireless telephone industry continues to expand rapidly as new PCS providers enter the market, and both new and existing carriers implement and expand digital systems. The wireless telephone industry added a record 13.9 million new subscribers in 1998 as lower prices prompted more people to sign up for wireless telephone service (see Table 6).

Table 6  
The growth of the US wireless telephone industry<sup>a</sup>

Date	Estimated total subscriber	Annualized total service revenues (IN 000S)	Cell sites	Direct service provider employees	Cumulative capital investment (IN 000S)	Average local month bill (US\$)
1985	340,213	482,428	913	2727	911,167	N/A
1986	681,825	823,052	1531	4334	1,436,753	N/A
1987	1,230,855	1,151,519	2305	7147	2,234,635	96.83
1988	2,069,441	1,959,548	3209	11,400	3,274,105	98.02
1989	3,058,944	3,340,595	4169	15,927	4,480,142	89.30
1990	5,283,055	4,548,820	5616	21,382	6,281,596	80.90
1991	7,557,148	5,708,522	7847	26,327	8,671,544	72.74
1992	11,032,753	7,822,726	10,307	34,348	11,262,070	68.68
1993	16,009,461	10,892,175	12,824	39,810	13,956,366	61.49
1994	24,134,421	14,229,922	17,920	53,902	18,938,678	56.21
1995	33,785,661	19,081,239	22,663	68,165	24,080,467	51.00
1996	44,042,992	23,634,971	30,045	84,161	32,573,522	47.70
1997	55,312,293	27,485,633	51,600	109,387	46,057,910	42.78
1998	69,209,321	33,133,175	65,887	134,754	60,542,774	39.43

<sup>a</sup> Source: CTIA (1999).

Furthermore, PCS providers are attracting more customers with low prices, better phones, and batteries, and value-added services such as voice-mail and caller-ID. In response to intense competition, AT&T Wireless launched the single-rate plan in May 1998 with a concept of making every wireless call a local one without roaming or long-distance charge. Most big wireless providers such as Sprint PCS, GTE, Bell Atlantic Mobile, Ameritech Cellular and Omnipoint Communications now follow AT&T Wireless by launching similar regional or national flat-rate plan. Indicating an inelastic demand, the average US monthly bill fell to US\$39.43 at the end of 1998 without sacrificing the revenue. The jump in subscribers helped increase the wireless providers' revenues about 20% in 1998.

In the meantime, according to Stoetzer and Tewes (1996), the price-elasticity of individual demand function of a wireless provider is high while the price-elasticity of the wireless market demand is low. It implies that, with the emergence of new PCS entrants, churn rates will increase, and that wireless telephone service will be more heterogeneous and segmented into several clusters such as analog cellular, digital cellular and PCS. The appearance of digital PCS offerings may well speed up the cellular digital migration as cellular providers fight to retain their customers in the face of new competitors (Agarwal and Goodstadt, 1997). Thus the battle for market share will be particularly intense because of changing technology (analog to digital), conflicting standards, falling prices, and an extraordinary growth and diversity in demand.

## 6.2. Industry channel

As a results of new PCS entries, the industry channel structure will be as follows (see Table 7).

In retailing stage, the distributors' portion is still about 24%. Lederman and Sawyer (1996) argue that there is no way the wireless telephone industry will be able to pay a distributor high commission to serve customers who may only generate US\$10–20 per month in revenue. Thus, it is likely that the wireless telephone providers will try to expand their distribution channel to the general retail chain for customers to pick their wireless phone off-shelf. AT&T Wireless has opened 600 kiosks in the shopping malls, supermarkets, and other retail locations. AT&T employees run the kiosks. The kiosk program is designed to reduce the cost of sales operation. Sprint PCS has a Sprint store inside about 6000 Radio Shacks stores which have been remodeled. Sprint PCS also has relationships with a number of other retailers including Best Buy, May Co., Circuit City and OfficeMax. In addition, MCI and SAM's Club have an agreement to provide MCI-owned retail center in more than 300 SAM's Club stores nationwide. A PCS provider, Omnipoint Communications has recently reached a deal to offer digital PCS wireless phones and pre-paid coupons at 72 Shell oil product stations.

