TABLE 4 **U.S. Cellular Telephone Industry: Explaining Conduct (Nonlinear three-stage least squares)[a]**

Variables	Parameter Estimates of θ	Perfect Competition (t-statistic)	Cournot (t-statistic)	Cartel (t-statistic)
BELLBELL	.754	9.93	3.34	−3.24
INDBELL	.715	8.30	2.50	−3.31
BELLIND	.835	16.62	6.70	−3.30
INDIND	.993	16.34	8.22	−.12
			t-statistic	
Operators				
REST	.698		6.63	
GTE	.558		4.19	
CONTEL	.423		1.99	
MCCAW	.307		2.65	
CENTEL	.123		.90	
*BELLATL**	.715		2.99	
*PACTEL**	.594		3.41	
*USWEST**	.352		2.49	
*BELLSTH**	.331		2.17	
*AMERITECH**	.011		.07	
*NYNEX**	−.092		−.47	
*SWBELL**	−.165		−.75	
Regulation				
No regulation	.811		16.71	
REGLOW	.157		2.95	
REGHIGH	−.029		−.53	
Structural variables				
CROSSOWN	10.726		2.53	
MULTIMARKET	9.085		3.06	
LEAD	−.181		−1.30	
AGE	−.561		−2.64	

[a] Second-order conditions are imposed. We do not report the demand and cost parameter estimates, in order to focus on conduct. Both the cost and the demand parameter estimates are essentially unchanged. Elasticities are evaluated at sample mean. RBOCs are indicated by an asterisk.

market characteristics or firm dummies. The first set of results refers to competition among RBOCs and independent companies. We reestimate the model (1a) and (5a) specifying (6) as

$$\theta_{ts} = \begin{cases} 1 & \text{if monopoly period} \\ \gamma_1 BELLBELL + \gamma_2 INDBELL + \gamma_3 BELLIND + \gamma_4 INDIND & \text{if duopoly period,} \end{cases}$$

where *BELLBELL* is one whenever two Bell companies compete, *INDBELL* is one when the wireline is an independent telephone company and the nonwireline is a Bell company. *BELLIND* and *INDIND* are defined accordingly (see above for data information). The dummy variables and their occurrences in our sample are given in Table 2. The estimated conduct parameters are reported in Table 4.[20]

It can be seen in Table 4 that all industry structures are more collusive than Cournot. Thus RBOCs as well as independent firms are part of a collusive outcome. Moreover, for industry structures where at least one firm is a RBOC, no significant difference in θ from the overall industry average reported in Table 3 can be detected. This is not true, however, for the industry structure where both operators are independent, which occurs in about 22% of our markets (see Table 2). In this case, we find a significantly higher θ than the average industry level. Most important, we cannot reject the hypothesis of cartel behavior for independent operators (t-statistic of $-.12$).

The second set of results attempts to identify individual firms' behavior directly. We therefore specify (6) as follows:

$$\theta_{ts} = \begin{cases} 1 & \text{if monopoly period} \\ \sum \gamma_i D_i & \text{if duopoly period,} \end{cases}$$

where the D's are the firm dummies as reported in Table 2. Note that typically two dummies will be on, since by definition we have two operators in each market. Therefore one cannot interpret the γ parameters as the respective θ in the markets concerned. The correct interpretation is that a particular γ_i is operator i's contribution to the industry's θ. The results are reported in Table 4 and show that there is a considerable variance in collusive behavior across operators. In particular, all but one of the independent operators increase the level of collusion significantly. The highest contribution to θ among the independents is found by the *REST* (which is an aggregate dummy of the remaining independent operators). The second-highest contribution is attributed to *GTE,* followed by *CONTEL* and *MCCAW.* The only exception among the independents is *CENTEL,* with no significant contribution in θ. The results on the RBOCs are quite different. Three RBOC operators are not significantly colluding at all: *AMERITECH, SWBELL,* and *NYNEX,* with the last two actually reducing the industry θ. We conclude that in terms of directly identifying operators that are colluding, we again find that many of the independent firms are charging higher prices for their services. This is consistent with the previous findings that there is no evidence the RBOCs are setting higher prices than the independents. We now turn to one possible explanation of this fact.

The next set of results refers to the issue of the impact of the regulatory environment on conduct. As discussed above, the articles by Hausman (1995) and Shew (1994) illustrate that regulation can have a positive effect on prices. To test the impact of regulation on conduct, we specify

$$\theta_{ts} = \begin{cases} 1 & \text{if monopoly period} \\ \gamma_1 + \gamma_2 REGLOW + \gamma_3 REGHIGH & \text{if duopoly period,} \end{cases}$$

where *REGLOW* is a dummy variable defined as "low regulation," where operators were asked to file prices with the public utilities commission on a voluntary basis. *REGHIGH* is equal to one when operators were required to report their prices. Markets

[20] To simplify the exposition and because the results are essentially unchanged, we do not report parameter estimates of the cost and demand equations again.

with low regulation occur in 26% of the cases, whereas 24% of the markets are classified as high-regulation markets (see Table 2). As can be seen in Table 4, low regulation has a statistically significant effect on conduct (t-statistic of 2.95), whereas high regulation has no significant impact. Moreover, low regulation has a positive impact, which implies that regulation tends to increase prices. This is consistent with the findings of Hausman (1995) and Shew (1994). Hausman, in particular, argues that regulation might lead to higher prices by allowing firms to collude. Interestingly, it appears from the results in Table 4 that the ability to voluntarily report prices (rather than mandatory reporting) is a better instrument to facilitate collusion. This might be due to signalling behavior, where the signal carries no value if mandatory. In general, the above evidence suggests that the relationship between regulation and higher prices might be nonlinear, and that regulation per se might not lead to lower prices.

The last set of results refers to explaining conduct in terms of market and ownership characteristics. As discussed in Section 2, we test whether multimarket contact and/or cross-ownership explain collusion and therefore higher prices. As we have argued above, we need to control for other factors that might possibly explain conduct. Here we have chosen to control for (i) long lead times, that is, the time the monopolist has before a second entrant appears, and (ii) given that there is no explicit public rate oversight or approval system, we hypothesize that operators, over time, may learn to recognize the lack of exogenous enforcement mechanisms to prevent collusion. Under such circumstances, industry experience and a lack of regulatory intervention is hypothesized to increase the level of market power over time.

As before, we reestimate the model, allowing (6) to take the form

$$\theta_{ts} = \begin{cases} 1 & \text{if monopoly period} \\ \gamma_1 CROSSOWN + \gamma_2 MULTIMARKET + \gamma_3 LEAD + \gamma_4 AGE & \text{if duopoly period,} \end{cases}$$

where *CROSSOWN* is a dummy variable that indicates whether the two competitors are partners in any other market, *MULTIMARKET* measures the total number of markets where the two competitors face each other, *LEAD* measures the length of the monopoly period (the monopolists' lead time over the second entrant), and *AGE* measures the number of months since the introduction of cellular service in a given market.

Table 4 shows the results from reestimating our model, allowing for θ to depend on these structural variables. It can be seen that we find significant cross-ownership effects (t-statistic of 2.53) in the mobile telephone industry, indicating that if operators co-own an operating license elsewhere, they tend to collude more. Since independent operators have fewer restrictions to co-own other operators than the RBOCs do, this result explains our earlier findings in which RBOCs collude less than independent operators. In other words, one reason that RBOCs collude less is that they co-own less.

We also find empirical support for multimarket effects. Recall that we reject constant returns to scale, which is a sufficient condition for multimarket effects to be theoretically plausible. According to our results in Table 4, multimarket contact significantly increases collusion (t-statistic of 3.06), supporting the model by Bernheim and Whinston (1990). This finding is consistent with the empirical analysis performed by Evans and Kessides (1994) for the airline industry. They find that fares are higher on routes where the competing carriers have interroute contacts.[21]

On the other hand, we do not find any empirical evidence that the incumbent's lead time has any impact on prices after the entry of a second operator. Finally, it appears that

[21] Reportedly, airlines were reluctant to undercut competitors in fear of retaliation. This conduct was referred to as living by the "Golden Rule."

the data are consistent with a downward trend on prices, since *AGE* has a significantly negative impact on prices (t-statistic of -2.64). This indicates that despite a generally high level of collusion in the industry, there is a trend toward a more competitive environment.

6. Conclusions and policy implications

■ In this article we estimate a structural model of competition for the U.S. cellular telephone industry in order to determine the degree of competition and its sources. The unique regulatory environment in this industry allows us to make several important simplifications that make it possible to address and identify issues of collusion and its driving forces in an efficient and consistent way. In particular, we can exclude preemption behavior, and more important, we can use the monopoly period to test the appropriateness of our empirical model.

We find a need for public concern, as the duopolistic industry structure generally appears to be significantly more collusive than a noncooperative duopoly. The evidence suggests that cellular prices are significantly above competitive levels. Although firms offering cellular services can point to the rapid availability of service as the primary result of FCC policies to restrict entry, it appears from our study that certain firms nevertheless obtain higher-than-normal rents, given such an industry structure. We find that it is not the RBOCs but rather the independent operators that realize the highest markups. In fact, in markets where independent operators face each other exclusively—this structure occurs in about 22% of our markets—we find outright cartel pricing. It is also clear from our analysis of the operators' conduct that there is considerable variance in behavior among markets and operators. Regarding regulation, we find evidence that regulation might lead to higher prices but that the relationship between the level of regulation and collusive conduct might be nonlinear. Finally, we investigate the underlying market and organizational structures that might explain competitive behavior further. In this article we have shown that cross-ownership and multimarket contact are important factors in explaining noncompetitive prices.

Our model, while based on the U.S. cellular telephone industry, extends earlier models of market power by explicitly considering factors that contribute to collusive conduct. These have included variables capturing various industry structures. Similar extensions would appear possible for similar situations where governments, in efforts to introduce market economies to traditionally regulated monopolistic markets, opt to determine the level of competition based on the explicit number of competing firms. Such is the case in a number of countries for cellular services, cable television services, air transportation routes, public utilities, and medical services. Should limited-entry schemes be adopted for these industries, they should be accompanied by some form of oversight, especially with respect to cross-market ownership or multimarket contact. Recently, for example, the FCC has been awarding Personal Communications Services (PCS) licenses per local market area, as in the cellular industry. Our study suggests that particular concern should be given to the resulting market and organizational structures, as well as to the impact of two or more entrants per market, in order to ensure competitive pricing.

References

ABREU, D. "Extremal Equilibria of Oligopolistic Supergames." *Journal of Economic Theory*, Vol. 39 (1986), pp. 191–225.

APPELBAUM, E. "The Estimation of the Degree of Oligopoly Power." *Journal of Econometrics*, Vol. 19 (1982), pp. 287–299.

BERNHEIM, B.D. AND WHINSTON, M.D. "Multimarket Contact and Collusive Behavior." *RAND Journal of Economics*, Vol. 21 (1990), pp. 1–26.

BERRESFORD, J.W. "The Impact of Law and Regulation on Technology: The Case History of Cellular Radio." *Business Lawyer*, Vol. 44 (1989), pp. 721–735.

BRANDER, J.A. AND ZHANG, A. "Market Conduct in the Airline Industry: An Empirical Investigation." *RAND Journal of Economics,* Vol. 21 (1990), pp. 567–583.

——— AND ———. "Dynamic Oligopoly Behavior in the Airline Industry." *International Journal of Industrial Organization,* Vol. 11 (1993), pp. 407–436.

BRESNAHAN, T.F. "Empirical Studies in Industries with Market Power." In R. Schmalensee and R.D. Willig, eds., *Handbook of Industrial Organization.* New York: North-Holland, 1989.

———. "Competition and Collusion in the American Automobile Industry: The 1955 Price War." *Journal of Industrial Economics,* Vol. 35 (1987), pp. 457–482.

——— AND REISS, P.C. "Entry in Monopoly Markets." *Review of Economic Studies,* Vol. 57 (1990), pp. 531–553.

——— AND ———. "Entry and Competition in Concentrated Markets." *Journal of Political Economy,* Vol. 99 (1991a), pp. 977–1009.

——— AND ———. "Empirical Models of Discrete Games." *Journal of Econometrics,* Vol. 48 (1991b), pp. 57–81.

BULOW, J., GEANAKOPLOS, J., AND KLEMPERER, P. "Multimarket Oligopoly: Strategic Substitutes and Complements." *Journal of Political Economy,* Vol. 93 (1985), pp. 488–511.

DANNER, C. "The Oligopoly Paradox: Cellular Telephones and a Difficult Regulatory Problem." *Journal of Policy Analysis & Management,* Vol. 10 (1991), pp. 671–675.

EVANS, W.N. AND KESSIDES, I. "Living by the 'Golden Rule': Multimarket Contact in the U.S. Airline Industry." *Quarterly Journal of Economics,* Vol. 109 (1994), pp. 341–366.

FARRELL, J. AND SHAPIRO, C. "Asset Ownership and Market Structure in Oligopoly." *RAND Journal of Economics,* Vol. 21 (1990), pp. 275–292.

FRANKLIN, W.J. "Cellular Antitrust." *Cellular Business,* Vol. 3 (1986), pp. 14–45.

FUDENBERG, D. AND TIROLE, J. *Game Theory.* Cambridge, Mass.: MIT Press, 1991.

GOLLOP, F. AND ROBERTS, M. "Firm Interdependence in Oligopolistic Markets." *Journal of Econometrics,* Vol. 1 (1979), pp. 313–331.

GREEN, E.J. AND PORTER, R.H. "Noncooperative Collusion Under Imperfect Price Information." *Econometrica,* Vol. 52 (1984), pp. 87–100.

HAUSMAN, J.A. "The Cost of Cellular Telephone Regulation." Mimeo, MIT, 1995.

HEGGESTAD, A. AND RHOADES, S. "Multimarket Interdependence and Local Market Competition in Banking." *Review of Economics and Statistics,* Vol. 60 (1978), pp. 523–532.

IWATA, G. "Measurement of Conjectural Variations in Oligopoly." *Econometrica,* Vol. 42 (1974), pp. 949–966.

MALUEG, D.A. "Collusive Behavior and Partial Ownership of Rivals." *International Journal of Industrial Organization,* Vol. 10 (1992), pp. 27–34.

MAYO, J.W. AND OTSUKA, Y. "Demand, Pricing, and Regulation: Evidence from the Cable TV Industry." *RAND Journal of Economics,* Vol. 22 (1991), pp. 396–410.

MESTER, L. "The Effects of Multimarket Contact on Savings and Loan Behavior." Research Paper no. 85-13, Federal Reserve Bank of Philadelphia, 1985.

MUELLER, D.C. "The Effects of Conglomerate Mergers: A Survey of the Empirical Evidence." *Journal of Banking and Finance,* Vol. 1 (1977), pp. 315–347.

PORTER, R.H. "A Study of Cartel Stability: The Joint Executive Committee, 1880–1886." *Bell Journal of Economics,* Vol. 14 (1983), pp. 301–314.

REYNOLDS, R. AND SNAPP, B. "The Competitive Effects of Partial Equity Interests and Joint Ventures." *International Journal of Industrial Organization,* Vol. 4 (1986), pp. 141–153.

RHOADES, S.A. AND HEGGESTAD, A. "Multimarket Interdependence and Performance in Banking: Two Tests." *Antitrust Bulletin,* Vol. 30 (1985), pp. 975–995.

ROTEMBERG, J.J. AND SALONER, G. "A Supergame Theoretic Model of Price Wars During Booms." *American Economic Review,* Vol. 76 (1986), pp. 390–407.

RUBINOVITZ, R.N. "Market Power and Price Increases for Basic Cable Service since Deregulation." *RAND Journal of Economics,* Vol. 24 (1993), pp. 1–18.

RUIZ, L.K. "Pricing Strategies and Regulatory Effects in the United States Cellular Telecommunications Duopolies." Ph.D. dissertation, Boston University, 1994.

SCOTT, J.T. "Multimarket Contact and Economic Performance." *Review of Economics and Statistics,* Vol. 64 (1982), pp. 368–375.

SHEW, W.B. "Regulation, Competition, and Prices in the U.S. Cellular Telephone Industry." Working Paper, American Enterprise Institute, 1994.

SLADE, M.E. "Conjectures, Firm Characteristics, and Market Structure: An Empirical Assessment." *International Journal of Industrial Organization,* Vol. 4 (1986), pp. 347–370.

———. "Interfirm Rivalry in a Repeated Game: An Empirical Test of Tacit Collusion." *Journal of Industrial Economics,* Vol. 35 (1987), pp. 499–516.

———. "Vancouver's Gasoline-Price Wars: An Empirical Exercise in Uncovering Supergame Strategies." *Review of Economic Studies,* Vol. 59 (1992), pp. 257–276.

RAND Journal of Economics
Vol. 28, No. 2, Summer 1997
pp. 304–322

Collusive conduct in duopolies: multimarket contact and cross-ownership in the mobile telephone industry

Philip M. Parker*

and

Lars-Hendrik Röller**

With the deregulation of the telecommunications industry, a variety of industry structures have been created in hopes of increasing competition. One example is the licensing of cellular telephone services in the United States, where the FCC created duopolies in which two firms were granted licenses to compete in strictly defined product and geographic markets. Taking advantage of the unique regulatory environment, we test to what degree duopolistic competition leads to competitive market outcomes. We find that cross-ownership and multimarket contact are important factors in explaining noncompetitive prices.

Cellular phone users are finding that the price of making wireless phone calls has remained high—in some cases, as much as 80 times the price of a conventional call.

The New York Times (November 1992)

1. Introduction

■ Proponents of more competition in the U.S. telecommunications industry have often argued that increased competition drives down end-user service prices. In the case of the mobile (cellular) telephone industry created in the United States in late 1983, the U.S. Federal Communications Commission (FCC) has used two approaches to reduce competition and increase benefits to consumers. First, the FCC introduced competition by granting two licenses within a strictly defined geographic region, thereby creating a regional duopolistic market structure. Second, prices might be kept low through some sort of regulation. Casual empiricism suggests that the intended effect

* INSEAD, Fontainebleau, France; parker@insead.fr.

** WZB - Wissenschaftszentrum Berlin, Humboldt University, and INSEAD; roeller@medea.wz-berlin.de.

This article was partially written while the second author was visiting the Graduate School of Business at Stanford University. We thank Dietmar Harhoff, William Shew, and Frank Verboven, the Editor Timothy Bresnahan, and two anonymous referees for valuable comments. Asa Lundquist and Oliver Fallon provided excellent research support. We acknowledge financial support from INSEAD research and development grants.

of these measures on prices has yet to materialize in some service areas (as claimed by the *New York Times* article).[1] The absence of a service price decline has resulted in calls for broader deregulation and an opening of such markets to more competitors. In this article we study the structure of competition provided by the second entrant in the U.S. mobile telephone industry.

With respect to cellular telephone service, the FCC implemented rules that implicitly considered the high uncertainty of demand faced by potential service providers, the high up-front risks and costs in developing cellular networks, and the public need for mobile communications services, which was at the time reflected by oversubscriptions and waiting lists for existing substitutes (e.g., improved mobile telephone service (IMTS)). For each geographic market, two licenses would be granted to different operators, one with previous experience in traditional telephony (the wireline licensee) and the other to any private entity (the nonwireline licensee).[2] Public oversight on pricing or operating policy was not imposed given the establishment of a duopolistic structure, which was deemed sufficient to engender competitive behavior. In 1983, when these policies were first being implemented, many industry reports questioned whether a second entrant would ever be profitable given pessimistic demand forecasts. In return for their risk taking, the two firms might have reasonably anticipated that no third entrant would have been allowed into the market for the foreseeable future.[3]

This article studies whether limited entry regulatory policies, and in particular the duopolistic regulatory system prevailing for the U.S. cellular telephone industry, lead to collusive conduct and therefore high prices. We do this by taking advantage of the unique regulatory environment in this industry: monopoly followed by duopoly. In particular, we can exclude preemption behavior, and most important we can use the monopoly period to test the appropriateness of our empirical model. In a second step we explain the degree of collusion in terms of various firm, market, and regulatory variables. In particular, we focus on two main characteristics: multimarket contact and cross-ownership. Our analysis uses panel data collected in the United States over the period 1984 to 1988. We employ a structural model of competition, allowing for a simultaneous determination of demand, cost, and conduct (see Bresnahan (1989) for a survey). Our model of market power is similar to that previously used in a variety of industries, including the cable television industry (see Rubinovitz (1993)). Moreover, we consider the effect of regulation on prices, which connects our analysis to the articles by Hausman (1995) and Shew (1994), both of which look at the impact of regulation on prices. The advantage of our setup is that we can test for the effect of regulation on conduct (not prices) in a fully specified structural model.

Our analysis reveals that cellular prices are significantly above competitive, as well as noncooperative duopoly levels. We also find considerable variance in pricing behavior across markets and operators. In a second step we explain the identified conduct in terms of various market, organizational, and regulatory factors that explain competitive behavior. We find that cross-ownership and multimarket contact are important factors in explaining noncompetitive prices. Important policy implications are discussed.

---

[1] Price reductions for communications equipment, however, have been more substantial.

[2] The justification for establishing a duopolistic market structure was based on a drawn-out process of public hearings and submissions to the Federal Trade Commission by interested parties (often potential wireline and nonwireline firms). Further information on the historical justification for cellular regulatory policies can be found in Berresford (1989), Danner (1991), and Franklin (1986).

[3] The FCC is currently in the process of allowing additional entry in the form of Personal Communications System licenses. As these have been in operation no earlier than 1995, they have had no influence on competition during the study period (1984–1988).

The article is organized as follows. Section 2 describes certain institutional characteristics of the cellular telephone industry, discusses related work, and describes our modelling approach. Section 3 introduces the basic model. Section 4 develops the empirical model we use to detect market power, and Section 5 summarizes our empirical findings. We draw conclusions in Section 6.

2. Market structure, modelling issues, and related research

■ In the early 1980s, Federal Communications Commission (FCC) guidelines subdivided the United States into 305 nonoverlapping markets defined by strict geographic boundaries that correspond to standard metropolitan statistical areas (SMSAs).[4] Within each market, two companies were awarded licenses to provide competing mobile cellular telephone service. One license (called wireline) was awarded based on a comparative hearing (for the larger markets) or lottery (for the smaller markets) to firms that provide local fixed telephone service to the market in question: a regional Bell operating company (RBOC) or a local independent telephone company not affiliated with the RBOCs. The second license (called nonwireline) was awarded to any private U.S. citizen or company via comparative hearing or lottery. Licenses were awarded over a multiyear period beginning in 1983, by ten market tiers. The first tier consisted of the 30 most populous markets (SMSAs). The remaining licenses were awarded over time by remaining tiers that consisted of 30 to 65 markets each. For each nonwireline license, the number of applicants ranged from 6 to 579 per market; the number of wireline applicants was often only one or two. Following a startup period in which local construction permits for antenna sites (cell cites) were granted and outstanding litigation issues were resolved, a licensee began offering public mobile telephone service. Generally, the first company to offer service in the market was the wireline licensee, which enjoyed a monopoly status until the nonwireline operator began offering service. The entry of the second operator resulted in a restricted duopoly in that, by law, there is no threat of a third entrant. The first entrant, in all cases, foresaw the duopoly period, as the second license was granted only to firms that had the intention to build a cellular system. By the early 1990s, virtually all 305 metropolitan cellular markets had both licensees operating their networks. The first cellular system began offering services in Chicago by the wireline licensee (Ameritech Mobile) in October 1983; it enjoyed a monopoly period of some 14 months until the second entrant (Cellular One) appeared in January 1985. The next wireline licensee (NYNEX) offered service in April 1984 in New York City. By December 1984, there were 24 wireline licensees and 7 nonwireline licensees offering service in 25 markets. By July 1988, these figures had reached 223 wireline licensees and 130 nonwireline licensees in 233 markets.

This unique market structure and the regulatory environment leads to a number of interesting simplifications and testable hypotheses on market performance. Each cellular telephone market resembles an observation in a repeated experiment: competing products/services are relatively homogeneous, firms have similar production functions, prices and product offerings are public knowledge, services are "perfectly mobile" in that consumers/products do not travel distances as a requisite for purchase, and consumers can switch from one service provider to another, usually without high explicit cost.[5]

[4] The FCC divided the country into contiguous geographical areas consisting of metropolitan service areas (MSA) and rural service areas (RSA). The geographic definition of an MSA corresponds to the one used by the Census Bureau to define SMSAs. Therefore, MSAs are delimited by SMSAs.

[5] While we assume low switching costs, it should be noted that some may have been present. During the period studied, however, consumer switching was more commonplace compared to later periods (i.e., there was higher "churn"). This decline in switching is due to annual service contracts that involve a free handset coupled with a one- or two-year service contract to recover the costs. Such contracts, however, became common after the study period.

The industry structure is rigidly regulated: a monopoly period followed by a duopoly period. One advantage of this regulation is that we do not need to control for entry deterrence. As discussed above, the FCC issued *at most two* licenses to operate cellular telephones for each geographical region, and there was no overt or immediate controversy that the duopolistic structure would persist for the foreseeable future. As there have been many applicants for each license, presumably because cellular telephony is perceived as a very profitable industry, there has been a period of monopoly, followed by duopoly, in virtually all markets. Since the second entrant always entered, it seems reasonable to assume that entry deterrence is not a feasible strategy. Moreover, the length of the monopoly period (we call this lead time below) is not a function of the monopolist's behavior, but purely influenced by technical constraints. This rules out any preemption behavior during the monopoly period, which implies that the monopoly period must be characterized by "nonstrategic" monopoly pricing. We shall return to this point in the next section. More important, preemption during the duopoly period is ruled out by the regulatory environment. Given this regulatory environment, pricing during the duopoly period is therefore determined by internal market forces alone.[6]

This article empirically estimates the degree of competition in the duopolistic market setting of the cellular telephone industry. Our first goal is to address the following question: Does the entry of a second operator lead to market prices in line with two noncooperative firms, or do firms tacitly collude? (See Fudenberg and Tirole (1991) for a summary.) Second, we shall attempt to explain the degree of collusion in a given market in terms of organizational, market, and regulatory factors. In particular, we focus on two main characteristics: multimarket contact and cross-ownership. We now briefly discuss these factors.

Collusion might emerge from the *multimarket* nature of this industry. Operators of cellular licenses are present in several geographical markets, on average about 19 markets. For example, some companies own licenses in multiple markets due to the lottery outcome or subsequent mergers and acquisitions of licenses. This implies the possibility of strategic market interdependence, both static and dynamic. Bulow, Geanakoplos, and Klemperer (1985) investigate the effects of cost- and demand-based linkages across markets in a static oligopolistic framework. However, for the cellular industry it does not seem reasonable to allow for such explicit interdependence: neither costs nor demand are interdependent.[7] Bernheim and Whinston (1990) explicitly assume away any cost and demand interlinkages and show that collusion through multimarket contact may arise in a repeated game setup. They point toward a variety of asymmetric market conditions that need to be present, which allows firms to *pool* the incentive constraints across the markets, leading to more collusive outcomes than would be supportable by trigger price strategies in each market separately. In particular, Bernheim and Whinston show in their "irrelevance result" that multimarket contact does not enhance firms' abilities to sustain collusive prices whenever firms are identical, markets are identical, and the technology exhibits constant returns to scale. Given these possibilities of pooling constraints, firms allocate their "slack enforcement power" to markets where the incentive constraint is violated, enabling firms to sustain more collusive outcomes (see Bernheim and Whinston (1990)). A test for multimarket effects would then be that collusion is more likely to emerge in situations where firms have contact in many markets. The empirical implementation of such a test poses another well-known difficulty. Empirical studies of multimarket effects face the problem of differentiating between market-specific factors (entry barriers, demand conditions,

[6] An implication of the above discussion is that we can treat entry as exogenous. For models of endogenous entry, see the work by Bresnahan and Reis (1990, 1991a, 1991b).

[7] The availability of roaming might introduce the possibility of demand interdependence. We believe, however, that it is likely to be of minor importance and assume that no such interdependence is present.

concentration) and external factors, such as multimarket contact.[8] Using the unique regulatory environment discussed above, our structural model of competition will be able to separate these market-specific effects from the multimarket external factors.

There might also be collusion through *cross-ownership.* Besides the fact that firms have multimarket contact, they often co-own an operating license in a given market. The extent to which firms behave on a corporate basis, as opposed to a market-by-market basis, may reduce the independence of strategies across markets and facilitate collusive behavior. Considering such cross-market behavior is especially critical in cases where a wireline operator (company A) is competing against a nonwireline operator (company B) in one market, and the same two companies are joint venture partners in, say, the nonwireline operation (company C) in a second market. One would expect that collusion is more likely in markets where firms in the same family of companies are in competition. The literature on cross-ownership shows that increased cross-ownership yields a more collusive outcome (see Farrell and Shapiro (1990) and Reynolds and Snapp (1986)). A notable exception is the article by Malueg (1992). Using a supergame approach, he shows that depending on the demand structure, increased ownership may *decrease* the ease or likelihood of collusion. This result is driven by the fact that cross-ownership alters the incentive constraint to deviate from the collusive outcome in a nontrivial way. Generally speaking, whether cross-ownership facilitates collusion in a dynamic setting is thus an empirical question, to which we hope to contribute some evidence in this article.

As is usually the case in empirical analysis, there are numerous other factors influencing pricing during the duopoly period besides multimarket contact and cross-ownership. Although these other factors are not the primary focus of this article, it is still necessary to control for them in order to obtain consistent estimates of our main effects. These other hypotheses include the conjecture that in markets where the first entrant has a long lead time over the second entrant, the latter firm will have less incentive to engage in competitive rivalry and may opt to tacitly collude with the former.[9] A second variable is a simple time trend, in particular the age of the market, which controls for any other factors that exert significant downward (or upward) pressure on prices over time. These might include the ability of the duopolists to search out and implement an optimal pricing strategy. Finally, there is the possibility of collusion in a repeated game. Any collusive outcome can be an equilibrium in a supergame using punishment strategies.[10] Our empirical model will allow for such equilibria, although we do not explicitly model equilibrium price wars. Equilibrium price wars occur when firms implement punishment strategies to enforce collusion in an uncertain environment (see Green and Porter (1984), Abreu (1986), Rotemberg and Saloner (1986); see also Porter (1983) and Brander and Zhang (1993) for empirical tests of switching regimes).[11]

---

[8] Empirical work includes Mueller (1977), Heggestad and Rhoades (1978), Scott (1982), Rhoades and Heggestad (1985), and Mester (1985). For a recent test of multimarket collusion in the airline industry, see Evans and Kessides (1994).

[9] Shew (1994, p. 11) argues that "it was clear that many of the wireline licensees would enjoy reputational and head-start advantages that would reduce the competitiveness below what one might expect to see in a duopoly market."

[10] One such punishment strategy might involve the incumbent's (usually the wireline that also owns the fixed telecommunication network) threatening less favorable terms for access to the fixed network unless the entrant cooperates. We thank the referee for pointing this out to us.

[11] In some cellular markets, multiple resellers were permitted to offer service in addition to the official license holders (i.e., "resellers" of the airtime). Clearly, the existence of these resellers should place downward pressure on prices. While our prices cover reselling, this activity was limited in nature during the study period.

We also consider the effect of regulation on prices, which connects our analysis to the articles by Hausman (1995) and Shew (1994), both of which look at the impact of regulation on prices. Generally speaking, they both find significant evidence that regulation leads to *higher* prices in many markets. They conclude that regulation is an imperfect instrument to reduce prices. The advantage of our setup is that we can test for the effect of regulation on conduct (not prices) in a fully specified structural model.[12]

In the next section we propose a structural model that measures the extent to which firms compete in restricted duopolies, such as the cellular telephone industry. We also consider variables that might explain the level of collusion in such duopolies, including multimarket contact and cross-ownership. The structural model is then estimated using data collected from the cellular telephone industry.

3. A model of the cellular telephone industry

■ To assess the degree of competition in the cellular industry we employ a structural duopoly model at the industry level (see Bresnahan (1989) for a survey).[13] As discussed in the previous section, the unique regulatory environment of the industry during the study period allows us to make several interesting simplifications. In particular, we can rule out any entry deterrence strategy for either the monopoly or the duopoly periods. An implication of the above argument is that the monopoly period must be characterized by "nonstrategic" monopoly pricing behavior.

There are several ways to take advantage of this unique institutional structure. One way to proceed could be to "calibrate" our model using the monopoly period as the period where conduct is known (i.e., monopoly behavior). This procedure might be particularly attractive in situations where data on marginal cost are unavailable. Since we have data to estimate marginal costs, we prefer not to calibrate our model based on this procedure. Instead, we use the monopoly period to perform a specification test. It is well known that the empirical estimation of conduct depends crucially on the correct specification and estimation of marginal costs and marginal revenue functions. Misspecification of marginal costs and demand elasticities, for instance, has a direct impact on the inferred degree of market power. Given that we "know" market power during the monopoly period, we can test for the correct specification of costs and demand. If our model predicts monopoly behavior correctly, we can be more confident that the model is not misspecified.

As discussed in the previous section, the duopoly period is more complicated, however. There are potentially several market structure characteristics that could lead to collusion. We wish to focus our attention on empirically identifying two such structural characteristics. First, many of the operators face each other in more than one market (the multimarket effect). Second, there are instances where two competitors in one market jointly own part of a license in another market (the cross-ownership effect). The institutional constraints discussed above present us with a rather unique empirical opportunity to estimate these effects.

We proceed with the following monopoly-duopoly model. To properly identify conduct, we need to specify demand and cost conditions. We assume that firms in the cellular telephone industry face a market demand function of the following type:

---

[12] In a recent dissertation, Ruiz (1994) estimates a reduced-form price equation. She considers regulation and its implication on prices and concludes that the empirical tests "do not provide compelling arguments for policy recommendations."

[13] An incomplete list of the literature on static specifications of structural estimation or calibration of oligopolistic conduct includes Iwata (1974), Gollop and Roberts (1979), Appelbaum (1982), Slade (1986), and Brander and Zhang (1990). Dynamic contributions not mentioned earlier include Bresnahan (1987) and Slade (1987, 1992).

$$p_{ts} = f(q_{1ts} + q_{2ts}, Z_{ts})\ t = 1, \ldots, T; \qquad s = 1, \ldots, S, \tag{1}$$

where s is the market subscript, in our case the geographical region (i.e., the SMSA), t is the time period, q_{its} is the quantity produced and sold by firm i at price p, Z_{ts} is a vector of market-specific, exogenous factors affecting demand, such as market population, percentage of high-potential business establishments, and a time trend to pick up market growth. Costs are modelled by specifying the following firm-level cost function:

$$C_{its} = F_{its} + C^{VC}(q_{its}, \omega_{ts}), \tag{2}$$

where F represents firm-specific fixed costs,[14] and variable costs depend on output and a vector of market-specific factor prices (ω), which include wages, energy prices, capital costs, operating expenses, and rent. Given the above cost and demand conditions, the corresponding first-order condition is given by

$$\lambda \cdot \frac{\partial p_{ts}(\cdot)}{\partial q_{its}} q_{its} + p_{ts}(\cdot) - MC_{its}(\cdot) = 0, \tag{3}$$

where $MC_{its}(\cdot)$ is the marginal cost function, defined by $\partial C^{VC}(\cdot)/\partial q_{its}$. The parameter λ measures the degree of collusion. If $\lambda = 0$, prices equal marginal costs and the industry is perfectly competitive. $\lambda = 1$ is consistent with Nash behavior, whereas λ's larger than one imply collusive price setting. Monopoly pricing is identified whenever $\lambda = N$ (where N is the number of symmetric firms in the industry). Since our unit of observation is a market at a point in time, we proceed by summing (3) over firms, yielding

$$\lambda \cdot \frac{\partial p_{ts}(\cdot)}{\partial Q_{ts}} Q_{ts} + N \cdot p_{ts}(\cdot) - \sum_{i=1}^{N} MC_{its}(\cdot) = 0. \tag{4}$$

For the monopolist this expression is identical to (3). At this point we assume that the individual firm's marginal cost functions are symmetric, which implies that $q_{1ts} = q_{2ts}$. Thus we can rewrite (4) as

$$\theta \cdot \frac{\partial p_{ts}(\cdot)}{\partial Q_{ts}} Q_{ts} + p_{ts}(\cdot) - MC_{ts}\left(\frac{Q_{ts}}{N}, \omega_{ts}\right) = 0, \tag{5}$$

which can be estimated with industry-level data. Note that $\theta = \lambda/N$. Therefore, perfect competition is consistent with a θ of zero. A θ equal to $1/N$ is indicative of Nash, and finally monopoly is consistent with $\theta = 1$. The assumption that firms have the same marginal costs excludes the possibility that the entrant has a cost disadvantage, even initially. To the extent that the entrant needs some time to become as efficient as the incumbent, the conduct parameter in (5) would not be estimated consistently. A higher θ might in that case be incorrectly interpreted as collusion.

In order to explain conduct further, we allow θ to depend on a variety of market characteristics, that is,

$$\theta_{ts} = f(\mu_{ts}), \tag{6}$$

[14] This could be interpreted as a fixed effect, measuring efficiency or productivity differential across firms.

where μ_{ts} is a vector of market characteristics such as multimarket contact and cross-ownership. It should be noted that the empirical implementation of the above model will estimate (6) simultaneously with the demand and cost equations. In other words, we do not first estimate "average" conduct (from equation (5) for example) and then, in a second step, estimate (6) conditionally on (5).[15] This assures that our estimates are consistent, which is of course essential in light of our stated goal to disentangle the μ_{ts} effects from other market-specific factors.

One more observation might be in order regarding the possibility of collusion through repeated play. Since there are no apparent price wars during the study period of 1984–1988, the mobile industry is not an ideal dataset for identifying periods of collusion from punishment phases. Nevertheless, in a world of certainty, collusion through repeated play is possible without punishment being observed. As long as the game played is repeated (not dynamic), our model will be able to allow for collusion from repeated play. However, we need to assume that the payoffs, that is the demand and marginal costs functions, are not misspecified and are stationary. This observation adds to the significance of the specification check for the monopoly period, to which we now turn.

4. Specification and empirical implementation

■ The empirical implementation of the above model involves the specification and estimation of equations (1) and (5), subject to (6). Before we discuss the functional specification we describe the data used in the empirical analysis below.

□ **Data.** The data used in this study cover four areas: (1) service prices and output quantities, (2) input factor prices, (3) demand variables, and (4) industry structure variables. The data sources are as follows. Service prices were collected from *Cellular Price and Marketing Letter, Information Enterprises,* various issues, 1984–1988. Output variables (cell sites and startup dates) were collected from *Cellular Business,* various issues, 1984–1988. Factor price indexes/variables were collected from U.S. Department of Labor, Bureau of Labor Statistics; U.S. Department of Energy; *BOMA Experience Exchange Report: Income/Expense Analysis for Office Buildings,* Building Owners and Managers Association, 1984–1989; and *Statistical Abstracts of the United States,* 1989. Demand variables were collected from the U.S. Department of Commerce, Bureau of the Census, using FCC Cellular Boundary Notices, 1982–1987, available in the *Cellular Market Data Book,* EMCI, Inc. Ownership data across cellular markets were collected from public filings with the FCC. Summary statistics of all the variables discussed below are provided in Tables 1 and 2. The study period begins in December 1984 and ends in July 1988. During this period most cellular markets experienced both a monopoly and duopoly period.

Service prices and output. Our analysis uses retail prices. Wholesale prices offered by operators during the study period consisted of quantity discounts for users purchasing more than one subscription. These prices were mostly offered to larger corporate accounts, as opposed to small business and individuals. During the study period, cellular operators self-reported price and product offering information. In addition to the initial prices set by the first entrant, prices were collected for either operator when these changed. We define the price of a single cellular subscriber as the monthly bill paid for a given level of usage. Most cellular operators offer nonlinear prices in the form

[15] A recent study that has used the conditional two-step approach, where conduct is estimated in a first step followed by a further explanation of it in a second step, is Brander and Zhang (1990). Generally speaking, this approach increases the efficiency of the results and thus increases the statistical significance; however, results are inconsistent. By contrast, our simultaneous approach is similar to that of Mayo and Otsuka (1991).

TABLE 1 U.S. Cellular Telephone Industry: Data

Variable	Mean	Minimum	Maximum
P	196.26	60.00	304.00
Q	15.75	1.00	119.00
TIME	21.44	3.10	57.90
POP	.19	0	1.50
BUSINESS	2,179.26	21.38	139,880.00
ENERGY	1.77	.70	4.43
PRIME	9.51	7.75	11.00
WAGES	522.63	276.06	1,304.79
RENT	15.97	8.10	36.12
OPERATE	6.68	3.13	14.69
CROSSOWN	.33	0	1.00
MULTIMARKET	3.50	1.00	10.00
LEAD	10.53	0	33.84
AGE	10.91	0	85.78

Notes: Number of observations = 557. The units of the variables are as follows: *P* = monthly bill, *Q* = number of cell cites, *TIME* = trend in months, *POP* = market population in millions, *BUSINESS* = number of high-potential business establishments, *ENERGY* = average monthly cost per square foot, *PRIME* = prime lending rate in %, *WAGES* = average weekly salary, *RENT* = average monthly office rent, *OPERATE* = average monthly operating expense per square foot, *MULTIMARKET* = number of markets, *LEAD* = in months, *AGE* = in months, *CROSSOWN* = dummy. All monetary units are in dollars.

of multiple price plans, from which consumers self-select the plan that would minimize their monthly bill. A typical price plan is a two-part tariff with a peak-load component. A plan has a monthly access fee, a price per minute of peak-hour "air time" usage, a price per minute for off-peak usage, and, in some cases, a given number of peak and/or off-peak minutes included without charge. Three plans are generally offered: (1) a "high usage plan," which has a high access fee with a large number of minutes included, and low air time fees per minute; (2) an "average usage plan," which has a modest access fee and number of minutes air time included, and moderate air time charges; and (3) a "low usage plan," which often has no monthly access charge or free minutes included, but has high per-minute air time charges—this plan is designed for households or other infrequent users. The level of discrimination (or number of plans) varies across markets/operators, with some firms offering only one plan and others offering as many as six. Three prices were calculated for each time observation based on three levels of monthly usage: 5 minutes (P1), 500 minutes (P2), and 3,000 minutes (P3) of monthly peak air time usage. For a given usage level, a monthly bill was calculated by assuming that the consumer chose the least expensive plan. These three usage levels were chosen based on various simulations of cellular price plans. The results reported here are based on a usage of 500 minutes for two reasons. The choice of plans over time is relatively invariant for consumers who use between 300 and 1,000 minutes per month. In other words, a consumer who uses 300 minutes will choose the same plan as a consumer who uses 1,000 minutes. The monthly bills generated for any usage level in this range will exhibit the same variance across markets, and over time. The second reason to use 500 minutes is that operators see such a level

TABLE 2 U.S. Cellular Industry: Dummy Variables

Variable	% Occurrence
BELLBELL	.12
INDBELL	.05
BELLIND	.62
INDIND	.22
CONTEL	.06
GTE	.12
MCCAW	.16
USWEST	.10
CENTEL	.09
PACTEL	.07
SWBELL	.13
AMERITECH	.10
BELLATL	.10
NYNEX	.10
BELLSTH	.19
REST	.49
REGLOW	.26
REGHIGH	.24

as depicting the "typical" cellular subscriber. It should be pointed out that the results based on other usage levels are essentially unchanged.

Output levels are not directly observable, since operators are not required to report their subscriber levels to public authorities. Instead, data were collected on the number of cellular antenna sites used by operators over time and across markets. Each cell site represents from 1,100 to 1,300 subscribers each, depending on the engineering configuration of the local network. As such, the total number of cells in a given network can act as a proxy for the industry's output (Q). On the other hand, it is not clear in the context of our model that output (subscribers) and cell sites (capacity) lead to the same inference about collusion. This might be due to the lumpiness of capital investment in a growing market or because the load profile of cellular calls has been changing over time, and the relationship between load profiles and cell sites is unclear. In addition, firms might hold less excess capacity when demand grows more than expected. This could be interpreted as less "output" and therefore collusion. Alternatively, firms may hold excess capacity in order to avoid congestion (and improve quality). In order to support the assumption that cell sites are a reasonable proxy for subscriber output, we have done an additional analysis based on a limited sample of markets where both subscriber and cell-site data were available at the firm and market level. Based on 86 observations collected in 1987, we find a simple Pearson correlation of .9237 (p-value $< .0001$) between cell sites and subscribers at the firm level, and .9251 (p-value $< .0001$) at the market level. To the extent that output and cell sites are not proportional, our results below need to be qualified.

Input factor prices. Factor inputs required to run a cellular telephone company include labor, energy (electricity), capital equipment (radio and switching equipment), and general overhead (leases, office expenses, administrative costs, etc.). Factor prices were collected for each of these inputs across the markets and over the periods studied. Average annual wages per employee (*WAGES*) for the cellular industry have been reported by the Bureau of Labor Statistics on a state-by-state basis since 1988. Before 1988, wage rates were calculated for communications employees in general. Wages for cellular employees were back-extrapolated over time, across states, for the missing years of the cellular index using the general communications index. To obtain a continuous series, percentage changes calculated using the general index from 1987 to 1988, for example, were divided into the earliest year of the cellular index, in 1988, in order to obtain the cellular wages estimate for 1987. This procedure was repeated until the remaining years in the cellular index were estimated back to 1984.[16] State-level wage prices are then applied to markets located in each state. Electricity prices (*ENERGY*), measured in dollars per kilowatt hour, were also collected across states, over time, from the U.S. Department of Energy. The measure of capital price used (*PRIME*) is simply the one-period lagged prime lending rate, which reflects the costs of financing cellular equipment (a common practice in this industry). General overhead and operating expenses (*OPERATE*) are measured using an index developed by the Building Owners and Managers Association International (*BOMA Experience Exchange Report: Income/Expense Analysis for Office Buildings,* various issues, 1985–1989). The index measures, on a per-square-foot basis, the typical operating expenses for an office building across U.S. metropolitan areas over time. The index includes the following expenses: cleaning, repair and maintenance, administrative costs, utilities, local taxes, security and ground services, office payroll, and other leasing expenses associated with running an office. *RENT* is the average monthly rent per square foot of office space in each of the cellular markets (*BOMA,* 1985–1989).

Demand variables. Demand variables used in the model include market population (*POP*), number of high-potential business establishments (*BUSINESS*), and a time trend to proxy for market growth (*TIME*).[17] All demand variables should positively affect market demand, except for Q. All of the data were collected from the U.S. Bureau of the Census and aggregated from the county level to the SMSA level based on FCC cellular market boundary definitions.

Market structure variables. Two alternative schemes are used to identify collusive arrangements of particular firms or types of firms. The first generates four dummy variables: *BELLBELL, INDBELL, BELLIND,* and *INDIND.* Each dummy signifies the status of the wireline-nonwireline pair. *BELLBELL,* for example, is one when both the wireline and the nonwireline competitors are both regional Bell operating companies (RBOC) and zero otherwise. *INDBELL* is equal to one when the wireline is a non-RBOC (an independent telephone company) and the nonwireline is an RBOC; and so forth for the other pairs.

Second, dummy variables were defined for each of the "major" cellular operators (defined as companies holding majority shares in more than 5% of the cellular markets). These include CONTEL Cellular (*CONTEL*), GTE Mobilnet (*GTE*), McCaw Communications (*MCCAW*), US West Cellular (*USWEST*), Nynex Mobile (*NYNEX*), PacTel Mobile Access (*PACTEL*), Bell Atlantic Mobile (*BELLATL*), Ameritech Mobile

[16] The empirical results presented in the article are insensitive to the use of the extrapolated cellular wages index, or to the general communications index.

[17] High potential business establishments include the number of firms engaged in business services, health care services, professional and legal services, contract construction, transportation, finance, insurance, and real estate.

(*AMERITECH*), BellSouth Mobility (*BELLSTH*), SouthWest Bell Mobile (*SWBELL*), and Century Cellular (*CENTEL*). Otherwise, remaining firms are captured in the dummy *REST*.