In addition, the wireless telephone providers will focus on the establishment of electronic commerce store-fronts on the Internet. More carriers such as AT&T Wireless, Bell Atlantic Mobile, AirTouch and Airadigm are moving to the Internet,

Table 7  
Stages of wireless industry channel

	Stage	Key players	Feature
1	Retailing	<ul style="list-style-type: none"> <li>• Own branded store (39%): NextWave store</li> <li>• Distributor (24%): Brightpoint, Cellstar and MCIWorldCom</li> <li>• General retail chain (18%): K-mart and Best buy</li> <li>• Web store-fronts: Bell Atlantic Mobile</li> </ul>	Monopolistic competition
2	Communication	<ul style="list-style-type: none"> <li>• National Multi-system operators (MSO): AT&amp;T Wireless, Sprint PCS &amp; Nextel Communications</li> <li>• Regional MSO: SBC Communications, Bell Atlantic Mobile, Alltel &amp; AirTouch</li> <li>• Independent operators: Airadigm</li> </ul>	From duopoly to oligopoly or monopolistic competition (maximum 8 providers per market)
3	Service/content provision	<ul style="list-style-type: none"> <li>• Information access provider: AOL</li> <li>• Online Database provider: Yahoo</li> </ul>	Monopolistic competition
4	Equipment	<ul style="list-style-type: none"> <li>• System equipment vendors: Nortel and Ericsson</li> <li>• Handset vendors: Motorola and Samsung</li> <li>• Tower siting</li> </ul>	Oligopoly (a few strategic groups)

staking out complex domains that move the traditional retail outlet into cyberspace. One of the most sophisticated wireless sites on the web belongs to Bell Atlantic Mobile, the first carrier to offer end-to-end retailing through the Internet. Internet store-fronts will be an important new sales channel for wireless carriers, not only as a stand-alone retail opportunity but also as an information complement to traditional stores (Clark, 1999).

In communication stage, the traditional duopoly structure has been replaced by monopolistic competition among maximum 8 players in each market. In the US, 48% of consumers today can choose from five wireless carriers, and 10% can choose from six. It means that this wireless industry became truly the first competitive segment of telecommunications (Gohring, 1999). In the meantime, it is expected that mass advertising-driven product differentiation will be prominent in marketplaces. For example, Sprint had an advertising campaign promoting its PCS offering during ABC's NFL Monday Night Football game. All of the spots concerned the humorous use of Sprint products during a football game. The campaign was backed by Radio Shack locations and printed ads in the NFL's GameDay magazine.

### 6.3. Horizontal concentration

Since one of two cellular licenses was given to the ILECs, the original cellular market has been highly concentrated in terms of multiple ownership. According to our calculation, though the H-H index is below 0.1, the CR8 is so high (see Table 8). Thus this existing cellular market can be regarded as highly concentrated market dominated by the ILECs and AT&T Wireless. The former AT&T Wireless, McCaw Cellular Communications collected licenses from independent cellular providers and

Table 8  
Concentration in cellular market<sup>a</sup>

Companies	Subscribers (thousands)	Market share (%)
1 AT&T Wireless	5,500,000	16.7
2 AirTouch/US West	3,725,000	11.3
3 SBC Communications	3,659,000	11.1
4 Bell Atlantic/Nynex	3,356,000	10.2
5 GTE	3,011,000	9.1
6 Bell South	2,854,000	8.6
7 Ameritech	1,891,000	5.7
8 360 Degree Communications	1,502,000	4.6
Total	33,000,000	100.0
	CR4 49.2	
	CR8 77.3	
	H-H Index 0.08	

<sup>a</sup> Calculated by using data from Deloitte and Touche Consulting Group (1996).

expanded their network. In 1994, by acquiring McCaw Cellular Communications, AT&T became the largest cellular provider in the US (Regli, 1996).

In new PCS sub-market, high ownership concentration can be found only in MTA sector (see Table 9). In MTA sector which covers mainly metropolitan and urban areas, CR4 is 67.6, CR8 is 83.3 and H-H Index is 0.15. This means that this sector is highly concentrated in terms of license ownership. This result is critical because the MTA sector includes around 75% of population. In contrast, the rural BTA sector seems to be not concentrated because there are so many small firms and 4 licenses were given in each BTA.