To test the impact of regulatory regimes, we define the following dummy variables. During the study period, prices for cellular services were regulated at the state level. Broadly speaking, three forms of regulation can be identified for the period of our study: (1) no regulation at all, which occurred for about half of all states, (2) "low regulation," where operators were asked to file prices with the public utilities commission, i.e., voluntary disclosure, and (3) "high regulation," where operators were required to file prices, i.e., mandatory disclosure. Accordingly, we define two more dummy variables corresponding to low regulation (*REGLOW*) and high regulation (*REGHIGH*).

Industry structure variables we use to explain variances in collusive behavior across markets include cross-ownership (*CROSSOWN*), multimarket competition (*MULTIMARKET*), the monopolist's lead over the second entrant (*LEAD*), and the age of the cellular system (*AGE*). *CROSSOWN* is a dummy variable that indicates whether the two competitors are, in any other market, partners. *MULTIMARKET* measures the total number of markets where the two competitors face each other; if the competitors face each other only in the market in question, the value of *MULTIMARKET* is one. As many cellular licenses are owned by multiple partners, *MULTIMARKET* reflects those markets where the two competing firms are both plural owners (i.e., the largest shareholders) of the respective licenses. *LEAD* measures the length of the monopoly period in months (the monopolist's lead time over the second entrant). *AGE* measures the number of months since the introduction of cellular service in the market in question.

□ **Empirical model.** As mentioned above, the implementation of the model outlined in Section 3 involves the specification and estimation of equations (1) and (5), subject to (6). To identify the parameters, we specify demand as semilogarithmic and marginal cost as linear, which implies that costs are quadratic. We therefore implement (1) by

$$p_{ts} = \alpha_0 + \alpha_1 \log(Q_{ts}) + \alpha_2 \log(POP_{ts}) + \alpha_3 TIME_{ts} + \alpha_4 \log(BUSINESS_{ts}) + \epsilon_{ts}, \quad (1a)$$

where Q denotes output, *POP* is the market population, *BUSINESS* is the number of high-potential business establishments, and a time trend (*TIME*) is a proxy for market growth (see the previous section for definitions of the variables and Table 1 for summary statistics). Using (1a) we can simplify (5) to

$$p_{ts} - MC_{its} + \theta_{ts} \cdot \alpha_1 + \nu_{ts} = 0, \quad (5a)$$

where ν_{ts} is an identically and independently distributed stochastic disturbance, and

$$MC_{ts} = \beta_0 + \beta_1 Q_{ts} + \beta_2 ENERGY_{ts} + \beta_3 PRIME_{ts} + \beta_4 WAGES_{ts} + \beta_5 RENT_{ts} + \beta_6 OPERATE_{ts},$$

where marginal costs is a function of factor prices and output. Factor prices are electricity prices (*ENERGY*), capital prices (*PRIME*), labor prices (*WAGES*), overhead and operation costs (*OPERATE*), and rental prices (*RENT*) (see again the previous section and Table 1). One advantage of the above model is that data on total or marginal costs are not needed. Marginal costs, and consequently price-cost margins, are implicitly assumed in (5a). Fixed costs are not directly estimated either, so that only variable profitability can be inferred from the above model.

In principle, there are several other variables that might presumably be included in the demand and cost specification.[18] Rather than trying each additional variable in an ad hoc fashion, we proceed by using the unique regulatory environment to test whether the above model "correctly" predicts the monopoly period. If our specified model predicts monopoly conduct correctly, then the estimated cost and demand functions appear to be properly specified.

Specification test. As discussed above, we can now make use of the unique structure of the cellular industry and test whether our specified model correctly predicts the monopoly period. Using our sample data for both the monopoly and the duopoly periods, we estimate the system (1a) and (5a), allowing the conduct parameter θ to vary across the two regimes. In other words, we specify (6) as

$$\theta_{ts} = \begin{cases} \theta^M & \text{if monopoly period} \\ \theta^D & \text{if duopoly period.} \end{cases}$$

The estimated θ^M for the monopoly period is equal to 1.079 with a standard error of .17. This implies that the developed model and its specification assumptions correctly predict monopoly behavior, increasing confidence in our specification.

The empirical implementation of the above model involves the simultaneous estimation of equations (1a) and (5a) subject to various specifications of (6) by three-stage least squares. Since we accept monopoly conduct during the monopoly period, we proceed by imposing it via $\theta^M = 1$, in order to increase the efficiency of our estimates. Similarly, we also impose the second-order conditions defined by (5a).[19]

5. Results and interpretations

■ Table 3 shows the results for the baseline model. The baseline model is defined by a constant, θ^D. On the demand side, all variables have the expected sign and are significant (the parameters are converted into elasticities, evaluated at the sample means). The demand elasticity is estimated at -2.5. This implies a rather elastic demand structure for cellular services. As a consequence, a reduction in prices would generate an increase in revenue; a 10% reduction in price would increase revenue by 25% and demand by 15%. Both the population as well as the number of business establishment elasticities are equally large around 2.5. Market growth (*TIME*) is estimated at roughly 8.5% per month. This indicates that this market is expanding at a very high annual rate. At this growth rate the market is expected to double in close to one year.

[18] For example, on the suggestion of the referees, we have reestimated our model incorporating other relevant cost and demand variables. These variables include per-capita income in the demand equation, population density in the marginal cost equation, and a time trend in the marginal cost equation. As we had hoped, the main results of the article are essentially unchanged (with some differences in the firm dummy analysis below).

[19] The second-order condition is obtained by differentiating (3), again yielding

$$[\partial^2 p/\partial q_i^2]q_i + 2[\partial p/\partial q_i] - [\partial MC_i/\partial q_i] \leq 0,$$

where we drop the s and t subscripts. Summing over firms using symmetry gives

$$[\partial^2 p/\partial q_i^2]Q + 2N[\partial p/\partial Q] - N[\partial MC_i/\partial q_i].$$

For the functional specifications (1a) and (5a) this simplifies to $\alpha_1(2N - 1) - N\beta_1 Q \leq 0$ or $3\alpha_1 - 2\beta_1 Q \leq 0$ for the duopoly case.

TABLE 3 U.S. Cellular Telephone Industry: Baseline Model (Nonlinear three-stage least squares)[a]

	Parameter	*t*-statistic
Demand[b]		
Intercept	−116.208	−1.66
Q	−2.456	−5.06
POP	2.365	5.41
TIME	.085	3.22
BUSINESS	2.710	5.35
Marginal cost		
Intercept	41.264	1.99
Q	.650	3.78
ENERGY	−13.27	−4.26
PRIME	4.84	3.11
WAGES	.017	1.67
RENT	1.578	4.65
OPERATE	3.342	2.91
Behavioral		
θ	.857	20.30
Test for Cournot ($\theta = .5$)	—	8.45
Test for cartel ($\theta = 1$)	—	−3.39

[a] Second-order conditions are imposed.
[b] The demand estimates are converted into elasticities evaluated at the sample mean.

The variables influencing marginal costs are also very significant. As expected, most factor prices have a significant impact on marginal costs. Marginal costs are increasing in output, rejecting the hypothesis of constant returns to scale. This result is important in light of the test for multimarket effects below. Recall that nonconstant returns to scale is a sufficient condition for multimarket effects to be theoretically plausible (Bernheim and Whinston, 1990). This implies that our empirical model does not *a priori* exclude the possible existence of multimarket effects.

We now turn to the conduct parameter: θ^D is estimated at .857. We reject the hypothesis that the industry is perfectly competitive (*t*-statistic of 20.30). A duopolistic industry structure is therefore not competitive and prices are not equal to marginal costs. On the other hand, the hypothesis that the duopoly's pricing behavior is consistent with cartel is also rejected, although at a lower level of significance (*t*-statistic of 3.39). The hypothesis consistent with noncooperative behavior is $\theta = .5$, which is also rejected by our model (*t*-statistic of 8.45). We therefore conclude that the industry on average is more collusive than noncooperative duopoly after the second firm enters the market. The implied price-cost margin can be obtained by dividing θ^D by the demand elasticity, which indicates a 35% markup.

Table 4 reports results for various specifications of (6). Our goal is to explain the degree of collusion further by making the conduct parameter a function of various

TABLE 4 **U.S. Cellular Telephone Industry: Explaining Conduct (Nonlinear three-stage least squares)[a]**

Variables	Parameter Estimates of θ	Perfect Competition (t-statistic)	Cournot (t-statistic)	Cartel (t-statistic)
BELLBELL	.754	9.93	3.34	−3.24
INDBELL	.715	8.30	2.50	−3.31
BELLIND	.835	16.62	6.70	−3.30
INDIND	.993	16.34	8.22	−.12
			t-statistic	
Operators				
REST	.698		6.63	
GTE	.558		4.19	
CONTEL	.423		1.99	
MCCAW	.307		2.65	
CENTEL	.123		.90	
*BELLATL**	.715		2.99	
*PACTEL**	.594		3.41	
*USWEST**	.352		2.49	
*BELLSTH**	.331		2.17	
*AMERITECH**	.011		.07	
*NYNEX**	−.092		−.47	
*SWBELL**	−.165		−.75	
Regulation				
No regulation	.811		16.71	
REGLOW	.157		2.95	
REGHIGH	−.029		−.53	
Structural variables				
CROSSOWN	10.726		2.53	
MULTIMARKET	9.085		3.06	
LEAD	−.181		−1.30	
AGE	−.561		−2.64	

[a] Second-order conditions are imposed. We do not report the demand and cost parameter estimates, in order to focus on conduct. Both the cost and the demand parameter estimates are essentially unchanged. Elasticities are evaluated at sample mean. RBOCs are indicated by an asterisk.

market characteristics or firm dummies. The first set of results refers to competition among RBOCs and independent companies. We reestimate the model (1a) and (5a) specifying (6) as

$$\theta_{ts} = \begin{cases} 1 & \text{if monopoly period} \\ \gamma_1 BELLBELL + \gamma_2 INDBELL + \gamma_3 BELLIND + \gamma_4 INDIND & \text{if duopoly period,} \end{cases}$$

where *BELLBELL* is one whenever two Bell companies compete, *INDBELL* is one when the wireline is an independent telephone company and the nonwireline is a Bell company. *BELLIND* and *INDIND* are defined accordingly (see above for data information). The dummy variables and their occurrences in our sample are given in Table 2. The estimated conduct parameters are reported in Table 4.[20]

It can be seen in Table 4 that all industry structures are more collusive than Cournot. Thus RBOCs as well as independent firms are part of a collusive outcome. Moreover, for industry structures where at least one firm is a RBOC, no significant difference in θ from the overall industry average reported in Table 3 can be detected. This is not true, however, for the industry structure where both operators are independent, which occurs in about 22% of our markets (see Table 2). In this case, we find a significantly higher θ than the average industry level. Most important, we cannot reject the hypothesis of cartel behavior for independent operators (t-statistic of $-.12$).

The second set of results attempts to identify individual firms' behavior directly. We therefore specify (6) as follows:

$$\theta_{ts} = \begin{cases} 1 & \text{if monopoly period} \\ \sum \gamma_i D_i & \text{if duopoly period,} \end{cases}$$

where the D's are the firm dummies as reported in Table 2. Note that typically two dummies will be on, since by definition we have two operators in each market. Therefore one cannot interpret the γ parameters as the respective θ in the markets concerned. The correct interpretation is that a particular γ_i is operator i's contribution to the industry's θ. The results are reported in Table 4 and show that there is a considerable variance in collusive behavior across operators. In particular, all but one of the independent operators increase the level of collusion significantly. The highest contribution to θ among the independents is found by the *REST* (which is an aggregate dummy of the remaining independent operators). The second-highest contribution is attributed to *GTE,* followed by *CONTEL* and *MCCAW.* The only exception among the independents is *CENTEL,* with no significant contribution in θ. The results on the RBOCs are quite different. Three RBOC operators are not significantly colluding at all: *AMERITECH, SWBELL,* and *NYNEX,* with the last two actually reducing the industry θ. We conclude that in terms of directly identifying operators that are colluding, we again find that many of the independent firms are charging higher prices for their services. This is consistent with the previous findings that there is no evidence the RBOCs are setting higher prices than the independents. We now turn to one possible explanation of this fact.

The next set of results refers to the issue of the impact of the regulatory environment on conduct. As discussed above, the articles by Hausman (1995) and Shew (1994) illustrate that regulation can have a positive effect on prices. To test the impact of regulation on conduct, we specify

$$\theta_{ts} = \begin{cases} 1 & \text{if monopoly period} \\ \gamma_1 + \gamma_2 REGLOW + \gamma_3 REGHIGH & \text{if duopoly period,} \end{cases}$$

where *REGLOW* is a dummy variable defined as "low regulation," where operators were asked to file prices with the public utilities commission on a voluntary basis. *REGHIGH* is equal to one when operators were required to report their prices. Markets

[20] To simplify the exposition and because the results are essentially unchanged, we do not report parameter estimates of the cost and demand equations again.

with low regulation occur in 26% of the cases, whereas 24% of the markets are classified as high-regulation markets (see Table 2). As can be seen in Table 4, low regulation has a statistically significant effect on conduct (t-statistic of 2.95), whereas high regulation has no significant impact. Moreover, low regulation has a positive impact, which implies that regulation tends to increase prices. This is consistent with the findings of Hausman (1995) and Shew (1994). Hausman, in particular, argues that regulation might lead to higher prices by allowing firms to collude. Interestingly, it appears from the results in Table 4 that the ability to voluntarily report prices (rather than mandatory reporting) is a better instrument to facilitate collusion. This might be due to signalling behavior, where the signal carries no value if mandatory. In general, the above evidence suggests that the relationship between regulation and higher prices might be nonlinear, and that regulation per se might not lead to lower prices.

The last set of results refers to explaining conduct in terms of market and ownership characteristics. As discussed in Section 2, we test whether multimarket contact and/or cross-ownership explain collusion and therefore higher prices. As we have argued above, we need to control for other factors that might possibly explain conduct. Here we have chosen to control for (i) long lead times, that is, the time the monopolist has before a second entrant appears, and (ii) given that there is no explicit public rate oversight or approval system, we hypothesize that operators, over time, may learn to recognize the lack of exogenous enforcement mechanisms to prevent collusion. Under such circumstances, industry experience and a lack of regulatory intervention is hypothesized to increase the level of market power over time.

As before, we reestimate the model, allowing (6) to take the form

$$\theta_{ts} = \begin{cases} 1 & \text{if monopoly period} \\ \gamma_1 CROSSOWN + \gamma_2 MULTIMARKET + \gamma_3 LEAD + \gamma_4 AGE & \text{if duopoly period,} \end{cases}$$

where *CROSSOWN* is a dummy variable that indicates whether the two competitors are partners in any other market, *MULTIMARKET* measures the total number of markets where the two competitors face each other, *LEAD* measures the length of the monopoly period (the monopolists' lead time over the second entrant), and *AGE* measures the number of months since the introduction of cellular service in a given market.

Table 4 shows the results from reestimating our model, allowing for θ to depend on these structural variables. It can be seen that we find significant cross-ownership effects (t-statistic of 2.53) in the mobile telephone industry, indicating that if operators co-own an operating license elsewhere, they tend to collude more. Since independent operators have fewer restrictions to co-own other operators than the RBOCs do, this result explains our earlier findings in which RBOCs collude less than independent operators. In other words, one reason that RBOCs collude less is that they co-own less.

We also find empirical support for multimarket effects. Recall that we reject constant returns to scale, which is a sufficient condition for multimarket effects to be theoretically plausible. According to our results in Table 4, multimarket contact significantly increases collusion (t-statistic of 3.06), supporting the model by Bernheim and Whinston (1990). This finding is consistent with the empirical analysis performed by Evans and Kessides (1994) for the airline industry. They find that fares are higher on routes where the competing carriers have interroute contacts.[21]

On the other hand, we do not find any empirical evidence that the incumbent's lead time has any impact on prices after the entry of a second operator. Finally, it appears that

[21] Reportedly, airlines were reluctant to undercut competitors in fear of retaliation. This conduct was referred to as living by the "Golden Rule."

the data are consistent with a downward trend on prices, since *AGE* has a significantly negative impact on prices (t-statistic of -2.64). This indicates that despite a generally high level of collusion in the industry, there is a trend toward a more competitive environment.

6. Conclusions and policy implications

■ In this article we estimate a structural model of competition for the U.S. cellular telephone industry in order to determine the degree of competition and its sources. The unique regulatory environment in this industry allows us to make several important simplifications that make it possible to address and identify issues of collusion and its driving forces in an efficient and consistent way. In particular, we can exclude preemption behavior, and more important, we can use the monopoly period to test the appropriateness of our empirical model.

We find a need for public concern, as the duopolistic industry structure generally appears to be significantly more collusive than a noncooperative duopoly. The evidence suggests that cellular prices are significantly above competitive levels. Although firms offering cellular services can point to the rapid availability of service as the primary result of FCC policies to restrict entry, it appears from our study that certain firms nevertheless obtain higher-than-normal rents, given such an industry structure. We find that it is not the RBOCs but rather the independent operators that realize the highest markups. In fact, in markets where independent operators face each other exclusively—this structure occurs in about 22% of our markets—we find outright cartel pricing. It is also clear from our analysis of the operators' conduct that there is considerable variance in behavior among markets and operators. Regarding regulation, we find evidence that regulation might lead to higher prices but that the relationship between the level of regulation and collusive conduct might be nonlinear. Finally, we investigate the underlying market and organizational structures that might explain competitive behavior further. In this article we have shown that cross-ownership and multimarket contact are important factors in explaining noncompetitive prices.

Our model, while based on the U.S. cellular telephone industry, extends earlier models of market power by explicitly considering factors that contribute to collusive conduct. These have included variables capturing various industry structures. Similar extensions would appear possible for similar situations where governments, in efforts to introduce market economies to traditionally regulated monopolistic markets, opt to determine the level of competition based on the explicit number of competing firms. Such is the case in a number of countries for cellular services, cable television services, air transportation routes, public utilities, and medical services. Should limited-entry schemes be adopted for these industries, they should be accompanied by some form of oversight, especially with respect to cross-market ownership or multimarket contact. Recently, for example, the FCC has been awarding Personal Communications Services (PCS) licenses per local market area, as in the cellular industry. Our study suggests that particular concern should be given to the resulting market and organizational structures, as well as to the impact of two or more entrants per market, in order to ensure competitive pricing.

References

ABREU, D. "Extremal Equilibria of Oligopolistic Supergames." *Journal of Economic Theory*, Vol. 39 (1986), pp. 191–225.

APPELBAUM, E. "The Estimation of the Degree of Oligopoly Power." *Journal of Econometrics*, Vol. 19 (1982), pp. 287–299.

BERNHEIM, B.D. AND WHINSTON, M.D. "Multimarket Contact and Collusive Behavior." *RAND Journal of Economics*, Vol. 21 (1990), pp. 1–26.

BERRESFORD, J.W. "The Impact of Law and Regulation on Technology: The Case History of Cellular Radio." *Business Lawyer*, Vol. 44 (1989), pp. 721–735.

BRANDER, J.A. AND ZHANG, A. "Market Conduct in the Airline Industry: An Empirical Investigation." *RAND Journal of Economics,* Vol. 21 (1990), pp. 567–583.

——— AND ———. "Dynamic Oligopoly Behavior in the Airline Industry." *International Journal of Industrial Organization,* Vol. 11 (1993), pp. 407–436.

BRESNAHAN, T.F. "Empirical Studies in Industries with Market Power." In R. Schmalensee and R.D. Willig, eds., *Handbook of Industrial Organization.* New York: North-Holland, 1989.

———. "Competition and Collusion in the American Automobile Industry: The 1955 Price War." *Journal of Industrial Economics,* Vol. 35 (1987), pp. 457–482.

——— AND REISS, P.C. "Entry in Monopoly Markets." *Review of Economic Studies,* Vol. 57 (1990), pp. 531–553.

——— AND ———. "Entry and Competition in Concentrated Markets." *Journal of Political Economy,* Vol. 99 (1991a), pp. 977–1009.

——— AND ———. "Empirical Models of Discrete Games." *Journal of Econometrics,* Vol. 48 (1991b), pp. 57–81.

BULOW, J., GEANAKOPLOS, J., AND KLEMPERER, P. "Multimarket Oligopoly: Strategic Substitutes and Complements." *Journal of Political Economy,* Vol. 93 (1985), pp. 488–511.

DANNER, C. "The Oligopoly Paradox: Cellular Telephones and a Difficult Regulatory Problem." *Journal of Policy Analysis & Management,* Vol. 10 (1991), pp. 671–675.

EVANS, W.N. AND KESSIDES, I. "Living by the 'Golden Rule': Multimarket Contact in the U.S. Airline Industry." *Quarterly Journal of Economics,* Vol. 109 (1994), pp. 341–366.

FARRELL, J. AND SHAPIRO, C. "Asset Ownership and Market Structure in Oligopoly." *RAND Journal of Economics,* Vol. 21 (1990), pp. 275–292.

FRANKLIN, W.J. "Cellular Antitrust." *Cellular Business,* Vol. 3 (1986), pp. 14–45.

FUDENBERG, D. AND TIROLE, J. *Game Theory.* Cambridge, Mass.: MIT Press, 1991.

GOLLOP, F. AND ROBERTS, M. "Firm Interdependence in Oligopolistic Markets." *Journal of Econometrics,* Vol. 1 (1979), pp. 313–331.

GREEN, E.J. AND PORTER, R.H. "Noncooperative Collusion Under Imperfect Price Information." *Econometrica,* Vol. 52 (1984), pp. 87–100.

HAUSMAN, J.A. "The Cost of Cellular Telephone Regulation." Mimeo, MIT, 1995.

HEGGESTAD, A. AND RHOADES, S. "Multimarket Interdependence and Local Market Competition in Banking." *Review of Economics and Statistics,* Vol. 60 (1978), pp. 523–532.

IWATA, G. "Measurement of Conjectural Variations in Oligopoly." *Econometrica,* Vol. 42 (1974), pp. 949–966.

MALUEG, D.A. "Collusive Behavior and Partial Ownership of Rivals." *International Journal of Industrial Organization,* Vol. 10 (1992), pp. 27–34.

MAYO, J.W. AND OTSUKA, Y. "Demand, Pricing, and Regulation: Evidence from the Cable TV Industry." *RAND Journal of Economics,* Vol. 22 (1991), pp. 396–410.

MESTER, L. "The Effects of Multimarket Contact on Savings and Loan Behavior." Research Paper no. 85-13, Federal Reserve Bank of Philadelphia, 1985.

MUELLER, D.C. "The Effects of Conglomerate Mergers: A Survey of the Empirical Evidence." *Journal of Banking and Finance,* Vol. 1 (1977), pp. 315–347.

PORTER, R.H. "A Study of Cartel Stability: The Joint Executive Committee, 1880–1886." *Bell Journal of Economics,* Vol. 14 (1983), pp. 301–314.

REYNOLDS, R. AND SNAPP, B. "The Competitive Effects of Partial Equity Interests and Joint Ventures." *International Journal of Industrial Organization,* Vol. 4 (1986), pp. 141–153.

RHOADES, S.A. AND HEGGESTAD, A. "Multimarket Interdependence and Performance in Banking: Two Tests." *Antitrust Bulletin,* Vol. 30 (1985), pp. 975–995.

ROTEMBERG, J.J. AND SALONER, G. "A Supergame Theoretic Model of Price Wars During Booms." *American Economic Review,* Vol. 76 (1986), pp. 390–407.

RUBINOVITZ, R.N. "Market Power and Price Increases for Basic Cable Service since Deregulation." *RAND Journal of Economics,* Vol. 24 (1993), pp. 1–18.

RUIZ, L.K. "Pricing Strategies and Regulatory Effects in the United States Cellular Telecommunications Duopolies." Ph.D. dissertation, Boston University, 1994.

SCOTT, J.T. "Multimarket Contact and Economic Performance." *Review of Economics and Statistics,* Vol. 64 (1982), pp. 368–375.

SHEW, W.B. "Regulation, Competition, and Prices in the U.S. Cellular Telephone Industry." Working Paper, American Enterprise Institute, 1994.

SLADE, M.E. "Conjectures, Firm Characteristics, and Market Structure: An Empirical Assessment." *International Journal of Industrial Organization,* Vol. 4 (1986), pp. 347–370.

———. "Interfirm Rivalry in a Repeated Game: An Empirical Test of Tacit Collusion." *Journal of Industrial Economics,* Vol. 35 (1987), pp. 499–516.

———. "Vancouver's Gasoline-Price Wars: An Empirical Exercise in Uncovering Supergame Strategies." *Review of Economic Studies,* Vol. 59 (1992), pp. 257–276.

MULTIMARKET CONTACT AND PRICE COORDINATION IN THE CELLULAR TELEPHONE INDUSTRY

MEGHAN R. BUSSE

Yale School of Management
New Haven, CT 06520-8200
meghan.busse@yale.edu

Empirical studies have confirmed the prediction of theoretical models that contact in multiple markets may enhance firms' abilities to tacitly collude and consequently achieve higher prices and profits. It has remained largely unexplored, however, how firms coordinate their actions. This paper identifies a method of pricing in the cellular telephone industry that seems to enable firms to coordinate their actions across markets. This pricing pattern is found to raise prices by approximately 7–10%, and cannot be attributed to a variety of noncooperative explanations.

1. INTRODUCTION

Between the clear predictions microeconomic theory makes for perfectly competitive and monopoly pricing lies the gray area of oligopoly pricing. Given the variety of objectives oligopolists may pursue, instruments they may use, and contexts in which they meet, F. M. Scherer noted, "Casual observation suggests that anything can happen" (Scherer, 1980, p. 151). This is particularly true of theories of tacit collusion. The large number of possible equilibria—what Jean Tirole called "an embarrassment of riches"—is the particular bane of empirical attempts to identify tacit collusion (Tirole, 1988, p. 247). The absence of a clear theoretical prediction of how oligopolists will coordinate makes it difficult to distinguish *ex ante* a behavior used to facilitate tacit collusion from the same behavior employed innocuously.[1] Empirical economists are often left with the back-door approach of inferring

This paper has benefited from helpful contributions from Susan Athey, Glenn Ellison, David Genesove, Mary Hallward-Driemeier, Jerry Hausman, Kip King, Bhanu Narasimhan, seminar participants at MIT, and two anonymous referees. Particular thanks go to Nancy Rose and Florian Zettelmeyer. I am grateful to Phil Parker, who provided me with the data for this paper. Any errors are my own.

1. An extended discussion of these issues is contained in Fisher (1989).

Journal of Economics & Management Strategy, Volume 9, Number 3, Fall 2000, 287–320

tacit collusion from the observation of higher prices, leaving unspecified the mechanism used to accomplish the coordination. The aim of this paper is to identify tacit collusion in the cellular telephone industry through a front-door approach by considering an observed pricing pattern as a mechanism to achieve tacit collusion.

Economists and antitrust authorities have identified *consciously parallel* pricing practices as one means of coordinating noncompetitive behavior without explicit agreement. The specific form that such coordination takes often appears to be an outgrowth of the prevailing business practices of an industry. An example is price leadership, in which firms closely match the price changes of a designated leader, as has been alleged in the airline industry, where computer reservation systems make observation and response to price changes easy. Another example is the adoption of common pricing formulas, such as those used by GE and Westinghouse in the 1960s to generate identical bids for turbogenerators. A well-known type of price formula is basing-point pricing, whereby geographically dispersed firms offer identical delivered prices to each customer by calculating transportation costs from the same basing point. (See Scherer 1980.) This paper will refer to pricing schemes in which different firms set the same price within a market as *price matching*.

This paper hypothesizes that firms in the cellular telephone industry in the mid-1980s used a different sort of parallel pricing practice as a signal or a focal point to enable them to coordinate their actions. During this period, cellular telephone carriers are observed to set the same prices in multiple markets that they serve, particularly where they compete with the same competitor across multiple markets. In the context of this paper, this pricing pattern (the same firm setting the same price in different markets) will be referred to as *identical pricing across markets* or *identical pricing*. This should not be confused with the more familiar practice of price matching described above. While the extension of identical prices into multiple markets is not a previously documented means of coordination, it grows out of the structure and business practice of the industry.

As has been argued by firms accused in antitrust cases of consciously parallel practices, behaviors that seem to enable tacit collusion can also have benign, noncoordinated motivations. Therefore, the analysis in this paper of identical pricing across markets as a coordination mechanism begins with the consideration of noncooperative explanations. Parsimonious noncooperative models are found to be insufficient to explain this phenomenon. Moreover, using identical prices across markets is associated with higher prices, which is presumably the goal of tacit collusion. This evidence of tacit collusion is reinforced by the inability of several alternative hypotheses to explain

the incidence of higher prices. Since *tacit* collusion leaves no "smoking gun"—or, more aptly, "smoke-filled room"—to prove that the motivation for the behavior is collusive, this result should be taken as suggestive; it provides empirical evidence of a mechanism by which firms can use contact across multiple markets to tacitly coordinate their activities.

This paper is related to the literature on multimarket contact, much of which evaluates the effect of multimarket contact by examining the price level or profitability in a market as a function of the number of other markets in which the firms in that market also compete. This paper expands on this approach. First, it considers firms' strategic instruments to be their price schedules, not just their average prices. Second, it examines a firm's behavior across markets in which it has contact with a single competitor, and contrasts that with the firm's behavior across markets in which it meets different competitors. This expands on the standard approach which considers the outcome in each market in isolation as a function of the contact that firms in that market have outside the market. The approach used in this paper makes it possible to observe mechanisms through which firms can coordinate *across* markets. The resulting insights into pricing in the cellular telephone industry may suggest research directions for understanding pricing in other oligopolistic markets as well.

The paper proceeds as follows. Section 2 describes the background and structure of the cellular industry. Section 3 describes theoretical and empirical research on multimarket contact and tacit collusion. Section 4 describes pricing in the cellular telephone industry, and both collusive and noncollusive explanations for identical pricing across markets. Section 5 begins the empirical analysis by considering whether identical pricing is associated with multimarket contact or noncollusive explanations. Section 6 tests whether identical pricing raises prices, as would be expected if the motivation is collusive. Section 7 tests the robustness of the empirical results in Section 6. Section 8 examines an alternate form of parallel pricing. Section 9 summarizes and concludes the paper.

2. The Cellular Telephone Industry

2.1 Industry Background

Before the mid-1980s, the chief obstacle to widely available mobile communication was the problem of how to carry a large number of transmissions using a limited amount of scarce radio spectrum. Cellular telephony provides a two-pronged solution. First, service areas are divided into many small *cells*, each served by its own low-power

transmitter. This makes it possible for a frequency in use in one cell to be reused to carry a different call in a nonadjacent cell, thus multiplying the number of individual communications that can be carried by a limited amount of spectrum. The second prong of the solution is the mobile telephone switching office (MTSO), which maintains a continuous transmission when a caller moves into a cell that uses different frequencies by handing off calls to an available frequency in the adjacent cell.

Once cellular technology was viable, the FCC moved to make it commercially available by allocating 40 MHz of spectrum to cellular usage and, in 1982, beginning the process of licensing carriers to provide service. In doing so, the FCC designed an industry structure that was explicitly intended to foster competition (Kellogg et al., 1992, pp. 650–651). This was possible because, unlike the provision of local wireline service, cellular service provision is not a natural monopoly. Most of the costs of operating a cellular network are represented in the construction of transmitters within the cells and switching offices to transfer traffic among them. While these costs are fixed costs in the sense of being sunk and invariant to a small increment of additional usage, the number of cells (and associated towers and MTSOs) is ultimately proportional to the number of subscribers a carrier serves, because a cell and its associated bandwidth can handle only a certain number of calls. As a result, serving a given number of customers in a particular area could be accomplished at approximately the same total cost either by one carrier serving all the customers with some number of cells or two carriers each serving half the customers with cells that are half as numerous and twice as big as the single carrier's cells.

The FCC's design for fostering competition was to grant two licenses in each cellular market, which were defined according to standard metropolitan areas (SMAs). Within each market, one license was reserved for a local wireline carrier and the other was granted to a carrier not currently serving the local telephone market. Most of the wireline licenses went to the newly created Bell operating companies (BOCs). For example, Nynex holds several licences in Massachusetts, Pactel holds licenses in southern California, and Ameritech holds licenses in southwestern Ohio. (See Fig. 1 for a map of wireline license allocation.) The nonwireline licenses generally were granted either to a wireline service provider from another area of the country, or to a company specializing in providing cellular service.[2] For example,

2. The market structure established by the FCC allowed additional firms to enter by buying wholesale blocks of time from the license holders and then reselling it to consumers. In 1984–1988, the period covered by this study, resellers played only a minor role in the industry.

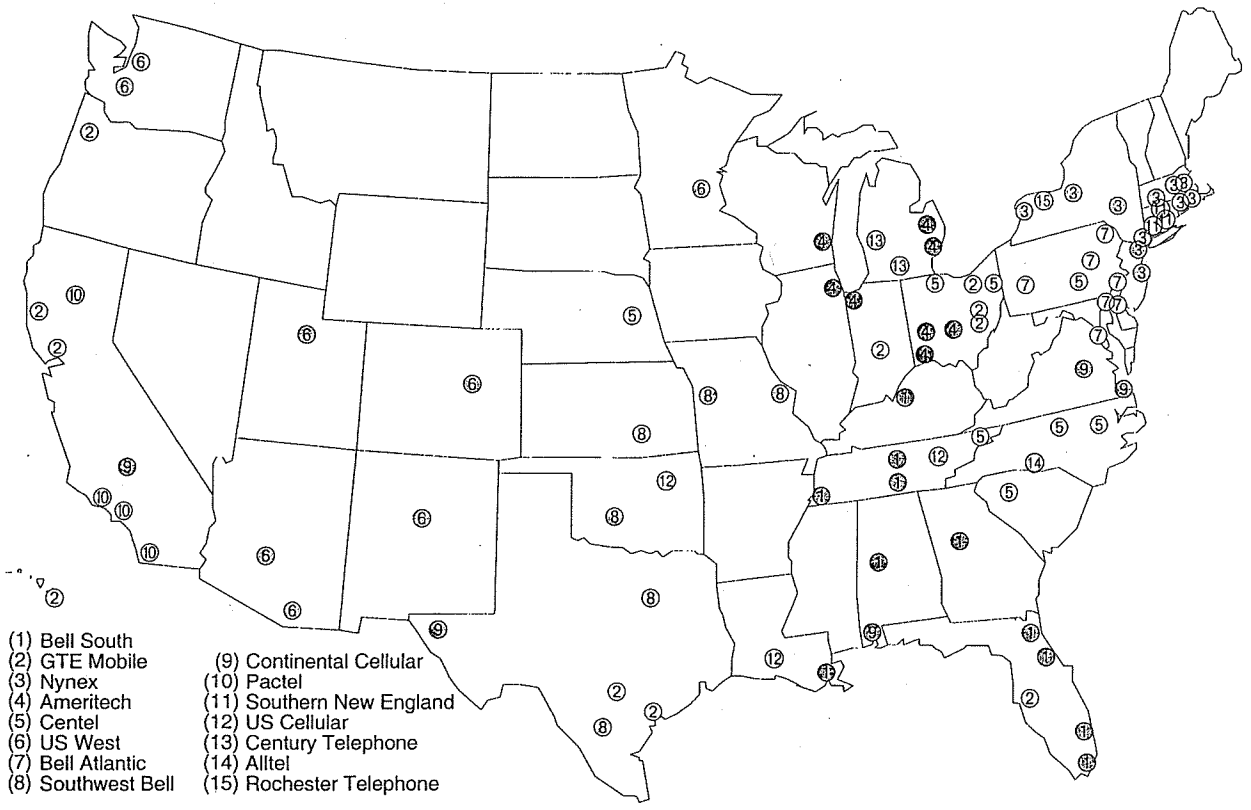

FIGURE 1. WIRELINE CARRIERS

Pactel holds licenses in Michigan, Cellular Communications holds licenses in Ohio, and MetroMobile holds licenses in southern New England. (See Fig. 2 for a map of nonwireline license allocation.) In order to be awarded licenses, carriers were required to submit detailed applications, and the licenses were granted based on the FCC's review of the applications.

Since the FCC anticipated that competition between the two carriers in each market would prevent the exercise of market power, explicit price regulation was not considered necessary. In the early phase of the industry, most states did not impose any regulation; in some cases there was a requirement to file tariffs as a matter of information, but not as the basis for regulatory review (Anon., 1992, pp. 28–29).

This study is based on data from the 90 largest cellular markets, which correspond to the first three sets of licenses awarded by the FCC, during the period from December 1984 to July 1988. Not all the markets were operational at the beginning of the sample period, but service was offered in almost all by the end of the sample period. The data contain information on the markets, the carriers, and detailed price data submitted by the carriers. A complete data appendix is included at the end of the paper.

2.2 Market Contact in the Cellular Telephone Industry

There are three reasons that the cellular telephone industry is an interesting arena in which to examine issues of multimarket contact and tacit collusion. First, the FCC's design of the industry as distinct markets served by duopolists leads to a simple and intuitive way to identify multimarket contact. Second, the multidimensional pricing structure allows firms a broad scope for coordination via price signaling. Third, since the FCC's design of the market structure was predicated on the assumption that two carriers in each market would be enough to produce competitive pricing, it is of interest to examine whether that assumption was borne out in the subsequent operation of the market. The remainder of this section discusses identification of multimarket contact.

Defining "market contact" usually involves problems of market definition, and also requires a judgment about what qualifies as meaningful contact. In the cellular telephone industry, the FCC's license allocation process created an industry structure that avoids most of these complications. Licensing carriers to serve particular SMAs means that markets are clearly defined, especially in the early period of the industry which is considered here, when markets were

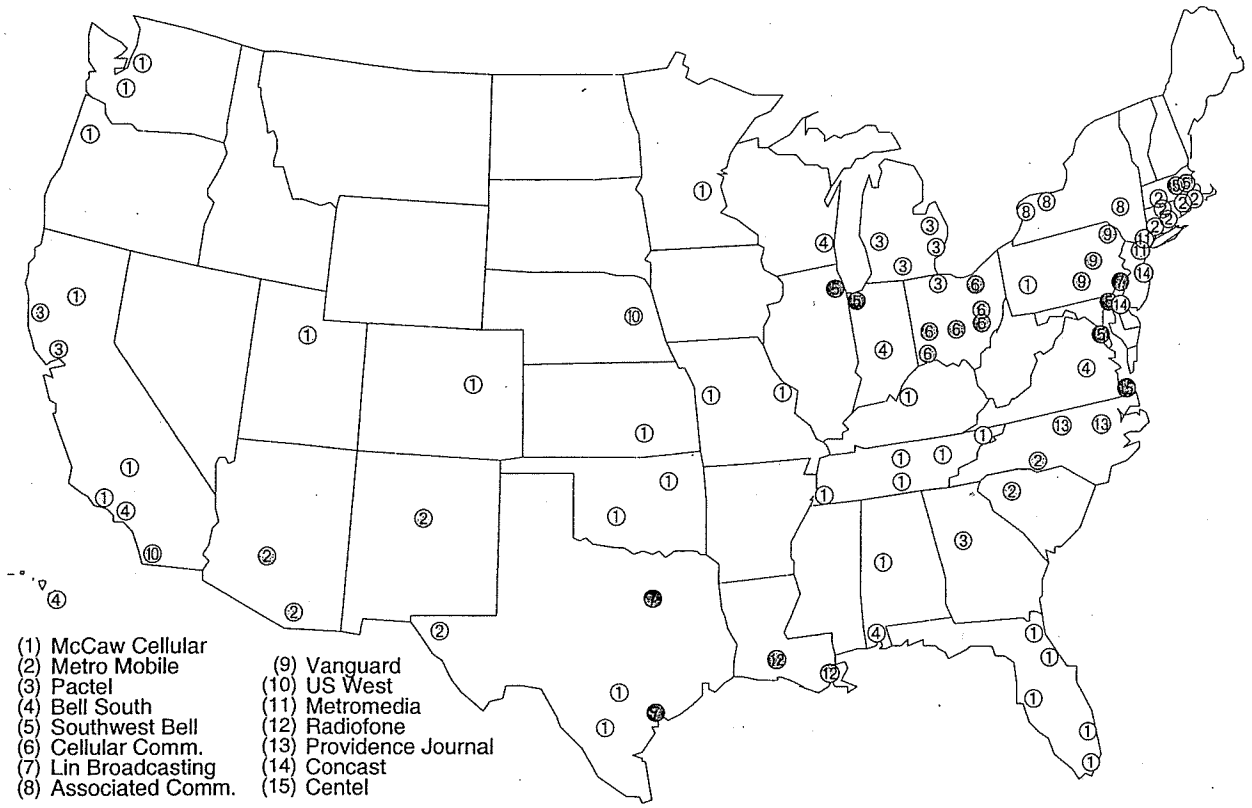

FIGURE 2. NONWIRELINE CARRIERS

geographically noncontiguous because licenses had been granted only for large metropolitan areas. In addition, it is clear who a firm's competitor is in each market, since it faces exactly one, roughly equivalent competitor in each market that it serves.[3] A collection of single-product, geographically distinct duopolies is the simplest structure for which to define multimarket contact, and suggests the following straightforward definition: two firms are considered to have contact in a market if they both hold licenses to serve that market, and to have multimarket contact if there is more than one market in which they have contact. (See Fig. 3 for markets in which carriers have multimarket contact.)

There are two minor difficulties in identifying multimarket contact in the cellular telephone industry, which have to do with how a firm is identified. The first is that in some markets licenses were awarded to joint ventures comprising several telecommunications companies. In all cases, the largest shareholder in the venture has at least a 50% share, and for the purposes of this paper, a carrier is identified as the largest shareholder in the venture that holds the license.

The second issue is that in some cases service is marketed under a brand name that is different from that of the underlying provider. This appears to happen in two situations. The first is when a joint venture chooses to use a different name from that of any of its members. For example, L.A. Cellular is the nonwireline license in Los Angeles, owned 60% by Bell South, 35% by Lin Broadcasting, and 5% by McCaw Cellular. The second situation is when a carrier, primarily a nonwireline license held by a nonlocal BOC, chooses to adopt a nationally recognized brand, such as Cellular One, rather than using its own name. For the purposes of this study, a carrier is identified as the underlying operator, not as the name under which service is marketed.

3. MULTIMARKET CONTACT

The best-known theoretical characterization of multimarket contact is that of Bernheim and Whinston (1990). The intuition for their primary finding is that when firms compete in multiple markets, their ability to punish deviation from tacit collusion is enhanced. As a result

3. The competitors can be considered equivalent in the sense that both were new entrants into cellular service at the same time. While the wireline licensee usually began service several months before the nonwireline, this does not appear to have established insuperable first-mover advantages. The BOCs were required to offer equal access to both cellular providers, regardless of affiliation with the BOC. This point is contended by Reiffen et al. (1996), who argue that in practice affiliated carriers nevertheless received preferential treatment.

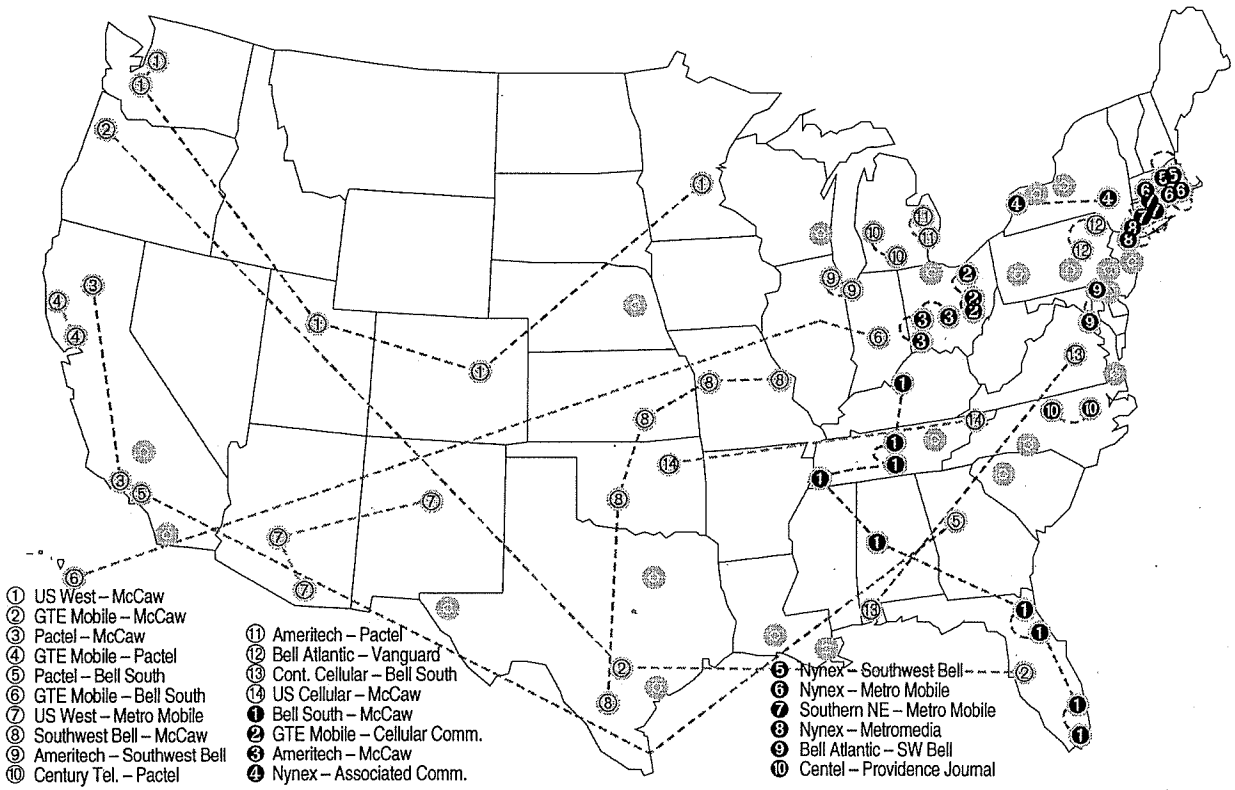

FIGURE 3. MULTIMARKET CONTACT

of this increased ability to punish deviation, tacit collusion may be sustainable in markets where it would not be if firms did not have multimarket contact.

In keeping with this reasoning, the empirical literature has focused on examining how price levels or profitability are affected by the extent of firms' multimarket contact, usually measured as the number of markets in which firms compete. Examples include Evans and Kessides's (1994) and Singal's (1993) examinations of the airline industry, and Rhoades and Heggestad's (1985) study of the banking industry. This approach has also been taken by Hughes and Oughton (1993) and Scott (1982) in the context of conglomerate firms that compete in multiple product markets. An alternative approach to examining how price levels or profitability are affected by multimarket contact is to relate collusion or rivalry directly to multimarket contact. Examples include Parker and Röller's (1997) study of the cellular telephone industry, and Heggestad and Rhoades's (1978) study of the banking industry. Most of these studies have found that multimarket contact increases prices and profitability, and decreases competition.

The emphasis of Bernheim and Whinston's model and of the empirical work related to it is that sustainable prices and profits are higher when firms have multimarket contact. These papers do not consider how firms might communicate or coordinate in order to achieve such an equilibrium. The emphasis of the theoretical model is on the existence of such an equilibrium, and the emphasis of the empirical work is on the achievement of prices or profits suggestive of such an equilibrium. Anecdotal evidence suggests, however, that oligopolists who wish to move to a tacitly collusive equilibrium do so by finding a way to communicate their intentions and coordinate their actions. Examples include price leadership, basing-point or other pricing formulas, and pronouncements of trade organizations. Some of these practices have also received more formal treatment in the industrial organization literature, including Rotemberg and Saloner (1990) and Gilligan (1992).