The major players in the PCS market, in particular, in the MTA sector, are overlapped with the dominant existing cellular providers. The winning consortia in the A- and B-block auctions were all backed by the deep pockets of either long distance, cable or regional Bell operating companies or some combination. For example, AT&T Wireless, GTE, and SBC Communications won the greatest number of the 30 MHz PCS licenses for major trading areas (MTAs) and got additional spectrum to expand their service coverage. In the meantime, Sprint emerged the most active new player in wireless industry by winning enough licenses in both BTA and MTA sector to create near-nationwide coverage (Wireless Co., the Sprint-led

Table 9  
Concentration in PCS market<sup>a</sup>

MTA markets (A–B blocks)				BTA markets (C–F blocks)			
	Companies	# of market	Market share(%)		Companies	# of market	Market share(%)
1	Wireless Co.	29	28.4	1	AT&T Wireless	222	11.3
2	AT&T Wireless	21	20.6	2	Sprint PCS	160	8.1
3	PrimeCo	11	10.8	3	OPCSE-Galloway Consortium	109	5.5
4	American Portable Telecoms	8	7.8	4	Western PCS Corp.	100	5.1
5	Western PCS Corp.	6	5.9	5	Alltel Communications	73	3.7
6	GTE Macro Communications Corp.	4	3.9	6	Nextwave Personal Communications	63	3.2
7	PowerTel	3	2.9	7	US West	53	2.7
8	SBC Mobile Systems	3	2.9	8	Northcoast Operating Co.	49	2.5
Total		102	100.0	Total		1972	100.0
		CR4 67.6				CR4 30.0	
		CR8 83.3				CR8 42.0	
		H-H Index 0.15				H-H Index 0.03	

<sup>a</sup> Calculated by using FCC Auction data.

consortium was the biggest winner in the MTA sector and Sprint itself was the second biggest winner in BTA sector). Therefore, through the PCS auctions, the horizontal concentration in the wireless telephone industry became much increased.

In particular, AT&T Wireless and Sprint PCS, the two major long-distance companies became ready for the greater competition and confrontation in the wireless telephone industry because of their deep pockets and national wireless coverage. On the contrary, MCIWorldCom has provided wireless services through reselling and has no physical presence in the wireless telephone industry. Recently, based on the economies of scale concept, AT&T Wireless initiated a national single rate plan which eliminates the extra charge for roaming and long-distance call. AT&T's plan has certainly affected the entire wireless market, as other operators roll out similar plans. Depending on its nationwide PCS network, Sprint PCS, a powerhouse competitor quickly followed up AT&T's plan with its own version. GTE just introduced a national plan as well as a number of regional plans. Bell Atlantic Mobile also has been successful with similar regional plans. However, there is a danger if these flat rates (single rates) plans promote unlimited usage because they can put pressure on existing network capacities and lead to congestion or queuing problems.

In the meantime, AT&T Wireless runs comparable partner program to expand their coverage. AT&T's strategy is to give spectrum in exchange for an equity stake, leading to speculation that AT&T's partners could be possibly be taken over in several years. In contrast, Sprint has its affiliate companies which are normally utilities and small wireless providers that have access to their own telecommunication infrastructure or local retail distribution network in small markets. They provide local knowledge and reputation while Sprint provides national coverage and a recognized name. Sprint PCS receives 8% of the revenue raised by the partnership.

The economics of having a national footprint in the wireless telephone industry has produced merger-mania aiming at the realization of enough scale and scope to be competitive. The industry patterned mergers are summarized in Table 10. For example, SBC, which recently announced its intention to acquire Ameritech, is moving to acquire Philadelphia-based Comcast Co.'s wireless properties. Bell Atlantic has acquired Nynex and agreed to buy GTE. In addition, GTE recently announced to buy about half of Ameritech's wireless business.

Considering the recent mergers among the big wireless players, there is little doubt that concentration in the domestic as well as global wireless telephone industry will be more accelerated and the future market will be dominated by a few large wireless operators (Mason, 1999).

However, as the large providers build volume in total numbers of subscribers, smaller independents may play a critical role. With subscriber churn hovering between 25% and 150%, there clearly is a place for the smallest local wireless carrier to build a loyal and airtime-rich customer base even as the bigger competitors merge all around (Sextro, 1999).