This paper differs from previous work by suggesting that multimarket contact facilitates tacit collusion not only by enhancing the ability to punish, but by increasing firms' scope for price signaling and coordination. Since tacit collusion cannot, by definition, rest on explicit agreement, it must rely on indirect patterns in pricing or other instruments that will be recognized or understood by competitors to signal a willingness to deviate from competition as usual. When firms have contact in multiple markets, it increases the scope of signals they can send to each other, and thus increases their ability to use consciously parallel patterns that can help coordinate tacit collusion. The emphasis of this paper is to find not only supracompetitive prices or

Plan	Monthly fee	Minutes included free	Per minute price
"Budget"	$ 10	0	$ 0.75
"Regular"	$ 25	30	$ 0.30
"High Use"	$ 100	100	$ 0.15

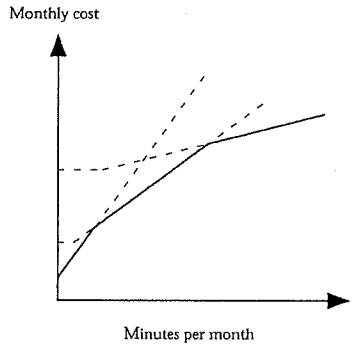

FIGURE 4. HYPOTHETICAL CELLULAR PRICING EXAMPLE

profits, but a mechanism firms use to achieve them. In particular, this paper hypothesizes that multimarket contact in the cellular telephone industry makes possible such signaling or coordination. As described below, firms can be seen to set distinctive prices in markets in which they have multimarket contact, and when they do so, prices are higher in ways that are not attributable to other market characteristics.

4. Cellular Telephone Pricing

Generally, cellular telephone carriers do not offer simple linear prices. The typical cellular provider offers its customers a choice among three or four different plans, each of which usually includes a fixed monthly fee, a price per minute of usage, and sometimes free minutes. Assuming that a customer chooses the plan that minimizes costs for his or her expected level of usage, the effective price schedule a customer faces is the lower envelope of a menu of two-part tariffs offered by the carrier. An example is given in Figure 4.

Each cellular carrier sets its own, unregulated schedule of prices, which it is free to change over time. Carriers usually offer different prices in different markets. For example, at a given point in time a typical carrier serves five markets and offers four unique price schedules.[4] The exceptions—markets in which the carrier sets identical prices—are often markets in which there is multimarket contact, i.e., where the same carriers serve both markets. Furthermore, in such cases, it is often true that *both* carriers use identical prices across markets.

4. This characterization of the typical firm is based on a calculation of the number of different schedules a carrier offers at a particular point in time across all the markets it serves, divided by the number of markets the carrier serves at that point in time. The median of this statistic is 0.83, the mean is 0.78. The average numbers of unique prices and markets served are approximately 4 and 5.

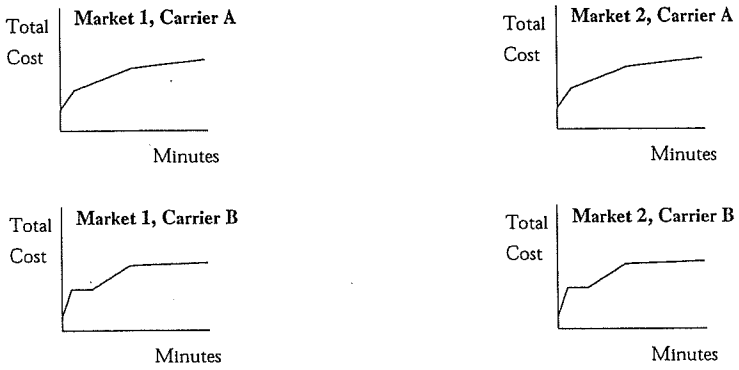

FIGURE 5. ILLUSTRATION OF IDENTICAL PRICING

Figure 5 illustrates a hypothetical example. Consider two markets, market 1 and market 2, that are both served by the same two carriers, A and B. Each carrier offers a menu of two-part tariffs in each of the markets, which defines the carriers' effective price schedules. In the data, there are a number of cases in which the price schedules set by carrier A in market 1 and in market 2 are identical point by point over the range of usage levels between 1 and 1000 minutes per month. Frequently in such cases, carrier B also offers a price schedule in market 1 that is identical to the schedule it offers in market 2, although its price schedule differs from carrier A's.

This paper hypothesizes that this practice is a method for facilitating tacit collusion. Thomas Schelling suggested that players are likely to use a mechanism of this sort to coordinate their actions if they are unable to communicate directly (or are legally forbidden to do so).

> People *can* often concert their intentions or expectations with others if each knows that the other is trying to do the same. Most situations... provide some clue for coordinating behavior, some focal point.... Finding the key, or rather finding *a* key... may depend on imagination more than on logic; it may depend on analogy, precedent, accidental arrangement, symmetry, aesthetic or geometric configuration, casuistic reasoning, and who the parties are and what they know about each other. (Schelling, 1960, p. 67)

Of course, there are alternative, noncollusive hypotheses that could explain why a firm sets the same price schedules across different markets. For example, as Figure 3 shows, the markets in which firms have multimarket contact are often geographically close to each

other. If markets that are geographically close have similar demand characteristics, then firms may set the same price schedules in those markets because of the similarity of demand, not because they are trying to coordinate.

Another possible reason for using a single price schedule in multiple markets is that it reduces menu costs associated with pricing. For example, it may be that setting the same prices in two markets enables a firm to produce only one set of marketing materials (brochures, leaflets, contracts). Alternatively, the firm may save the cost of conducting specialized market research in each market it serves by using the same schedule in multiple markets. Finally, if advertising media—radio, television, or newspapers—spill over between markets, then advertising a price in one city may also advertise it in another, which means that if the firm sets the same prices in both markets, it can reduce its advertising costs.

Identifying the role played by tacit collusion in the presence of these alternative explanations for identical pricing across markets is a potential difficulty, since the two explanations are not mutually exclusive. In recognition of these difficulties, the empirical strategy proceeds in three steps. First, Section 5 examines whether identical pricing across markets depends on multimarket contact or whether it can be explained by other, unrelated reasons. The second step, in Section 6, examines whether identical pricing across markets actually raises price, which should be the case if the motivation for identical pricing is tacit collusion, but not if only noncooperative explanations hold. The second step is important because even if identical pricing does depend on multimarket contact, tacit collusion need not be the motivation.[5] In a final step, Section 7 verifies that the empirical finding of higher prices in the markets in which there is identical pricing across markets is the result of coordination and not some other characteristic of the market.

5. Identical Pricing and Multimarket Contact

This section begins the empirical investigation of the primary hypothesis of this paper, namely that identical pricing across markets is a mechanism whereby firms with multimarket contact can coordinate

5. For example, suppose that a firm would like to set the same prices in several markets in order to reduce menu costs. If the firm has different competitors in those markets who have very different price schedules, using the same prices across the markets may be very far from a best response in at least one of the markets. As a result, the firm may set identical prices in two markets only when it meets the same competitors (who are also using identical prices), although its motivation for doing so would be purely noncooperative.

their efforts to tacitly collude. There are, in the time period covered by this study, multiple occasions in which the same effective price prevails in two markets at once. What remains to be tested is whether there is evidence that this is a tool for facilitating tacit collusion.

If the reason that the same effective price schedule is observed in multiple markets is that firms are using identical pricing across markets as a tool for tacit collusion, then one would expect those to be markets across which there is multimarket contact. Furthermore, one would expect to see multimarket contact continue to have explanatory power even when allowing for some alternative explanations for observing the same prices in multiple markets. Two alternative explanations, demand similarity and menu costs of pricing, were introduced in the previous section and are tested here.

In order to test these explanations empirically, I use a probit regression based on carriers in pairs of markets drawn from the 90 largest SMAs in the US. I have complete information for 81 of these markets, and they are the basis for the empirical analysis of Sections 5 through 8. For all possible pairs of markets, I calculate the prevailing effective price schedule at 6-month intervals for both the wireline carrier and the nonwireline carrier in each market. I can thus identify any pair of markets in which the same effective price schedule prevails in both markets at a single point in time.

The regression is performed as follows. There is one observation for each unique market pair. The 81 individual markets yield 3240 pairs of markets. The dependent variable equals one if the same effective price schedule is observed in the two markets in the market pair at some point during the sample period. If the same effective price schedules are never simultaneously available in the two markets in the pair, the dependent variable is equal to 0.

To test whether the same prices being available in different markets is associated with multimarket contact, and thus possibly with tacit collusion, one of the explanatory variables is an indicator variable for multimarket contact. Consider an observation of markets m_1 and m_2. Each market is served by two carriers, a wireline carrier (w) and a nonwireline carrier (n). Suppose that market m_1 is served by carriers w_1 and n_1, market m_2 by carriers w_2 and n_2. If $w_1 = w_2$ and $n_1 = n_2$, then the multimarket contact dummy variable equals 1; otherwise it is 0.[6]

To test the alternative explanation that carriers use identical prices in markets that have similar demand, I control directly for the similarity across the markets of characteristics that are correlated with

6. The multimarket contact indicator variable is also set equal to 1 in the sole case in which $w_1 = n_2$ and $n_1 = w_2$.

demand for cellular telephone service: population, the growth rate of population, median income, average commuting time, and number of business establishments. Similarity is measured as the percentage absolute difference in the characteristics across the markets. (If x_i is a demand-related characteristic of market i, then the percentage absolute difference between markets 1 and 2 is given by $|x_1 - x_2|/[\frac{1}{2}(x_2 + x_2)]$. The smaller the difference is, the more similar the markets are.

It is difficult to account directly for menu costs. However, the suggested ways in which identical pricing might reduce menu costs (e.g., through advertising spillovers) apply to markets that are geographically close. Measures of geographic proximity are included as indicator variables for whether the markets are less than 100, between 100 and 200, or between 200 and 400 miles apart. Indicator variables are used instead of using the distance directly so as not to constrain it to have a linear effect.

The probit regression also includes indicator variables identifying the carriers operating in the markets in each observation to capture any idiosyncratic tendencies of firms to price identically across the markets they serve. The regression results are presented in Table I. In each entry in the table, the probit coefficient is reported first, followed by the standard error in parentheses.

While the results in Table I do not on their own establish that identical pricing is a means to facilitate tacit collusion. However, they do show that the same prices are more likely to be offered in two different markets in which there is multimarket contact than when there is not. This is the case even when allowing for demand similarities and the proximity of the markets to play a role. In particular, the coefficient estimate on the multimarket contact indicator variable is positive and significant in all three specifications reported in Table I.

The coefficients on the demand characteristic differences are generally negative, which implies that the greater the differences in these characteristics across markets, the less likely it is for the same prices to be offered in the two markets; the results, however, are not statistically significant in most cases. The one demand characteristic that is statistically significant at the 5% level, population growth, is of opposite signs in columns II and III. It is thus difficult to draw any consistent conclusions about the role of demand similarity in determining the similarity of prices across markets.

As is also shown in Table I, the same effective price schedule is more likely to be offered in two markets if they are geographically closer. The menu-costs explanation for identical pricing applies primarily to markets that are geographically close to each other. In addition, since demand characteristics are likely to be similar in adjacent areas, the proximity of markets helps to control for similarity in any unobserved demand characteristics.

TABLE I.
PROBIT RESULTS[a]

	I	II	III
Multimarket contact (same carriers serve both markets)	1.832 (0.167)	1.461 (0.226)	0.683 (0.287)
Percentage absolute difference between markets in:			
Population		−0.298 (0.358)	−0.624 (0.474)
Population growth		−0.208 (0.101)	0.284 (0.132)
Income		−0.781 (0.725)	−0.789 (0.953)
Commuting time		−1.224 (0.829)	−1.162 (1.172)
Businesses		0.562 (0.356)	0.755 (0.469)
Distance between markets < 100 miles			3.028 (0.321)
Distance between markets is 100–200 miles			1.232 (0.319)
Distance between markets is 200–400 miles			0.788 (0.277)
Firm dummies	Yes	Yes	Yes
Number of observations	3240	3240	3240
Pseudo R^2	0.184	0.368	0.595

[a]Observations are of market pairs. Dependent variable is 1 if same effective price schedule is available simultaneously in both markets in the pair. Table reports probit coefficients with standard errors in parentheses.

The results of this section suggest that identical pricing across markets is associated with multimarket contact. While there is some evidence that demand similarities and particularly the proximity of the markets also increase the likelihood of observing the same effective price schedule in different markets, this is not necessarily inconsistent with identical pricing across markets aiding in facilitating tacit collusion. Even if the primary motivation is signaling, identical pricing across markets is a signal that is less costly to use in cases where the markets are more similar.

6. IDENTICAL PRICING AND AVERAGE PRICES

The section continues the empirical investigation of whether the reason the same effective price schedule is observed in multiple markets

is that firms are choosing to set identical prices across markets as a means to tacitly collude. The association found in the previous section of multimarket contact with the likelihood of observing the same effective price schedule in multiple markets is consistent with this explanation. Furthermore, the empirical results of Section 5 fail to find strong evidence to support alternative explanations; however, the market demographics and proximity measures used to test these alternative hypotheses are likely imperfect. As a result, this section seeks further evidence that carriers in this industry use identical prices across markets as a way to coordinate tacit collusion by examining the effect identical pricing has on average prices. If identical pricing is a means to facilitate tacit collusion, it should raise average prices.

To determine the effect of identical pricing across markets on price levels, I regress average price on demand characteristics, firm and time effects, and dummies for the use of identical pricing. The study uses data on the same 81 markets used in the probit regressions of Section 5, although in a slightly different configuration. Since Section 5 was concerned with the conditions under which the same effective price schedule would be observed in multiple markets, the unit of observation was a pair of markets drawn from the sample of 81 markets. The regressions of this section are concerned with prices charged in individual markets; therefore each observation is based on a single market. Each observation can be defined by the triple (m, j, t), where m denotes the market, j denotes the carrier, and t denotes the date. There are up to 8 observations of each carrier in each market, taken at 6-month intervals. Since not all markets are in operation at the beginning of the sample period, the sample contains 584 out of a maximum possible of 1296 observations.

The dependent variable is the average price charged by a carrier in a market at a point in time, which is calculated in terms of average cents per minute. Let $T(i)$ be the total cost for usage of i minutes per month using the effective price schedule (the lower envelope of the two-part tariffs). Using $T(i)$, the average number of cents per minute for each usage level can be calculated, and then averaged over usage levels from 1 to 1000 minutes per month. The final measure can be written as[7]

$$\text{average price} = \frac{1}{1000} \sum_{i=1}^{1000} \frac{T(i)}{i} \text{ cents/min.}$$

7. This measure of average price is the average price of a minute under a particular effective price schedule, but does not necessarily measure the average price paid in the market, unless customers' usage levels are uniformly distributed between 1 and 1000 minutes per month. Results using alternative measures of price are reported in later regressions.

TABLE II.
VARIABLES IN PRICE LEVEL REGRESSIONS

Variable	Mean	Standard deviation
Population (millions)	2.0	2.5
Population growth (annual percentage)	0.9	1.0
Median income (thousands of dollars)	28.7	3.8
Average commute time (min)	25.9	3.3
Number of businesses (thousands)	43.5	60.3
Average price (cents/min)	46.5	10.2
100-min usage	57.1	14.0
300-min usage	41.6	8.3
500-min usage	37.1	7.8
1000-min usage	34.0	7.7
Carrier using identical prices (1-0)	0.27	0.44
Both firms using identical prices (1-0)	0.16	0.37

The explanatory variables of interest are indicator variables for whether the market is part of a pair in which there is identical pricing by the firm under consideration, or by both firms. Additional controls for the average level of prices are the demand characteristics of the market, a firm dummy for the carrier, and time effects. Summary statistics for the variables in the regression are given in Table II.

The results of the regressions are reported in Table III. The regressions in Table III are estimated using ordinary least squares. The standard errors are corrected for heteroskedasticity, and are also corrected to allow for the correlation of errors over time within a firm in a particular market. In column I, average prices are estimated to be higher by 3.20 cents/min, or 6.9%, for a carrier that is using identical prices across markets. This coefficient is statistically different from zero at the 5% confidence level. Column II adds an additional explanatory variable, an indicator for both firms pricing identically. In this specification, a carrier's average price is estimated to rise by 3.97 cents/min, or 8.5%, when it uses identical prices across markets; there is no statistically significant additional effect of having both firms use identical prices across markets.

The positive coefficient estimated for "Carrier using identical prices" is supportive of the hypothesis that identical pricing across markets is a mechanism to facilitate tacit collusion. It indicates that average prices are higher, controlling for market and firm characteristics, when carriers offer the same prices in multiple markets. Under the tacit-collusion hypothesis, the variable "Both carriers using identical prices" might also have been expected to have a positive coefficient. This variable captures any incremental increase in the carrier's price

TABLE III.
RESULTS OF AVERAGE-PRICE-LEVEL REGRESSIONS[a]

	I	II	III
Carrier using identical prices	3.20 (1.19)	3.97 (1.47)	
Both firms using identical prices		−1.41 (1.70)	
Population	−0.10 (0.58)	−0.13 (0.58)	−0.12 (0.61)
Population growth	1.83 (0.64)	1.77 (0.64)	1.55 (0.64)
Income	−0.16 (0.23)	−0.15 (0.24)	−0.13 (0.24)
Commuting time	0.97 (0.29)	0.95 (0.29)	0.94 (0.29)
Number of businesses	0.03 (0.02)	0.03 (0.02)	0.03 (0.02)
Constant	20.34 (11.27)	20.84 (11.22)	21.90 (11.38)
Firm effects	Yes	Yes	Yes
Time effects	Yes	Yes	Yes
No. of observations	584	584	584
R^2	0.40	0.40	0.38

[a]Observations are market-carrier-dates. Dependent variable is average price in cents per minute. OLS estimates. Standard errors in parentheses. Standard errors are adjusted for correlation between observations of the same firm in a particular market.

level when its competitor joins it in using identical prices across markets. If the prices set by the carrier when it alone uses identical prices across markets already reflect the tacitly collusive price level it hopes to maintain once its competitor responded, then there may not be much incremental increase in the carrier's price level when the competitor responds with identical prices. This would explain why the estimated coefficient is statistically insignificant.

Two of the five demand characteristics are statistically significant, namely population growth and average commuting time. The implication of the coefficient estimates is that an increase in the population growth rate by one percentage point increases the average price by almost 2 cents/min, and an increase of one minute in the average commuting time raises the price by about one cent. Most of these

demand characteristics would be expected to raise demand and price; population growth, however, could have either a positive effect, if population growth is an indicator for economic growth, or a negative effect, if carriers price for market share. The importance of commuting time reflects the fact that over the period covered by these data, cellular phones were primarily a car accessory, among whose primary attractions was making commuting time productive. Thus longer commutes could be expected to raise the demand for and price of cellular service.

These results indicate that, controlling for the characteristics of the market and for the identity of the carrier, identical pricing across markets appears to raise average prices. Higher prices would not be expected if the motivation for identical pricing were one of the noncooperative motivations described in Section 4. When combined with the fact that identical pricing appears to be used most frequently when carriers meet in multiple markets, this evidence is suggestive of tacit collusion.

The average price measure used in Table III is a measure that is averaged over all usage levels. This measure is intended to capture general changes in prices (vertical shifts of the effective price schedule). If, however, the schedule rises in some places and falls in others, this could be obscured by using the average price measure. To find out whether the results reported in Table III reflect general changes in prices, I examine the effect of identical pricing at various points along the price schedule. If at each of these points identical pricing increases the price, then identical pricing can be inferred to shift the entire schedule. I reestimated column II of Table III, replacing average price as the dependent variable with the price calculated at usage levels of 100, 300, 500, and 1000 min/month. The results of the regressions using prices measured at each of these usage levels, reported in Table IV, are very similar to those reported in Table III. In particular, when a firm uses identical prices, its prices are higher by 2.24 cents/min (at a usage level of 1000 min) to 5.83 cents/min (at a usage level of 100 min), which is an increase of 6.7% to 10.2% on the price at these levels. As in Table III, the coefficients on the indicator for both firms using identical prices across markets are not statistically significant. These results indicate that prices are affected similarly over a range of usage levels when firms use identical prices across markets.

7. Alternative Explanations for Average Prices

So far, I have argued that the occurrence of identical pricing across markets cannot be explained solely by noncooperative motivations, and have shown that identical pricing is associated with higher prices.

TABLE IV.
RESULTS OF AVERAGE-PRICE-LEVEL REGRESSIONS AT DIFFERENT USAGE LEVELS[a]

	100 min	300 min	500 min	1000 min
Carrier using identical prices	5.83 (1.67)	3.22 (1.07)	2.82 (1.02)	2.24 (1.00)
Both firms using identical prices	−1.66 (2.27)	−1.16 (1.25)	−1.02 (1.09)	−1.11 (1.08)
Population	−0.24 (0.65)	−0.04 (0.37)	−0.02 (0.34)	0.17 (0.34)
Population growth	2.11 (0.73)	0.30 (0.51)	0.40 (0.54)	0.16 (0.56)
Income	0.20 (0.29)	0.14 (0.22)	0.03 (0.21)	0.02 (0.21)
Commuting time	0.92 (0.39)	0.37 (0.23)	0.39 (0.22)	0.32 (0.24)
Number of businesses	0.06 (0.02)	0.04 (0.01)	0.03 (0.01)	0.02 (0.01)
Constant	19.28 (15.13)	22.30 (10.56)	21.63 (9.38)	20.76 (9.24)
Firm effects	yes	yes	yes	yes
Time effects	yes	yes	yes	yes
No. of observations	584	584	584	584
R^2	0.40	0.34	0.32	0.29

[a]Observations are market-carrier-dates. Dependent variable is average price in cents per minute at specified level of monthly usage. OLS estimates. Standard errors in parentheses. Standard errors are adjusted for correlation between observations of the same firm in a particular market.

In this section, I consider several alternatives to the explanation of tacit collusion for the empirical association between identical pricing and higher prices.

7.1 THE DIRECT EFFECT OF MULTIMARKET CONTACT ON AVERAGE PRICES

Although I have argued that identical pricing is a mechanism through which cellular carriers tacitly collude, other empirical studies have shown that multimarket contact is generally associated with higher prices. To show that the higher prices indeed result from using the identical pricing mechanism and not from multimarket contact operating through some other mechanism, this section replicates the average-price regressions of Section 6, directly incorporating measures of

multimarket contact. This also allows for comparison with previous studies of multimarket contact.

If some other practice or feature associated with multimarket contact were the real cause of higher prices, and if identical pricing were correlated with multimarket contact, then the positive coefficient estimated for identical pricing could be picking up the effect of an omitted multimarket contact variable. To incorporate multimarket contact directly, I regress the average price charged by a carrier in a market on three different measures of multimarket contact, as well as the demand characteristics, identical-pricing dummies, and the firm effects used in Tables III and IV of Section 6.

The first measure of multimarket contact, used in column I of Table V, is the number of other markets in which the carrier meets the same competitor as it does in this market. The inclusion of this direct measure of multimarket contact has virtually no effect on any of the estimated parameters compared to column II of Table III. Furthermore, the coefficient on this variable is statistically indistinguishable from zero, providing no evidence that the results of Section 6 are due to an omitted variable. Using this measure supposes that the effect of multimarket contact is linear in the number of other markets in which carriers have contact. Since the measure takes on only five values (0, 1, 2, 4, and 8), a second way to measure multimarket contact would be to use dummy variables for each of the levels; these results are reported in column II of Table V. Using the discrete measure, multimarket contact appears to lower prices, not raise them, although not all of the coefficients are significant.[8] The estimated coefficient of the identical-pricing dummy, while reduced by about 22% compared to column II of Table III, is still significant. The third measure of multimarket contact, used in column III, is a simple indicator for whether firms compete with each other in any other market or not. The coefficient of this indicator variable is negative and significant, and the identical-pricing coefficient is now slightly larger than estimates in previous specifications.

These results do not comport with what has been found in most of the empirical literature, namely that multimarket contact is associated with higher prices (Evans and Kessides, 1994; Hughes and Oughton, 1993; Singal, 1993).[9] These results are, however, not inconsistent with the hypothesis of this paper, which is that although multimarket contact may enhance the sustainability of tacit collusion, firms

8. An *F*-test rejects at a 5% significance level the hypotheses that the coefficients on the multimarket contact dummies in column II of Table V are jointly zero.

9. Although Bernheim and Whinston (1990) in fact predict that in some cases multimarket contact can lower price, the more common expectation is that it will raise prices.

TABLE V.

RESULTS OF AVERAGE PRICE LEVEL REGRESSIONS INCLUDING MULTIMARKET CONTACT[a]

	I	II	III	IV
Carrier using identical prices	3.99	3.07	4.32	
	(1.46)	(1.40)	(1.46)	
Both firms using identical prices	−1.40	−1.32	−0.94	
	(1.71)	(1.70)	(1.74)	
Number of other markets in which firms compete	−0.04			
	(0.36)			
Firms compete in 1 other market		−4.10		
		(1.69)		
Firms compete in 2 other markets		−1.23		
		(1.76)		
Firms compete in 4 other markets		−6.05		
		(2.35)		
Firms compete in 8 other markets		1.77		
		(2.75)		
Firms compete in at least one other market			−3.09	−2.31
			(1.45)	(1.35)
Population	−0.13	0.10	−0.02	−0.05
	(0.58)	(0.59)	(0.57)	(0.60)
Population growth	1.77	1.21	1.68	1.43
	(0.66)	(0.64)	(0.64)	(0.65)
Income	−0.16	−0.01	−0.13	−0.11
	(0.25)	(0.25)	(0.24)	(0.24)
Commuting time	0.95	0.81	0.89	0.88
	(0.29)	(0.29)	(0.30)	(0.29)
Number of businesses	0.03	0.03	0.03	0.03
	(0.02)	(0.02)	(0.02)	(0.02)
Constant	20.93	23.52	23.30	24.09
	(11.38)	(11.17)	(11.02)	(11.28)
Firm effects	yes	yes	yes	yes
Time effects	yes	yes	yes	yes
No. of observations	584	584	584	584
R^2	0.40	0.43	0.41	0.39

[a]Observations are market-carrier-dates. Dependent variable is average price in cents per minute. OLS estimates. Standard errors in parentheses. Standard errors are adjusted for correlation between observations of the same firm in a particular market.

may still need to develop a means to communicate and coordinate their actions. Speaking loosely, multimarket contact is a necessary, but not sufficient, condition. The empirical results of Sections 5 and 6 suggest this is true. The same effective price schedule is more likely to be observed in two different markets if firms have multimarket contact in those markets, and when firms use identical prices across markets, prices are, statistically and economically, significantly higher. That multimarket contact itself is not associated with higher prices suggests only that it alone is not sufficient to achieve tacit collusion.

7.2 The Single-Market Effect on Average Prices

Another alternative explanation for identical pricing across markets is that arbitrage forces the prices in close markets together. In the cellular telephone industry, the power of arbitrage is mitigated by roaming fees imposed on callers when they use their telephones outside their local markets, a substantial deterrent against shopping in different markets for better rates.[10] However, even if arbitrage does not force carriers to price in multiple markets as if they were pricing in a single market, there may be managerial reasons to do so. For example, it may be that the markets are managed by a single office. Furthermore, the FCC in making its original awards might have treated some markets as if they were single market and awarded them to the same licensee, especially if they were markets that might be regarded as a single greater metropolitan area. Possible examples include Boston and Worcester, Miami and West Palm Beach, Los Angeles and Oxnard, and San Francisco and San Jose. To the extent that these are large cities with higher costs of living in general, they might also have higher prices also for cellular service. Thus the estimated identical-pricing coefficient could capture the higher prices associated with one of these greater metropolitan areas, rather than the effect of tacit collusion through the identical-pricing mechanism. To test whether this is the case, variables indicating whether the nearest market is served by the same carriers are added to the previously estimated average-price regressions. These variables should indicate markets that were awarded jointly because they were expected to be administered together.

As Table VI shows, having the nearest market served by one or both of same two carriers is associated with a statistically significant

10. The system of roaming rates enables a cellular customer to use his or her phone in any market, whether it is served by his or her carrier or not. The carrier in the outside market serves the call and bills the customer's home carrier, who bills the customer at the roaming rate charged by the outside carrier. Roaming fees were substantial and pervasive during this period.

TABLE VI.
RESULTS OF AVERAGE-PRICE REGRESSIONS INCLUDING SINGLE MARKET MEASURE[a]

Carrier using identical prices	3.05
	(1.48)
Both firms using identical prices	−2.01
	(1.68)
Nearest market served by at least one of the same carriers	4.58
	(1.60)
Population	−0.16
	(0.59)
Population growth	1.37
	(0.62)
Income	−0.17
	(0.24)
Commuting time	0.83
	(0.29)
Number of businesses	0.03
	(0.02)
Constant	22.72
	(11.10)
Firm effects	Yes
Time effects	Yes
No. of observations	584
Adjusted R^2	0.42

[a]Observations are market-carrier-dates. Dependent variable is average price in cents per minute. OLS estimates. Standard errors in parentheses. Standard errors are adjusted for correlation between observations of the same firm in a particular market.

increase in price of 4.6 cents/min. The inclusion of this variable nevertheless leaves the estimated effect of identical pricing similar to that found in previous specifications. This is consistent with the hypothesis that when close markets are served by the same carrier they have higher prices. Identical pricing, however, does not appear to be merely a proxy for this effect; in column II, the estimated effect of identical pricing is still positive and significant, although the estimates are smaller by about 23% than the comparable estimates in Table III.

7.3 THE REGIONAL EFFECT ON AVERAGE PRICES

Finally, I consider the possibility that the identical-pricing effect is a regional phenomenon. Since the northeastern region of the United

TABLE VII.
RESULTS OF AVERAGE-PRICE REGRESSIONS INCLUDING REGIONAL EFFECTS[a]

Carrier using identical prices	4.78 (1.30)
Both firms using identical prices	−0.83 (1.58)
West	−1.40 (3.24)
Midwest	−9.18 (2.63)
South	−2.22 (3.13)
Population	0.17 (0.51)
Population growth	0.31 (0.88)
Income	0.01 (0.26)
Commuting time	0.70 (0.31)
Number of businesses	0.02 (0.02)
Constant	28.05 (11.70)
Firm effects	Yes
Time effects	Yes
No. of observations	584
Adjusted R^2	0.46

[a]Observations are market-carrier-dates. Dependent variable is average price in cents per minute. OLS estimates. Standard errors in parentheses. Standard errors are adjusted for correlation between observations of the same firm in a particular market.

States is more densely populated than other areas of the country, it contains more large cities and a higher concentration of markets in which there is multimarket contact (see Fig. 3). As a result, this region has proportionately more cases of identical pricing than other regions. If the prices for cellular service in the Northeast are also generally higher than in other areas of the country, as the cost of living is, then the coefficient on identical pricing might reflect a regional effect rather than an increase in price due to tacit collusion.

I test this explanation by including regional dummy variables based on standard census definitions of four regions (West, South, Midwest, and Northeast). The results in Table VII include a constant, and hence exclude the dummy for the northeastern region. The estimates indicate that prices are very similar in the West, South, and Northeast (the excluded category), and distinctly lower in the Midwest. Once controlling for the regional effects, the estimated effect of identical pricing is about 20% larger than that estimated in the column II of Table III. Although there are regional effects in cellular prices, those effects do not appear to be confounded with the effect of identical pricing across markets.

8. Another Form of Tacit Collusion

In the introduction of this paper, a distinction was made between two forms of parallel pricing: price matching and identical pricing across markets. Up to this point, this paper has considered exclusively identical pricing across markets, that is, a firm using the identical price schedules in different markets. A more familiar kind of parallel pricing is price matching, in which different firms set the same prices within a market. This section takes up the question of whether price matching is used to facilitate tacit collusion in the cellular telephone industry. The empirical results of this section show that when cellular carriers match prices within a market, it does increase average prices. Price matching, however, does not appear to be associated with multimarket contact.

Price matching is defined as follows. Consider a market m that is served by two carriers, w and n. As in Section 6, let $T_j(i)$ be the total cost for the use of i minutes per month using the effective price schedule (the lower envelope of the two-part tariffs) offered by firm j. The two carriers, w and n, have matched prices at usage level i if $T_w(i) = T_n(i)$. The fraction of the price schedule in which the carriers have matched prices can be calculated as

$$\text{fraction of price schedule matched} = \frac{1}{1000}\sum_{i=1}^{1000} I(T_w(i) = T_n(i)),$$

where $I(\ )$ is an indicator function that equals 1 if the argument is true. If this measure is equal to 1, in other words if the schedules of the two carriers in the market are equal to each other at every usage level, then the price schedules are said to match exactly.

Table VIII modifies the specification used in Table III to examine the effect of identical pricing across markets on average price level

TABLE VIII.
RESULTS OF AVERAGE-PRICE REGRESSIONS USING PRICE MATCHING[a]

	I	II	III	IV
Fraction of price schedule matched	7.35 (1.82)		7.54 (1.77)	
Price schedules match exactly		6.41 (2.32)		6.25 (2.22)
Carrier using identical prices			4.05 (1.31)	3.98 (1.41)
Both firms using identical prices			−1.05 (1.48)	−1.28 (1.64)
Population	−0.11 (0.61)	−0.09 (0.60)	−0.01 (0.58)	−0.10 (0.57)
Population growth	1.37 (0.64)	1.42 (0.64)	1.63 (0.64)	1.65 (0.64)
Income	−0.14 (0.22)	−0.11 (0.24)	−0.16 (0.22)	−0.13 (0.24)
Commuting time	0.78 (0.28)	0.89 (0.27)	0.80 (0.29)	0.91 (0.28)
Number of businesses	0.02 (0.02)	0.03 (0.02)	0.02 (0.02)	0.03 (0.02)
Constant	26.14 (10.80)	22.80 (10.99)	24.94 (10.62)	21.67 (11.13)
Firm effects	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes
No. of observations	584	584	584	584
R^2	0.43	0.40	0.44	0.42

[a]Observations are market-carrier-dates. Dependent variable is average price in cents per minute. OLS estimates. Standard errors in parentheses. Standard errors are adjusted for correlation between observations of the same firm in a particular market.

by substituting variables that indicate when there is price matching between the two carriers in a market.[11] The estimates on the price-matching coefficients suggest that when carriers match price exactly within a market, prices are higher by about 7 cents/min, which is somewhat larger than the effect of identical pricing across

11. Price matching and identical pricing across markets typically do not occur simultaneously. Identical pricing across markets means that a carrier A sets the same prices in markets 1 and 2, and (usually) its competitor, carrier B, sets the same prices in markets 1 and 2. Price matching occurs if carriers A and B set the same prices as each other in market 1. There are isolated examples in which both occur. This would be the case if, for example, the same price schedule were used by carrier A in markets 1 and 2 and by carrier B in market 1.

TABLE IX.
RESULTS OF PRICE MATCHING AND MULTIMARKET CONTACT REGRESSIONS[a]

	I	II	III
Number of other markets in which firms compete	0.18 (0.18)		
Firms compete in 1 other market		0.11 (0.07)	
Firms compete in 2 other markets		0.024 (0.073)	
Firms compete in 4 other markets		−0.022 (0.134)	
Firms compete in 8 other markets		0.131 (0.157)	
Firms compete in at least one other market			0.085 (0.056)
Population	0.010 (0.013)	0.005 (0.013)	0.009 (0.013)
Population growth	−0.011 (0.028)	−0.018 (0.030)	−0.007 (0.027)
Income	0.014 (0.008)	0.015 (0.008)	0.013 (0.008)
Commuting time	0.023 (0.010)	0.022 (0.010)	0.024 (0.010)
Number of businesses	0.0004 (0.0006)	0.0007 (0.0006)	0.0004 (0.0006)
Constant	−0.836 (0.276)	−0.827 (0.289)	−0.885 (0.285)
Firm effects	yes	yes	yes
Time effects	yes	yes	yes
No. of observations	293	293	293
R^2	0.28	0.29	0.29

[a]Observations are market-dates. OLS estimates. Standard errors in parentheses. Standard errors are adjusted for heteroskedasticity.

markets. Other coefficient estimates are similar to those estimated in Table III.

While price matching does appear to raise average prices, it is not associated with multimarket contact. Table IX shows the results of regressions that predict whether there will be price matching in a market as a function of multimarket contact. Each observation is a market

at a particular point in time. The variables used in this regression have all been defined and described above. The dependent variable is the fraction of the price schedule that is matched by the two carriers, as described above.[12] The primary explanatory variables of interest are measures of multimarket contact, which is measured three ways, as in Table V: a count of the number of markets in which the carriers in this market also compete, an indicator variable for the level of contact, and an indicator that the firms compete in at least one other market. The regressions also include market demand characteristics, and fixed firm and time effects. The regressions are estimated using ordinary least squares, and the standard errors are corrected for heteroskedasticity. None of the multimarket contact coefficient estimates are significantly different from zero. The coefficient of the variable "Firms compete in at least one other market" in column III has the highest t-statistic, 1.52, with a p-value of 0.129.

Overall, I interpret the results of this section as having two primary implications. First, the results indicate that there may be multiple forms of tacit collusion operating in this industry, and that price matching may be one of them. The effect of price matching, however, appears to be orthogonal to that of identical pricing across markets. (This can be seen in columns III and IV of Table VIII. When indicators for both pricing behaviors are used in the regressions, the price-matching effects are very close to those estimated in columns I and II, while the identical-pricing effects are very similar to those estimated in Table III.) The second implication is that if firms are taking advantage of multimarket contact in order to enhance their abilities to tacitly collude, it appears that price matching is not their means of doing so.

9. Conclusion

This paper has examined the effect of multimarket contact in the cellular telephone industry by identifying a pattern of setting identical prices across markets, and hypothesizing that such a mechanism could be used to coordinate prices. This mechanism is related to higher average prices, and is used most commonly between firms that compete in multiple markets. Further examination showed that the higher prices are indeed the result of identical pricing, not of multimarket contact alone or some other characteristic of the analyzed markets. Together, these suggest that identical pricing across markets serves as a mechanism to support tacit collusion.

12. Substituting as the dependent variable an indicator for whether the two carriers are matching prices exactly gives results that are generally smaller in magnitude, with generally equal or larger standard errors than those presented in Table IX.

This paper makes two main contributions. First, the paper indicates that the FCC's expectation that competition between two firms would produce competitive pricing does not appear to have been fulfilled in all markets. Although prices were probably lower than they would have been if carriers had been granted exclusive licences by city, it appears that carriers were able to tacitly collude in some markets, and that the result was prices that were higher by approximately 7%–10% in those markets.

The paper's second contribution is in understanding the way in which multimarket contact facilitates tacit collusion. While previous empirical studies have found higher prices associated with multimarket contact, this paper demonstrates a mechanism that enables firms to translate contact with each other into the commonality purpose necessary to tacitly collude.

DATA APPENDIX

The purpose of this appendix is to explain how variables and observations are defined, given the nonstandard nature of some of the data used in this paper.

A.1 THE SOURCE OF THE DATA

The price data were collected by a small consulting company, which, during the initial development of the industry, persuaded the carriers to provide it with detailed price data. Carriers agreed to submit reports when their prices changed; thus the data take the form of a chronology of price changes for each carrier in each market that it serves.

A.2 PRICING DATA

In order to be able to compare pricing information across carriers within a market or across markets, I first create a full series by filling in the data between the periodic observations of each carrier in each market. The result is a monthly series of the menu of prevailing prices for each carrier in each market.

The pricing data contain detailed information on each price plan offered by the carriers. From these data, I can construct an effective price schedule, which I define as the lower envelope of the menu of two-part tariffs for usage levels between 1 and 1000 min/month. See Figure 4 for an example. In order to decide whether a carrier is using identical prices across markets I compare the effective price schedule that carrier A offers in market 1 with the effective price schedule A

offers in market 2 during the same month. If the two are the same point by point for all usage levels between 1 and 1000 min/month, then carrier A is said to be using identical prices across markets 1 and 2 in that month. If the same is true of the price schedules carrier B offers in markets 1 and 2 during the same month, then the (market 1, market 2) market pair is said to have both firms using identical prices in that month.

A.3 Data for the Probit Regression

An observation is a market pair. There are 81 markets in the sample, which can be combined into 3240 market pairs. The dependent variable in the probit regression is 1 if the same effective price schedule is ever available simultaneously in both markets in the market pair.

The primary explanatory variable of interest in the probit is an indicator for whether there is multimarket contact across the markets considered in the observation. For example, if market 1 is served by carriers A and B, and market 2 is also served by carriers A and B, then the multimarket contact indicator variable would equal one in the (market 1, market 2) observation.

There are controls in the regression, including the difference between the demographic characteristics of the market (measured as the percentage absolute difference), firm dummy variables, and measures of distance between the two markets.

A.4 Data for Average-Price Regressions

The second part of the paper answers the question of what effect using identical prices has on the average price level. For this, a linear regression is used. Each observation is of a single carrier in a particular market at a given date. This arrangement of the data is different from the probit where the basic unit of observation is a market pair.

For the average price regressions, there are 81 markets, each of which has 2 carriers, which are observed as many as 8 times, in March and September; so there could be as many as 1296 observations.[13] In practice, most of the markets do not have both carriers in operation for the whole time, so the actual number of observations is 584.

In the regression, the dependent variable is the average per-minute price, which is calculated as the average of the cents-per-minute charge for each level of usage from 1 to 1000 min/month,

13. This is true for all years except 1988, in which the data are from March and July. July 1998 was the last month of data collection. The decision to use March and September as the months of observation was made to avoid price promotions around holidays. A number of the regressions reported in the paper were run using alternative timing for the observations, with results similar to those reported in the paper.

according to the formula given in Section 6. In the sample, the mean of the average per-minute price is 46.4 cents/min.

The explanatory variables of interest are two indicator variables. The first, called "Carrier using identical prices," indicates whether the carrier is offering exactly the same effective price schedule as it offers in this market at this date in another market at this date. In other words, the indicator is equal to one if the answer to the question "Has this carrier set the same prices in some other market at this date?" is yes.

The second variable, called "Both firms using identical prices," indicates whether the carrier and its competitor in this market both offer the same prices in some other market where they compete. In other words, the indicator is equal to one if the answer to the question "Have the carrier and its competitor both set the same prices in some other market at this date as they do in this market at this date?" is yes.[14]

The regression also includes controls for the price level including market demographic characteristics and firm and time effects. The standard errors are adjusted to allow correlation across time for a given carrier in a given market.

REFERENCES

Anon., 1992, Concerns about Competition in the Cellular Telephone Service Industry. U.S. General Accounting Office.

Bernheim, B.D. and M.D. Whinston, 1990, "Multimarket Contact and Collusive Behavior," *RAND Journal of Economics*, 21 (1), 1–26.

Calhoun, G., 1988, *Digital Cellular Radio*, Norwood, MA: Artech House.

Evans, W.N. and I.N. Kessides, 1994, "Living by the 'Golden Rule': Multimarket Contact in the U.S. Airline Industry," *Quarterly Journal of Economics*, 109 (2), 341–366.

Fisher, F.M., 1989, "Games Economists Play: A Noncooperative View," *Rand Journal of Economics*, 20 (1), 113–124.

Gilligan, T.W., 1992, "Imperfect Competition and Basing-Point Pricing: Evidence from the Softwood Plywood Industry," *American Economic Review*, 82 (5), 1106–1119.

Heggestad, A.A. and S.A. Rhoades, 1978, "Multi-market Interdependence and Local Market Competition in Banking," *Review of Economics and Statistics*, 60 (4), 523–532.

Hughes, K. and C. Oughton, 1993, "Diversification, Multimarket Contact and Profitability," *Economica*, 60, 203–224.

Kellogg, M.K., J. Thorne, and P.W. Huber, 1992, *Federal Telecommunications Law*, Boston: Little, Brown, 641–688.

14. In this sample of data, it does not matter whether the phrase "some other market" in this question is restricted to refer to the same other market for both carriers, or allowed to be different markets for the two carriers. In this sample, the two interpretations would have the same result in defining the variable.

Parker, P.M. and L.-H. Röller, 1997, "Collusive Conduct in Duopolies: Multimarket Contact and Cross-ownership in the Mobile Telephone Industry," *Rand Journal of Economics*, 28 (2), 304–322.

Reiffen, D., L. Schumann, and M.R. Ward, 1996, "Discriminatory Dealing with Downstream Competitors: Evidence from the Cellular Industry," Mimeo, Federal Trade Commission.

Rhoades, S.A. and A.A. Heggestad, 1985, "Multimarket Interdependence and Performance in Banking: Two Tests," *The Antitrust Bulletin*, 30 (4), 975–995.

Rotemberg, J.J. and G. Saloner, 1990, "Collusive Price Leadership," *Journal of Industrial Economics*, 39 (1), 93–111.

Schelling, T.C., 1960, *The Strategy of Conflict*, Cambridge, MA: Harvard University Press.

Scherer, F.M., 1980, *Industrial Market Structure and Economic Performance*. Chicago: Rand McNally.

Scott, J.T., 1982, "Multimarket Contact and Economic Performance," *Review of Economics and Statistics*, 64 (3), 368–375.

Singal, V., 1993, "Interdepence among Firms That Compete in Many Markets: The Airline Industry and Its Mergers," Mimeo, Virginia Polytechnic Institute and State University.

Tirole, J., 1988, *The Theory of Industrial Organization*, Cambridge, MA: The MIT Press.

Switching costs and consumer behaviour: implications for telecommunications regulation

Patrick Xavier and Dimitri Ypsilanti

Patrick Xavier is based in the Faculty of Business, Swinburne University of Technology, Melbourne. Dimitri Ypsilanti is Head, Telecommunications Policy Section, OECD, Paris.

Abstract

Purpose – *This paper aims to examine the extent to which telecommunications consumers decide to switch and why.*

Design/methodology/approach – *Results from surveys of consumer switching behaviour in a number of countries are examined to ascertain reasons for actual consumer decision making regarding switching.*

Findings – *Implications for telecommunications regulation are considered. In essence, regulation should require that communications service providers ensure that switching is fast, cheap, predictable and reliable and that consumers are able to switch with minimum difficulty and delay.*

Practical implications – *The ability and willingness to switch from one to another supplier of telecommunications and internet services are an important aspect in manifesting consumer empowerment. In turn, empowered consumers are important for sustainable competition. If consumers are inert and passive, suppliers will not be under pressure to deliver the potential benefits of competition. And it is empowered assertive consumers, able and willing to switch, who will exert pressure on suppliers to deliver these benefits. Thus, in making well-informed choices between suppliers, consumers not only benefit from competition but also initiate and sustain it.*

Originality/value – *Insights from behavioural economics are incorporated in the analysis.*

Keywords *Telecommunications, Regulation, Pricing policy, Public policy, Broadband networks*

Paper type *Research paper*

1. Introduction

Switching patterns provide an important indicator that the demand-side of a market is well-developed and that consumers are sufficiently empowered to participate actively. The motivation to switch is generally a function of consumers' estimate of the performance of their existing supplier; and whether or not they believe there are better alternatives available from other suppliers on the aspects of service that matter to them. If the market is perceived to be undifferentiated and/or if their current supplier is perceived to be the best on the market on the criteria that are important, there is no expected benefit from switching.

The ability and willingness of consumers to switch is critically important. If switching is discouraged or impeded this could impact not only on the demand-side but also potentially raise supply side barriers (Barrow, 2007). This is because new entrants could be deterred from entering the market in the belief that it will be difficult to persuade consumers to switch from their existing provider. This could diminish the effectiveness of competition and serve to limit the benefits that consumers would otherwise derive from it.

It is important to note, however, that switching is not the only measure of a vibrant demand-side, nor is switching necessarily always in a consumer's best interests. The decision to engage in co-ordinated information gathering that will support the decision to

Received 17 March 2008
Accepted 16 April 2008

switch or not to switch is also important. If a consumer is satisfied with a current provider, switching is not necessarily an improvement. Moreover, choosing a new service does not necessarily mean switching provider.

The aim of this paper is to assess the extent to which consumers in telecommunications markets are able and willing to switch and the implications for policy and regulation. Issues covered by the paper include:

- the extent to which consumers are satisfied with their present providers;
- the extent to which dissatisfied consumers do switch;
- whether dissatisfied consumers are equipped (with information and confidence) to make rational switching decisions; and
- how "information asymmetry" and systematic bias in consumer decisions can be addressed.

The paper does not dwell on consumer complaints, including complaints to regulators and ombudsmen. It is known that a substantial number of consumers are dissatisfied. The issue focused on is why these dissatisfied consumers are not switching and how to address this.