Table 10  
New wireless concentration through M&A

Date	Partners	Deal	Value	Status
April 1999	GTE and Ameritech	GTE agreed to buy about half of Ameritech's wireless business	US\$3.27 B	Recently announced
March 1999	SBC and Comcast Cellular	SBC will buy Comcast's cellular operation	US\$1.67 B	Recently announced
January 1999	AirTouch and Vodafone	Vodafone agreed to buy AirTouch	US\$59.7 B	Recently announced
November 1998	AT&T and Vanguard Cellular	AT&T agreed to buy Vanguard Cellular	US\$1.5 B	Being processed
July 1998	Bell Atlantic and GTE	Bell Atlantic agreed to buy GTE	US\$55 B	Await regulatory approval
May 1998	SBC and Ameritech	SBC agreed to buy Ameritech	US\$62 B	Waiting for FCC approval
May 1998	Alltel and 360 Degree Communications	Alltel acquired 360 Degree Communications	US\$4.14 B	Completed
May 1998	AirTouch and US West MediaOne Group	AirTouch merged MediaOne Group's US cellular and PCS interests	US\$5.9 B	Completed
August 1997	Bell Atlantic and Nynex	Bell Atlantic acquired Nynex	US\$23 B	Completed
April 1997	SBC and Pacific Telesis	SBC acquired Pacific Telesis	US\$24 B	Completed

#### 6.4. Vertical integration and conglomeration

Actually, vertical integration in the wireless telephone industry is neither complete nor significant. However, there may be some chance of future vertical integration. For example, MCIWorldCom does not own any wireless system but it has been a major wireless reseller in the US. To compete with AT&T and Sprint which have already deployed nationwide wireless networks, MCIWorldCom is expected to buy a big independent wireless operator such as Nextel and Alltel. In addition, some wireless providers are trying to have long-term contracts with some big retail chains. They may also need the strong relationships with information providers because they are planning to offer multimedia services to cope with the Internet boom.

In the meantime, conglomeration as a structural element is more prominent in the wireless telephone industry. It is because that the owners of the major wireless telephone providers are existing telecommunication companies in most cases. Major players such as Sprint PCS, AT&T Wireless and PrimeCo have plans to integrate their upgraded wire-line local and long distance networks with wireless systems for

Table 11  
Partnerships related to the wireless telephone industry

Company	Partners	Purpose	Year
Alltel	Aliant Communications	Expand local wire-line service for that city and 22 surrounding areas	1999
AT&T Wireless	Bell South Cellular	Consolidate ownership of jointly owned cellular properties	1998
AT&T	British Telecom	Create a joint venture to offer voice, data and Internet service	1998
AT&T	TCI	Enter local telephone market and get high speed Internet access	1997
MCI	WorldCom	Offer more integrated services	1997
AirTouch, Bell Atlantic, Nynex, US West Media group & PrimeCo	Each other	Plan for common branding strategy with mass-market (Talk-Along) and high-end (PowerBand) offerings	1996
Sprint	Big cable TV operators such as Comcast Corp. Cox cable, and TCI	Try to get PCS licenses and establish a nationwide wireless network	1995
Nextel Communications, <sup>a</sup> Dial Page and CenCall	Motorola	Acquired 2500 dispatch frequencies in 21 states to set up a huge wireless system competing with cellular	1995

<sup>a</sup>Nextel is a national wireless carrier using enhanced specialized mobile radio (ESMR) technology.

nationwide coverage. What they want by joining this fast-growing industry is to achieve so-called “one-stop shopping” system. For example, by acquiring TCI, AT&T won big on several fronts in the quest to position itself as the major, national, all-in-one player providing wireless, long-distance, local telephone and multimedia/Internet service (Mason, 1999). Table 11 shows some examples of significant partnerships related to the wireless telephone industry.

## 7. Conclusion

This article attempts to analyze the wireless telephone industry, focusing on the emergence of new PCS providers. It also examines the potential economic impacts of PCS providers on the traditional market structure of the wireless telephone industry by using the IO model and the concept of strategic groups.

Since there are key strategic dimensions for grouping such as technology competition between cellular and PCS, and the existence of several competing standards including CDMA, TDMA and GSM, the notions of strategic groups and mobility barriers seem to work well in the wireless telephone industry. In addition, it was found that there are several dimensions of entry barriers for PCS providers such as high initial investment, economies of scale and scope, and local regulation and community resistance.



We also discovered that the wireless telephone industry continues to grow and be segmented into several clusters. The traditional concentrated wireless telephone industry channel was found to be replaced by more competitive structure.

As a result of structural analysis based on the IO model, it was found that horizontal market concentration is the most prominent in the US wireless telephone industry. In addition, conglomeration seems to be more prominent than vertical integration in this industry, thus indicating even more deep-pocketed competitors in the future.

Finally, we suggest that it is still necessary to study the impacts of structural changes to competitive conducts and firms' market performances in order to better understand this fast-changing industry structure.

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