2. Influences on switching

Switching costs can be defined as the real or perceived costs that are incurred when changing supplier but which are not incurred by remaining with the current supplier. Barriers to switching can be present due to high switching costs. Switching costs reduce consumer flexibility and lower the pressure exerted by the prospect of a consumer migrating to a competitor.

Research conducted by Ofcom (2006a), the UK National Consumers Council (2006) and others suggest that in the telecommunications sector there is a range of important deterrents to switching, including:

- Lengthy and cumbersome switching procedures can make it inconvenient for consumers to switch and can outweigh any potential benefits.
- Early exit charges, imposed by an existing provider, can reduce the benefits of switching.
- Confusing products and non-transparent pricing can make it difficult or time consuming to compare deals (as in the case of mobile telephony and the internet).
- Technical incompatibility of equipment can make it uneconomical for consumers to switch (for example, if they cannot use a blocked mobile phone with their new provider).
- Long-term deals can lock consumers into lengthy relationships with their providers (as may occur with mobile telephony and Internet contracts) and increase the risk of them being overcharged.

A survey of consumer opinion in the UK indicated that in 2007 only about 7 percent of fixed-line, 6 percent of mobile and 22 percent of internet consumers who had ever switched supplier considered that it was difficult to switch (see Table I). The Table shows that these percentages were slightly higher than for 2006. That is, there has been some increase in the perceived difficulty of switching telecommunications and internet service providers (ISPs). Moreover, the percentages for 2007 for these consumers who had never switched were somewhat lower than among those who had switched in the past (Ofcom, 2007b). This may mean that perception of ease of switching is not borne out in reality for some consumers.

Under-switching and over-switching

Under-switching errors can occur where a consumer does not switch (perhaps due to high switching costs) despite apparent benefits from doing so. And there could also be "over-switching" errors where a consumer switches despite incurring losses from doing so. Wilson and Waddams-Price (2005) identify a third type of error "consumer inaccuracy" when a consumer makes a surplus-improving switch, but makes a mistake in the choice of destination operator by not choosing the best operator for her requirements (perhaps as a

Table I Consumer opinion in UK in 2007 on ease of switching supplier among those who have ever switched

		Very easy (%)	*Fairly easy (%)*	*Fairly difficult (%)*	*Very difficult (%)*	*Do not know (%)*
Fixed Line	Q2 2006	57	33	5	1	5
	Q2 2007	52	37	4	3	4
Mobile	Q2 2006	63	32	3	2	0
	Q2 2007	64	30	3	3	0
Internet	Q2 2006	51	32	8	5	4
	Q2 2007	39	39	12	10	4

Note: Base is all adults who have ever switched fixed line, mobile, internet supplier
Source: Ofcom (2007b)

result of search costs). Their research on switching by low-income households in UK electricity markets found that on the whole people did not switch provider in a way that could be explained by any rational set of criteria. Only 7 percent of consumers chose the cheapest option and 32 percent changed to a supplier that was more expensive.

High switching levels do not necessarily signify that a market is competitive (Gans, 2005). First, if pricing is unclear and products complex, price differentials and subsequently switching can occur over a long period of time, without the market becoming more competitive. Second, if companies co-ordinate their behaviour to keep prices high, the market will not be competitive, regardless of switching levels. Third, high switching levels can conceal certain undesirable activities, such as mis-selling and market churning.

Conversely, low switching levels do not automatically indicate that markets are not competitive. Indeed, once price differentials have been exhausted through intensive switching, and prices have been driven down to a competitive level, only limited switching may occur. However, in such circumstances, the market is likely to be competitive.

It should also be recognised that consumers who have not switched will not necessarily be worse off. The existing provider may happen to offer the best deal for their particular circumstances. Besides, sometimes a mere threat to switch may bring about a better deal from a current provider.

In the UK, across all communications services, the most mentioned reason for not switching communications services is that consumers are happy with their current suppliers. For instance, among mobile consumers, 14 percent found that their current provider still offered the best deal, as did one in ten broadband consumers. Among fixed-line consumers, a significant minority claim they will look around, switch or renegotiate with their current supplier. About one-third of fixed-line consumers and some 38 percent of mobile consumers say they are likely to try to renegotiate with their current supplier in the next 12 months (Ofcom, 2007b).

Underestimating the benefits of switching?

Another reason why some consumers decide not to, or feel unable to, switch could be that the perceived or actual level of savings available is considered to be inadequate. According to research conducted by Ofcom, in the fixed line market consumers indicated that in order to switch they would require savings that are the equivalent to around 75 percent of their monthly phone bill. This might appear irrationally high. But it might also suggest that consumers find the searching, evaluation and actual switching process difficult and time consuming and thus require the promise of high levels of eventual savings as compensation for the time and effort involved in switching.

Respondents to a National Audit Office survey in the UK in 2003 appear to confirm this conclusion. When asked whether they would change their fixed line arrangements, either with their existing supplier or by switching to a different supplier, to achieve savings of 10, 25 and 40 percent, consumers gave answers that indicated the following:

- At each level, consumers are more likely to look for changes with their existing supplier than change supplier (see Table II). And even then, the level of savings has to reach 40 percent before the majority of consumers are "highly likely" to act.
- A significant minority of consumers are reluctant to change "at any price" – 32 percent of consumers would be "unlikely" or "highly unlikely" to switch supplier for savings of 40 percent, and 25 percent of consumers would not even make changes with their existing supplier.

Ofcom's (2006a) research suggests that the level of perceived savings is generally lower than the significant amounts that consumers say they would need in order to switch. However, it may be that actual savings are in fact higher than perceived savings and consumers are therefore underestimating the savings available to them. Indeed, uSwitch (a service-comparison web site) estimates that consumers switching telephone provider via its web site save an average of £120 per year on their fixed line calls – with 20 percent saving more than £170. While consumers using the uSwitch web site are unlikely to be representative of the UK population as a whole (they are likely to be higher spenders) this suggests that some consumers may be able to save an average of £10 rising to £14 on their monthly telephone bill (Ofcom, 2006a). Consequently, uSwitch's data suggests that consumers may be underestimating the benefits of switching and that actual savings are equal to – or potentially higher than – the amount that would make consumers switch.

In addition to general consumer inertia and disengagement associated with high levels of complexity in the telecommunications market, low levels of switching may also arise because of explicit practices by operators that hinder consumers from changing supplier.

Switching costs

The number of different factors consumers need to take into account when choosing a mobile telecommunications provider could create considerable search costs for consumers. This is because the cost and suitability of a particular mobile phone package for a particular consumer depends on a number of factors:

- how much the consumer uses the phone;
- the time of day the consumer makes most of their calls;
- the mobile network used by most of the people they are likely to call;
- the kind of services the consumers wants on their mobile (*e.g.* cameras, photo-messaging etc);
- whether and how much the consumer wants to use the mobile abroad;
- which networks have "coverage" where the consumer wants to use the mobile;
- whether the consumer wants to commit to a monthly contract or prefers to pay only for calls; and
- whether the consumer's preferred handset is available on their preferred network.

Table II Consumer motivation to change fixed line telecommunications arrangements in the UK (2003)

	Likelihood to change within supplier (%)				*Likelihood to change supplier (%)*			
Level of saving	*Highly unlikely*	*Fairly unlikely*	*Fairly likely*	*Highly likely*	*Highly unlikely*	*Fairly unlikely*	*Fairly likely*	*Highly likely*
Savings of 10 percent	23	28	35	14	34	34	25	7
Savings of 25 percent	17	17	37	29	24	23	38	15
Savings of 40 percent	14	11	23	52	19	13	26	42

Source: National Audit Office public survey cited in "The Office of Telecommunications: Helping consumers benefit from competition in the telecommunications market", Report by the Comptroller and Auditor-General, HC 768 Session 2002-2003, 11 July 2003

Compatibility costs

As different mobile operators have different handset ranges, the consumer's choice of a handset restricts their choice of mobile network, or alternatively, choosing a particular network leads to a limited range of handsets. This issue is discussed further below in the context of SIM locking.

Change of telephone number

A consumer switching mobile operator who has to change her telephone number faces a number of costs. For example, she must inform potential consumers of the number change (in the case of business users) and potentially miss calls from friends and clients. These costs are greater for a business consumer who may have to change stationery and advertising material and may suffer a loss of business due to the number change. In addition, correspondents of the consumer have to change the number in their address book and other database records. They also suffer some inconvenience in terms of misdialling on the old number.

The introduction of mobile number portability (discussed below) reduces these costs. However, the availability of number portability does not completely remove the transaction costs as there can be a delay between the request for number portability and when it is actually implemented. As a result, even with number portability, transaction costs of changing network will still exist.

Contractual costs

Some of the switching costs involved in changing mobile provider are contractual switching costs. Many mobile phones are sold with a minimum 12-month contract during which time the consumer would have to pay an early exit penalty for terminating the contract.

Locked handsets

In several countries consumers are prevented from keeping their mobile telephone when they switch providers either because of the technologies used to provide mobile services (e.g. CDMA) or because of software that locks the subscriber identity module (SIM) card in the handset and may prevent the handsets from being used on a competing network. In the UK, USA, Australia and other countries, most operators lock handsets to operate only on their network, particularly in the case of pre-paid consumers (NERA, 2003). The purpose of this locking is to ensure that where the handset is subsidised by the operator, the consumer does not purchase a subsidised handset from one provider and then switch to making calls with another network operator at a cheaper rate. Most handsets can be unlocked by means of the network providing the consumer with a code to enter into the handset. If a mobile handset has been locked, the consumer has to pay a fee to unlock the handset before the SIM card of another operator can be inserted. In some countries (e.g. France) mobile operators are required to provide the key to unlock SIM cards to subscribers after six months of signing-up.

"Lock-in" handsets target consumers' underestimation of the cost of being unable to switch provider, where a more attractive or suitable offer is being offered elsewhere. Further, it is difficult to justify the lock-in clause on cost grounds. In some industries, fixed costs may justify a lock-in clause. It is unlikely, however, that per-consumer fixed costs alone can explain the lengthy lock-in clauses observed in the mobile telephony industry.

3. Efforts to address barriers to switching

Number portability

In an effort to enhance competition and improve consumer satisfaction, regulators in many countries have introduced mobile number portability (MNP) which allows consumers to keep their mobile number when they change network provider. This is widely regarded as a fundamental prerequisite of open competition and choice. But take-up has been lower than some expected with less than 10 percent of mobile numbers being ported according to a

recent report by Analysys, a consultancy firm (Analysys, 2006). In the UK, a survey conducted by the National Consumer Council found that switching is quite limited in the mobile telephony market (NCC, 2006). This may be the consequence of high switching levels over the past few years leading to a reduction in current switching potential. Indeed the introduction of MNP was initially expected to result in a surge of competitive activity as carriers sought to seize the opportunity to grow market share by attracting consumers from rivals but this did not occur as much as some expected.

The Analysys report concludes that regulators and operators need to make improvements to current MNP solutions which have significant barriers to consumer take-up, such as high charges for porting a number, long delays before porting takes place, and limitations to data services after number porting. Notably the report concludes that one of the biggest barriers to MNP is that consumers do not realise it is available. It warns that even with the best technical solutions and processes in place, if regulators and operators do not publicise the availability of number portability it will fail.

In France, a Decree was adopted in January 2006 (to be implemented in June 2007) allowing consumers to keep the same phone number when switching operator. The new operator will have to take all the necessary steps to ensure such a switch occurs within a maximum of ten days.

In Japan, mobile number portability was introduced in October 2006 and by February 2007, an estimated 1 million subscribers – out of a total of 100 million – have switched. Notably, while subscribers who switch can take their phone numbers with them, they are not able to take their associated e-mail addresses which is a big disadvantage in that country since many subscribers rely on their phones as much for e-mail as for voice calls. Moreover, in Japan, switching can cost up to Yen 10,000 (US$83), plus the cost of a new handset, since Japanese handsets are network specific (*The Economist*, 2007). Another consideration is that subscribers in Japan must approach their existing operators to be released from their account before signing up with a rival. Nevertheless, most accounts can be switched within a day or two. But, according to some reports, it is made abundantly clear to switchers that many of their favourite services – such as downloadable games, mobile TV services or payment systems – may not be available on a rival network.

Even without switching, however, MNP may be resulting in increased benefits to consumers with operators offering incentives to discourage subscribers from switching. The extent of switching is not necessarily an accurate gauge of benefits accruing to consumers as a result of measures to facilitate switching. According to one report loyalty schemes have been strengthened, bigger discounts provided for heavier phone usage, new handsets have appeared and services have improved (*The Economist*, 2007).

Mobile portability lead times

The shorter the porting process, the better it is for competition and consumers. Table III shows the target maximum lead times in various countries. In Australia, for example, the maximum port lead time is two days.

In the UK, the regulator announced in July 2007 new procedures that would reduce the amount of time it takes for consumers to transfer mobile numbers when switching provider from five to two working days to take effect in April 2008. Ofcom has proposed that the time taken be reduced to two hours by 2009 (Ofcom, 2007a).

The European Commission has proposed that number portability be completed within one day (European Commission, 2006).

Broadband internet switching issues

Important characteristic of a competitive broadband market is the ability of consumers to switch between broadband service providers. In the UK, a study on this issue concluded that many consumers have found it difficult to switch between broadband suppliers or to move home without experiencing problems. Some consumers reportedly lost their

Table III Mobile number portability: time taken in various countries

Country	*Time to switch to new operator*	*Target maximum porting period*	*Porting process*
France	Two hour max	30 days (ten days from 1/1/07)	Led by recipient (but new process will be one-stop-shop)
Germany		31 days (standard contract termination period)	Led by recipient
Italy	One hour	Five days (reduced from 15 days target at MNP launch)	Led by recipient
Spain		48 hours	Led by recipient
USA	2.5 hours	14 days	Led by recipient
Australia	Three hours	Two working days	Led by recipient
Austria		Three working days	Led by recipient
Belgium		Two days	
Croatia		Five days	
Cyprus		14 days	
Estonia		Seven working days	
Finland		Five working days	Led by recipient
Hong Kong		36 hours (was 48 hours until 2004)	
Hungary		14 working days	
Iceland		Ten days	
Ireland	Two hours for a single line/eight hours for multi-line ports	24 hours from request	Led by recipient
Lithuania		28 days	
The Netherlands		Four working days (was up to three weeks until 2004)	Led by recipient
Norway		Seven days	Led by recipient
Portugal		5-20 working days	
Singapore		Seven days	
Slovenia		Five working days	
Sweden		Five working days	
Switzerland		Five working days	
UK		Five working days	

Source: IML Research, Ovum 2005. Reported in Ofcom, "Review of General Condition 18 – Number Portability", A Consultation, 16 November 2006, pp. 80-1

broadband service for several weeks, or were given confusing and contradictory information about what they need to do to migrate to another ISP (Ofcom, 2006b).

Over the course of 2005, Ofcom noticed an increase in the number of consumers contacting the Ofcom Contact Centre about issues relating to migration between broadband service providers. The largest source of complaints was about tag on line. "Tag on line" is a term used to describe a situation where a consumer cannot order broadband because there is (or appears to be) another broadband service provider already providing broadband on that line, or there is an incompatible product on the line. Tag on line affects people moving house, consumers who want to switch broadband service providers and even consumers ordering broadband for the first time.

To address these problems Ofcom decided to introduce General Condition 22 which requires all communications providers to comply with a number of obligations designed to address consumer harm associated with broadband migration (Ofcom, 2006b).

Bundling

Bundling offers a number of important benefits to consumers. However, in some situations, bundled services can make it more difficult to switch and lead to consumer detriment. For instance, once consumers have signed up for a bundled offering it is usually difficult to switch since the offers may lock in consumers, e.g. for one or two years and impose financial penalties on consumers who wish to exit the contract earlier. Moreover, the cost involved in switching provider for a single part of the bundle could be a strong disincentive. For example, switching broadband generates significant costs since the e-mail address is not

portable and has to be changed and for businesses and some individuals this may be a significant deterrent to switching.

It is also often difficult to compare bundled packages offered by alternative service providers since most packages involve different combinations of services, service features and terms and conditions. Moreover, operators can also use bundling to complicate and obscure their pricing. Prices are obscured because consumers do not always understand the relationship between the bundle price and a price for each component. This can lead to consumers being confused by the different varieties of bundles and therefore not choosing the products that best meet their needs. For example, in the USA bundled services typically include unlimited local, local toll, and long distance services at a single flat rate. This can make it difficult for consumers to compare that single rate to the sum of the rates of the components because the components (especially long distance and local toll service), when sold as stand alone services, are usually sold on a usage (rather than flat rate) basis. Further, confronted with a huge array of complicated bundles from different operators, consumers are disposed to stay with the operator they are accustomed to despite of the possibility of better offers being available elsewhere.

Finally, bundling can force consumers to buy elements that either they do not need, or that do not match their desired specifications. This is because it may not be possible (or may be too confusing) for consumers to specify what services they wish to be bundled as part of their preferred package.

Information derived from questionnaire surveys has indicated that consumers are only moderately satisfied with their bundling arrangements. An Australian survey (Australian Communications Authority (ACA), 2004) found that among small business consumers 19 percent were dissatisfied with their bundled packages, whereas among residential consumers, 22 percent were dissatisfied. Consumers with bundling arrangements found comparing services from different bundled service providers more difficult than comparing services from different fixed line or mobile service providers. For instance, only six percent of small business respondents considered it easy to compare bundled packages between different service providers.

4. Evidence of actual switching behaviour in telecommunications markets

4.1 Switching behaviour in the fixed line market

United Kingdom. Ofcom's research found that in the UK, although the majority of consumers in the fixed line market have not considered changing their supplier, they have "participated" in other ways. This research identified the following four "participation" segments that are common across fixed line, mobile and internet telecommunications markets: inactive consumers (those who have had no past involvement at all other than possibly thinking about getting involved and have low interest in the market); passive consumers (those who may have had some past involvement and have some current interest in the market); interested consumers (those who have had little past involvement are more likely to keep an eye on the market and act on their future intentions); and engaged consumers (those who are the most active group in terms of past behaviour, interest in the market and future switching intentions).

One in three (34 percent) of the fixed line consumers surveyed had changed the supplier providing their home fixed line service in the last four years (including decisions to move from a single provider to split providers for calls and line rental). However, two-thirds (66 percent) had not switched in this time period and the majority (52 percent) had not even considered doing so. Regardless of whether or not they had switched supplier in the last four years, 34 percent had made some change to their existing service with their current supplier in this time period. A similar proportion claimed to keep an eye on the market: around one-third (36 percent) agreed that they were always on the look-out for a better deal and a similar proportion (31 percent) agreed that they made a conscious effort to keep up-to-date with what other providers were offering.

According to Ofcom's research, 86 percent of fixed line consumers in the UK were satisfied with their overall experience with their current supplier: almost half (46 percent) were very satisfied and a similar proportion (40 percent) was fairly satisfied. Consumer responses to Ofcom's questionnaire surveys indicated that the greatest deterrent to shopping for an alternative fixed line supplier was the possibility of getting locked into a contract with a new supplier: two-thirds of consumers (67 percent) agreed that they would be put off by this. The second greatest barrier to switching was reluctance to leave a known and trusted supplier for one that was unfamiliar – stated by 65 percent of consumers. In the fixed line market, many consumers have been with their supplier for many years. For some consumers, their relationship with their fixed line supplier was perceived as being more important than whether they could get a better deal elsewhere. Because of the "endowment factor" (a factor influencing consumer behaviour that is underlined by behavioural economics), these consumers would only switch if they had experienced a serious betrayal of trust, that incites a "revenge value" to switching. As many as one in two (53 percent) fixed line consumers agreed that they had a strong sense of loyalty to their existing supplier (Ofcom, 2006a).

The process of switching was itself likely to discourage around half of the consumers surveyed: 56 percent agreed that shopping (searching) for a new supplier was too much hassle, 52 percent agreed that it was difficult to make comparisons between suppliers and 49 percent agreed that they did not have enough time to research the options. For a similar proportion (46 percent) there is concern that there is a reasonable degree of risk that something will go wrong in the transition, potentially leaving them without service altogether. Moreover, the majority (58 percent) perceived that the gain would be only short term because all the suppliers tend to follow each other. No significant differences were detected between demographic groups. In other words, for fixed line consumers the differences are driven by differences in attitudes and behaviour rather than by differences in demographics.

In summary, Ofcom concludes that in the fixed line market, in the face of an undifferentiated market (perceived or actual), inactive consumers are adopting fallback, risk-averse strategies and will stay with what they know and trust, even though it might not be the best rational option. This appears to support the arguments of behavioural economics. Ofcom's findings suggest that the greatest chance of furthering participation in the fixed line market are efforts to help consumers to overcome their inertia, by allaying fears regarding the potential risks associated with switching services, or by educating them regarding the tangible benefits of any new service over and above their existing arrangement (Ofcom, 2006a).

Sweden. Information about switching activity in Sweden appears to be broadly consistent with the UK experience. In Sweden as of the end of 2005, just over 19 percent of the total number of telephone subscriptions were provided by an operator other than Telia Sonera (the incumbent), which is an increase of 17 percent from 31 December 2004 (Swedish National Post and Telecom Agency, 2005)

Portugal. The level of switching in Portugal's fixed line market has also been relatively low. Table IV indicates that about two-thirds (64 percent) of consumers interviewed as part of an Anacom study were satisfied with the prices charged by their fixed network provider. This degree of satisfaction with a key aspect of service would clearly reduce the disposition to switch.

Table IV Degree of satisfaction towards fixed line prices in Portugal

	(%)
Very satisfied	5.8
Satisfied	58.2
Not satisfied	29.5
Not satisfied at all	4.1
Do not know/did not respond	2.5

Source: Anacom (2006)

4.2. Switching in the mobile telecommunications market

United Kingdom. Ofcom (2006a) found that more than one-third (36 percent) of mobile telecommunications consumers in the UK had changed their mobile phone network supplier in the last four years. The figure rises to 52 percent for those who are on an annual contract and falls to 29 percent for those who are on pre-pay packages. However, two-thirds (66 percent) had not switched in this time period and the majority (53 percent) had not even considered doing so. Even among the 7 percent who had considered switching, not all had actively started looking for an alternative.

Ofcom pointed out that although the majority of consumers in the mobile phone market have not considered changing their supplier, they are "participating" in other ways. 32 percent had made some change to their existing service with their current supplier during this time period. While consumers were far more likely to change the tariff or package they were on (31 percent) than ask their supplier to match a better deal they had seen elsewhere (8 percent), mobile phone users seemed aware of their potential to negotiate. Of those on contracts, 62 percent had changed their existing tariff/package and 16 percent had attempted to renegotiate their package/deal. Around a third of all consumers claimed to keep an eye on the mobile phone market. A total of 32 percent agreed that they were always searching for a better deal and 28 percent agreed that they made a conscious effort to keep up-to-date with what other providers were offering.

Ofcom's research disclosed that in the UK engaged consumers were significantly more likely to be younger and male (i.e. early adopters) and Inactives tended to be older consumers on pre-pay packages (who tend to spend less). However, Ofcom concluded that the degree of consumer engagement with the market is better explained by differences in attitudes and behaviour rather than by differences in demographics.

Price and interest in technology stood out as clear drivers of consumer participation in the Ofcom studies. The majority (at least 85 percent) of all consumers in this market agreed that the low cost of their service and overall value for money were very important to them. Consumers classified as "interested" and "engaged" consumers were significantly more likely to make this claim (97 percent and 98 percent respectively). With respect to technology, the majority (88 percent) of "engaged" mobile phone consumers were willing to spend time looking at all the options to make sure they got the best one for them (compared to 42 percent of inactive consumers) and they were significantly more likely to be early adopters (37 percent and 8 percent respectively).

In terms of reasons given for not switching, more than half the telecommunications consumers surveyed (54 percent) said that they were very satisfied with their overall experience with their current supplier and another third (36 percent) said that they were fairly satisfied. Post-pay and pre-pay consumers were equally satisfied with their current network supplier.

The research also identified a range of procedural and psychological barriers perceived by mobile telecommunications consumers (see Table V). The greatest deterrent to shopping for an alternative mobile phone network supplier was the possibility of getting locked into a contract with a new company: around two-thirds of consumers (68 percent) agreed that they would be put off by this.

Reflecting a similar sentiment, the second greatest barrier to shopping was reluctance to leave a known and trusted supplier for one that was unfamiliar, an issue for 64 percent of consumers. This refers to the extent to which consumers value their relationships with their mobile phone network supplier. More than one in two (55 percent) agreed that they had a strong sense of loyalty to their existing network supplier. This was particularly the case for inactive consumers of whom 39 percent were likely to be "relational" people (with a preference for using trusted brands known or recommended to them) and only 14 percent likely to be "transactional" people (willing to consider unfamiliar brands if they offer a good deal). This manifestation of the "endowment factor" and "irrational" fear of changing to a new provider are consistent with the arguments of behavioural economics.

Table V Perceived barriers to shopping and/or switching mobile phone suppliers in the UK

Response to question (with prompted reasons): "I did not switch my mobile phone supplier because...":

Reason	*Agree (%)*	*Strongly agree (%)*	*Total agree (%)*	*Post-pay (%)*	*Pre-pay (%)*
Do not want to get locked into contract with new provider	47	21	68	47	52
Reluctant to leave provider I trust for one I do not know	47	17	64	52	59
Strong sense of loyalty towards current provider	36	19	55	No difference	
Shopping for new provider too much of a hassle/chore	41	12	53	41	49
Only short-term gain as providers follow one another	43	9	52	No difference	
Difficult to make comparisons between providers	38	9	47	35	53
Do not have time to research options	38	9	47	34	54
Do not want to lose current deal/package	32	14	42	No difference	
Big risk that something will go wrong in transition	30	7	37	No difference	
Do not know enough to make right choice	28	9	37	27	42
Bound to feel stupid/out-of-date when I talk to sales staff	21	12	33	24	37
No difference in cost of supplier	28	4	32	27	33
No difference in quality of supplier	26	3	29	23	32
Do not know where to find trusted info about options	21	5	26	No difference	

Note: Base: All mobile (500); percentages represent share of total sample
Source: Ofcom (2006a)

Lack of confidence, heuristics, and information overload also appeared to play more of a role in decision-making among inactive consumers. A total of 48 percent did not feel they knew enough to make the right choice and 42 percent expressed concern about "appearing stupid in front of sales staff". A total of 44 percent were willing to accept a solution that they felt was "good enough" rather than investigate all options to find the "best" one (17 percent).

In this market, consumers on contracts may also be bound to their suppliers as a result of having negotiated or been given special deals: two-fifths (42 percent) of consumers expressed concern about losing the package or deal they were on. Early exit penalties could also apply.

The process of shopping was itself likely to discourage around half of the consumers surveyed: 53 percent agreed that shopping for a new supplier was too much hassle, 47 percent agreed that it was difficult to make comparisons between suppliers and 47 percent agreed that they did not have enough time to research the options. Moreover, the majority (52 percent) perceived that the gain would be short term because all the suppliers follow each other. As Table VI indicates, this is particularly the case among pre-pay consumers, who perceived higher barriers to shopping than those on contracts: 82 percent of pre-pay users agreed they did not want to be locked into contracts with a new provider. They were also significantly more likely to regard shopping for a new network supplier as an onerous process, approaching it with lower levels of interest and confidence than contract users.

In summary, Ofcom concluded that the evidence suggests that in the UK mobile telecommunications market, in the face of complexity and lack of market differentiation (perceived or actual), inactive consumers will stay with what they know and trust, even though it might not be the "best" option. Ofcom concluded that the greatest chance of furthering participation in the mobile phone market is through efforts made to influence these key drivers, for example by educating them in regard to the tangible benefits of any new service over and above their existing set-up, by making the switching process easier or by helping consumers to overcome their inertia.

Portugal. In Portugal, Table VI indicates that of those mobile telecommunications consumers responding to a survey conducted for Anacom, about 19 percent have switched. Of these,

Table VI Switching mobile telecommunications operator in Portugal

	(%)
Have already changed operator	19.3
Most of my contacts are clients of new operator	34.6
Unhappy with prices	33.3
Unhappy with quality of service	13.7
Offer from new operator	8.6
Other	20.6
Never changed operator	80.7
Satisfied with current operator	66.2
Most of my contacts are clients of current operator	31.2
Offers the best prices	6.6
Switching is too complicated/inertia	3.2
Decision of another person	2.8
More/better network coverage	0.8
Keep the same number	0.4
Other	4.0
Do not know/did not respond	2.3

Source: Anacom (2006)

about one-third switched because "most of my contacts are clients of the new operator" and presumably there was some advantage with being on the same network such as network coverage and/or discounted or free calls to customers on the same network, Another one-third of those who switched did so because they were "unhappy with prices" of their old operator. 13.7 percent of those who switched did so because they were unhappy with the quality of service provided by their old operator and 8.6 percent because of an offer from the new operator.

Of the 80.7 percent who had never changed their operator, 66 percent were satisfied with the current operator and 31.2 percent because "most of my contacts are clients of current operator". Only about 10 percent of consumers seemed focused on price as a driver of switching and even less (about 4 percent) on quality of service.

Australia. The results of a questionnaire survey in Australia for the ACMA, summarised in Table VII, provides some additional information on consumer satisfaction (ACMA, 2006).

During the July 2005 to June 2006 period satisfaction levels (defined as "exceeded" or "mostly met expectations") were more than 80 percent for mobile telecommunications providers as well as fixed line and internet service provider. The highest satisfaction levels

Table VII Consumer satisfaction with telecommunications services in Australia, 2004-2006

Respondents were asked "In the last 12 months, how well have each of the following service providers met your overall expectations?" Excludes "no answer" and "does not apply"

	Exceeded my expectations		*Mostly met my expectations*		*Sometimes met my expectations*		*Rarely met my expectations*	
	July 2004-June 2005 (%)	*July 2005-June 2006 (%)*	*July 2004-June 2005 (%)*	*July 2005-June 2006 (%)*	*July 2004-June 2005 (%)*	*July 2005-June 2006 (%)*	*July 2004-June 2005 (%)*	*July 2005-June 2006 (%)*
Local telephone company	7.8	8.2	73.9	73.3	13.3	13.5	5.0	4.9
STD telephone company	7.0	7.5	75.4	74.7	12.9	13.2	4.7	4.6
International telephone company	7.4	7.1	73.5	74.3	13.7	13.4	5.5	5.3
Mobile phone service provider	9.4	9.9	72.5	72.1	13.1	13.4	5.0	4.6
Internet service provider	10.2	11.2	68.6	68.9	15.6	15.3	5.5	4.6

Source: Roy Morgan Research, questionnaire survey sample of approximately 23,000 people aged 14+ years, cited in ACMA (2006)

were for long distance (STD) fixed line telephone companies (82.2 percent). Internet service providers were the providers who most exceeded expectations (11.2 percent).

Consumer expressions of the "likelihood" of them switching service provider offer another measure of consumer dissatisfaction with their current provider. The Australian survey also provides some information in this regard, summarised in Table VIII.

The likelihood of consumers switching service provider ranged from: about 13.5 percent for fixed line providers, 14 percent for mobile telecommunications providers and 16.5 percent for internet service providers during the period July 2005 to June 2006. The remainder of consumers said they were either "unlikely" or "neither likely nor unlikely" to switch providers.

United States of America. A US report based on responses to a questionnaire survey in 2005 from 1,000 households found that 36 percent of respondents replied that early termination fees (ranging from US$150-US$240 as shown in Table IX) had prevented them from switching (CALPIRG Education Fund, 2005).

A total of 89 percent of mobile telecommunications consumers considered that early termination fees are designed to prevent consumers from switching. They disagreed with the mobile telecommunications operators' position that the termination fees are a necessary part of the rate structure (to enable them to recover the costs of subsidizing handsets, "buckets" of free calls, etc.).

4.2 Consumer behaviour in the internet market

United Kingdom. According to Ofcom's research awareness of alternative suppliers is lowest in the internet market with around 20 percent of Internet consumers in the UK unable to spontaneously name any narrowband or broadband internet service providers (ISPs) in

Table VIII Consumer likelihood to switch providers in Australia, 2004-2006

Respondents were asked "How likely would you be to switch companies, if you were able to buy that service from another company?" Excludes "no answer" and "does not apply"

	Very or fairly likely to switch		*Neither likely nor unlikely to switch*		*Very or fairly unlikely to switch*	
	July 2004-June 2005 (%)	*July 2005-June 2006 (%)*	*July 2004-June 2005 (%)*	*July 2005-June 2006 (%)*	*July 2004-June 2005 (%)*	*July 2005-June 2006 (%)*
Local telephone company	13.5	13.2	29.2	27.9	57.3	58.8
STD telephone company	13.0	12.8	29.8	28.3	57.2	58.9
International telephone company	11.8	11.5	30.7	29.1	57.5	59.5
Mobile phone service provider	14.5	13.9	29.2	28.2	56.4	57.9
Internet service provider	16.8	16.5	30.6	28.3	52.5	55.2

Source: Roy Morgan Research, questionnaire survey sample of approximately 23,000 people aged 14+ years. Cited in ACMA (Australian Communications and Media Authority), 2006

Table IX Early termination fees of major US mobile telecommunications service providers, July 2005

Company	*Early termination fee*
Cingular	USD 150
Nextel	USD 200
Sprint	USD 150
T-Mobile	USD 200
Verizon	USD 175

Note: These operators control about 80 percent of the US mobile telecommunications market
Source: CALPIRG Education Fund (2005)

their area. Half of internet consumers were spontaneously aware of two or more narrowband suppliers, and this rises to 74 percent when prompted (Ofcom, 2006a).

Just over one-quarter (28 percent) of UK consumers have ever switched their ISP supplier – 18 percent having changed supplier more than 12 months ago, and 9 percent more recently. These are lower levels than for fixed or mobile services, perhaps reflecting the earlier stage of development for Internet/broadband services. Just over one-quarter (28 percent) of the internet consumers surveyed had changed the supplier providing their household's internet connection in the last four years. However three-quarters (72 percent) had not switched in this time period and the majority (46 percent) had not even considered doing so. Even among the 13 percent who had considered switching, not all had actively started looking for an alternative.

Ofcom found that regardless of whether or not they had switched ISP in the last four years, almost three-quarters (72 percent) had made some change to their existing service with their current ISP in this time period. This was mainly the result of consumers switching connection type (62 percent had done this) and/or switching tariff, including upgrades to connection speed (53 percent had done this). Few (10 percent) had re-negotiated their deal (i.e. asked their current ISP to match a better deal they had seen elsewhere). Thus, even though the research shows that many consumers in the internet market have not considered changing their internet service provider (ISP), competition had allowed them to "participate" in other ways.

Compared with broadband users, narrowband users were significantly less likely to have made any changes to their existing package than: 24 percent had changed connection type and 25 percent had changed their tariff or package.

According to Ofcom's research, the greatest deterrents to active participation include the possibility of getting locked into a contract with a new supplier (68 percent of consumers); reluctance to leave a known and trusted ISP for one that was unfamiliar (63 percent of consumers); and perceived efforts of shopping around, including difficulty in making comparisons between ISPs (44 percent) and not enough time to research all the options time (40 percent). The main drivers of participation include interest in technology and desire for low cost and/or willingness to consider unfamiliar brands if offered a good deal. Interestingly, there were few demographic differences between the four "participation" segments, suggesting participation is influenced by attitudes and behaviour rather than by differences in demographics.

This evidence suggests that in the face of complexity (perceived or actual), inactive consumers are adopting fallback, risk-averse strategies and will stay with what they know and trust, even though it might not be the "best" option. This is consistent with the argument of behavioural economics that an "endowment factor" will serve to influence decisions in favour of the present provider (Wilson and Waddams-Price, 2005).

5. Conclusion

If consumers are able to switch easily, operators would be less inclined to charge excessively high prices or supply poor quality of service. There is need for further research into the:

- key drivers in the decision to search or switch;
- impact on switching, including the extent of misperception; low awareness of savings from switching; ease of switching;
- consumer needs and motivation to ascertain what would encourage more participation – especially by "uninvolved", vulnerable consumers.

Such research could help enhance identification of the nature and extent of regulatory (and other) intervention that is warranted.

On the basis of the information available thus far, this paper arrives at the following conclusions.

Consumers' awareness of alternative providers of communications services is of primary importance. Steps could be taken to make comparisons across providers easier, thereby reducing search costs of consumers and facilitating the switching process. Regulators could encourage third parties, including consumer organisations, to provide price/quality of service-comparison facilities through radio, consumer hotlines, web sites, etc.

Regulators should install measures to reduce practical impediments to consumers switching from one supplier to another. Regulators could require that all fixed, mobile and internet service providers ensure that the migration process from one service provider to another is fast, cheap, predictable and reliable and that consumers are able to switch with minimum difficulty and delay. For example, regulators could ensure that the shortest possible time is taken to complete number portability for consumers switching fixed line and mobile telecommunications providers. Regulators could require that all internet service providers ensure a simple, costless (or at least cheap) and quick transfer of consumers who choose to switch provider. Regulators could examine the need to limit the "lock in" period for mobile phone handsets in order to facilitate switching. Where applicable, the fee for unlocking the handset should be related to the cost involved.

Bundling can be beneficial to consumers and, indeed, an increasing number of consumers are subscribing to bundled service plans. But bundling can also be unfairly restrictive if the consumer's wish to change service provider for one service (e.g. voice or internet) is constricted because it would necessitate changing the provider for all services. The shift towards bundling means that if a consumer cannot pay a bill, this risks disconnection from all bundled services, including landline telephony, mobile, internet, and pay TV. Regulators should ensure that access to a single service is available.

Consumers have a right to contracts that are fair and transparent. Where contract conditions require a minimum contract duration, the expiry date should be clearly specified. Consumers are entitled to adequate notice of any intention to modify contractual conditions and about their right of withdrawal in such cases.

Regulators could require that all mobile telecommunications contracts be no longer than one year, with an option to renew the contract. Regulators could consider requiring a mandatory "opt in" default provision (rather than an "opt out" default) as part of arrangements for extending a contract. Suppliers should not be permitted to extend a consumer's contract without written permission. Early termination penalties/fees inhibit switching and constrict consumer choice. Regulators should consider requiring communications operators to eliminate the use of such penalties. Because consumers tend to heavily discount future costs and are more focused on the immediate near-term benefits, regulators could restrict the practice of fee payments for equipment, e.g. for a handset or a modem, when the consumer terminates subscribership (rather than at commencement).

Regulators could require all fixed line and mobile operators and internet service providers (ISPs) to provide a risk-free trial period during which they can cancel any new service contract without penalty. This would give consumers time and opportunity to ascertain whether the communications service works as promised. For instance, consumers could be given 30 days to cancel after receiving the first bill so that they can verify promises regarding cost and quality of service.

References

Anacom (2006), *Electronic Communications Consumer Survey, February 2006 – Key Findings*, May.

Analysys (2006), *Mobile Number Portability: Strategies for Operators and Regulators*, December, available at: http://research.analysys.com

Australian Communications and Media Authority (ACMA) (2006), *Telecommunications Performance Report 2005-2006*, Australian Communications and Media Authority, Belconnen, October.

Australian Communications Authority (ACA) (2004), *Consumer Satisfaction Survey*, Australian Communications Authority, Belconnen, August.

Barrow, P. (2007), "Just enough: empowering fixed-line telecommunications consumers through a quality of service information system" CCP Working Paper 07-2, available at: www.ccp.uea.ac.uk/publicfiles/workingpapers/CCP07-2.pdf

CALPIRG Education Fund (California Public Interest Research Group) (2005), *Locked in a Cell: How Cell Phone Early Termination Fees Hurt Consumers*, August.

(The) Economist (2007), "Japanese Telecoms: change is in the air" (number portability has boosted competition in mobile telecoms)", *The Economist*, 20 January.

European Commission (2006), *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions on the Review of the EU Regulatory Framework for Electronic Communication Networks and Services{COM(2006)334 final} – Proposed Changes*, Staff Working Document, Brussels, 28 June, SEC(2006) 816.

Gans, J. (2005), "Real consumers and Telco choice: the road to confusopoly", paper presented at the Australian Telecommunications Summit, Sydney, 21 November.

National Economic Research Associates (2003), "Switching costs: a report prepared for the Office of Fair Trading and the Department of Trade and Industry", Economic Discussion Paper No. 5, April.

Ofcom (2006a), "Consumer experience research" Annexe 4, *Consumer Decision-Making in the Telecoms Market*, Report on research findings, Research Annexe, 16 November.

Ofcom (2006b), *Broadband Migrations: Enabling Consumer Choice*, 13 December.

Ofcom (2007a), *Protecting Consumers from Mis-selling of Telecommunications Services*, Consultation Document, 8 February.

Ofcom (2007b), *The Consumer Experience – Telecoms, Internet and Digital Broadcasting. Policy Evaluation*, November.

Swedish National Post and Telecom Agency (2005), *Swedish Telecommunications Market 2005*, July.

UK National NCC (2006), *Switched on to switching? A survey of Consumer Behaviour and Attitudes*, 2001 Consumers Council, April.

Wilson, C.M. and Waddams-Price, C. (2005), *Irrationality in Consumer Switching Decisions: When More Firms May Mean Less Consumer Benefit*, Industrial Organization, 0509010 EconWPA.

Further reading

Australian Communications Authority (ACA) (2001), *Monitoring and Reporting on Quality of Service*, Australian Communications Authority, Belconnen, December.

Australian Communications Authority (ACA) (2002), *Telecommunications Performance Report 2001-2002*, Australian Communications Authority, Belconnen, November.

Australian Communications Authority (ACA) (2004), *Understanding Your Broadband Quality of Service*, Australian Communications Authority, Belconnen, November.

Bar-Gill, O. (2006), "Bundling and consumer misperception", *The University of Chicago Law Review*, January.

Better Regulation Executive (2007), *Government Response to the Final Better Regulation Executive/National Consumer Council Report on Consumer Information*, UK Department for Business Enterprise and Regulatory Reform, London, November.

Camerer, C., Issacharoff, S., Loewenstein, G., O'donoghue, T. and Rabin, M. (2003), "Regulation for conservatives: behavioural economics and the case for asymmetric paternalism", *University of Pennsylvania Law Review*, Vol. 151, pp. 1211-54.

Canadian Telecommunications Policy Review (2006), *Final Report 2006*, Canadian Telecommunications Policy Review, Ottawa.

Department of Trade and Industry (2003), "Switching costs", Economic Discussion Paper No. 5, report prepared for the Office of Fair Trading and the Department of Trade and Industry by National Economic Research Associates, April.

Milne, R. (2006), "ICT quality of service regulation: practices and proposals", paper presented at the ITU Global Seminar on Quality of Service and Consumer Protection, Geneva, Switzerland, 31 August-1 September.

OECD (2005), *Guiding Principles on Regulatory Quality and Performance*, OECD, Paris.

OECD (2006), *Roundtable on Demand-Side Economics for Consumer Policy: Summary Report*, OECD, Paris, available at: www.oecd.org/dataoecd/31/46/36581073.pdf

OECD (2007), *Summary Report on the 2nd OECD Roundtable on Consumer Policy*, OECD, Paris.

Ofcom (2006a), *Ofcom's Consumer Policy – A Consultation*, 8 February, London, available at: www.ofcom.org/consult/condocs/ocp/ocp_web.pdf

Ofcom (2006b), *The Communications Market 2006*, August.

Ofcom (2007), *Ofcom's Consumer Policy: A Consultation*, 8 February, London.

Public Interest Research Group (Illinois PIRG) (2005), *Can You Hear Us Now? A Report on How the Cell Phone Industry has failed Consumers*, March, available at: www.illinoispirg.org/reports/canyouhearusnow.pdf

Sylvan, L. (2006), "The interface between consumer policy and competition policy", Lecture in honour of Professor Maureen Brunt, Department of Consumer Affairs, Melbourne.

UK National Consumers Council (2005), NCC's response to Ofcom's Consultation Strategic review of Telecommunications: Phase 2, February, available at: www.ofcom.org.uk/consult/condocs/telecoms_p2/restsrp2/ncc.pdf

UK Office of Telecommunications (Oftel) (2001), *Effective Competition Review: Mobiles*, UK Office of Telecommunications, London, February.

UK Office of Telecommunications (Oftel) (2002), *Review of SIM-Locking Policy*, 26 November, available at: www.oftel.gov.uk/publications/mobile/2002/sim1102.htm

Corresponding author

Patrick Xavier can be contacted at: poxavier@gmail.com

Before The
FEDERAL COMMUNICATIONS COMMISSION
445 12th Street, S.W., Washington, DC 20554

In the Matter of	)	
The State Of Mobile Wireless Competition	)	WT Docket No. 10-133

COMMENTS OF AT&T INC.

David L. Lawson
James P. Young
Christopher T. Shenk
SIDLEY AUSTIN LLP
1501 K Street, N.W.
Washington, D.C. 20005
202-736-8088

Michael P. Goggin
Gary L. Phillips
Paul K. Mancini
AT&T Inc.
1120 20th Street, N.W.
Washington, D.C. 20036
202-457-2055

Attorneys for AT&T Inc.

July 30, 2010

TABLE OF CONTENTS

Before The
FEDERAL COMMUNICATIONS COMMISSION
445 12th Street, S.W., Washington, DC 20554

In the Matter of	)	
The State Of Mobile Wireless Competition	)	WT Docket No. 10-133

COMMENTS OF AT&T INC.

Pursuant to the Public Notice ("*Notice*") released by the Wireless Telecommunications Bureau ("Bureau") on June 30, 2010,[1] AT&T Inc. ("AT&T") submits the following comments.

INTRODUCTION AND SUMMARY

The Commission's Fourteenth Annual Wireless Competition Report[2] reads as a search for the dark lining in a silver cloud. The great bulk of the Report lays out an enormous array of facts that confirm a vibrantly competitive wireless marketplace: falling prices, expanding output, substantial new entry, unprecedented options for consumers, rapid, breathtaking innovation, and tens of billions of dollars of new investment even in the midst of an historic economic downturn. Inexplicably, however, the *Fourteenth Report* refuses to draw the obvious conclusion of the Commission's past six annual wireless reports: that the wireless marketplace is characterized by "effective competition."[3]

Looking past a veritable mountain of direct evidence that U.S. mobile wireless consumers

[1] Public Notice, *The State Of Mobile Wireless Competition*, WT Docket No. 10-133 (rel. June 30, 2010) ("*Notice*").

[2] Fourteenth Report, *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, WT Docket No. 09-66, FCC 10-81 (rel. May 20, 2010) ("*Fourteenth Report*" or "Report").

[3] 47 U.S.C. § 332(c).

are reaping the benefits of a marketplace that is characterized by vigorous competitive rivalry – with providers constantly one-upping each other to offer consumers expanded and improved choices and more for less – the *Fourteenth Report* instead ballyhoos a series of indirect calculations that it suggests may be harbingers of doom.

The supposedly negative signs highlighted in the *Fourteenth Report's* executive summary and press release are, in fact, nothing of the sort. In some cases, such as the suggestions that provider investment and advertising are declining, the *Fourteenth Report* simply has the facts wrong. In other cases, such as the "weighted average" HHI concentration in the world's *least* concentrated wireless marketplace, the *Fourteenth Report* leaps to conclusions that would not be supported by its calculations even if they had been performed correctly (and they were not). And, in still other cases, such as "EBITDA" accounting "profitability," the *Fourteenth Report* itself acknowledges that no economically meaningful conclusions can be drawn from the variations between providers that it cites. Of course, none of this number-crunching can erase the directly observable market performance and, in the end, the *Fourteenth Report* attempts to shift attention entirely away from the congressional inquiry whether competition is "effective" (as it clearly is) under the theory that, no matter how effective the competition, "there are policy levers that can be used to produce superior outcomes."[4]

This conspicuous refusal to acknowledge effective wireless competition is not merely an academic issue – it is doing real harm. By leaving the impression that the Commission may impose regulatory "solutions" in the absence of *any* real market problems, the *Fourteenth Report* undeniably exacerbates regulatory uncertainty and discourages new infrastructure investment – a

[4] *Fourteenth Report* ¶ 16 (quoting *Ex Parte* Submission of the U.S. Dep't. of Justice, GN Docket No. 09-51, at 11 (filed Jan. 11, 2010) ("DOJ 1/4/10 *Ex Parte*")).