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Mobile Phone Mergers and Market Shares
Short Term Losses and Long Term Gains

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Abstract

The US mobile phone industry has dramatically consolidated through mergers. We investigate whether a merger increases the performance of a combined carrier over the sum of its constituent parts. We first directly compare the quantities of post-merger carriers to those of their pre-merger predecessors. This analysis considers only two years after a merger, as most carriers engage in new mergers after that time. To examine possible long run implications, we also explore the cross sectional relationship between outcomes and measures of firm size, as firm size is increased in a merger. We examine the market share of new subscribers. We also examine two measures of firm size: the amount of a carrier's geographic coverage and its past subscriber count.

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1 Introduction

A recent series of mergers has consolidated the mobile phone industry, so that a large fraction of the 208 million subscribers receive service from one of the four national carriers: Cingular, Sprint Nextel, T-Mobile and Verizon. In 2005, the latest year with data available, these four carriers signed up 87% of net new customers among carriers with reported subscriber data, and at the end of the year provided mobile phone service to 85% of customers in the United States.

The mobile phone industry is typical in that many growing industries experience a shakeout period, where a large number of initial players reduce to a smaller number of survivors. Because of the technology of mobile phone service, carriers must own a license from the Federal Communications Commission (FCC) to provide service in a given territory. Given this regulatory framework, a license is a scarce asset, so firms never exit the market. Instead, carriers merge to create larger carriers, and eventually the national carriers that we see today.

Our broad goal is to investigate why mergers occur. To do this, we first need to understand how the components of a firm's profit are affected by mergers. This paper focuses on how mergers alter revenues, rather than costs.

We seek to understand how mergers affect the product market performance of firms. We examine two firm outcomes, prices and the market share of new subscribers. We use two basic empirical approaches. First, we compare a post-merger firm's product market performance to the sum of the performance of its predecessor firms. Second, we view a large firm as a product of more mergers. We use the cross sections of firms to compare large to small firms, to see if large firms have higher levels of performance than some baseline model would suggest. Both of our empirical approaches are designed to place numbers on what firms pondering a merger might anticipate.

We focus primarily on quantities in the current draft. As customers sign two year contracts when subscribing to new service, we focus on the market for new subscribers. As mobile phones are diffusing into the US population, all carriers are increasing in total subscribers. Thus, our measure of market share is based on the number of net new subscribers. We calculate the increase in subscribers for each carrier separately: that is the carrier's net new subscribers. The sum of the total number of new subscribers is the total market, and so each carrier has a share of that market.

When we look directly before and after mergers, we find that market shares of the post-merger company are more likely to be lower than the sum of the shares of the pre-merger companies. Because observed mergers are selected to be those that will be most profitable, we interpret our finding of underperformance after a merger as evidence of significant organizational adjustment costs. Over the short run, the merged firm is distracted and unable to compete effectively in the product market.

Looking more than two years after a merger is not a clean exercise in merger evaluation, as carriers often

undertake another merger during that horizon. To get an idea of the long-run benefits of a merger, we examine the cross-sectional relationship between size and mergers. In recent years, the cross-sectional relationship has shifted so that large companies sign up more customers than would be expected given their coverage areas alone. We are not able to identify where this effect arises from. It could be because of a public perception of greater quality, a more dense network of retail stores, or returns to scale in advertising.

Our preliminary evidence on prices does not find much evidence of a direct link with mergers. While some firms are dropping their lowest end plans, it is not obvious that this is tied directly to mergers. For now, a slightly decreasing nominal price over the past five years is a good approximation of industry behavior.

2 Mergers and Profits

The economic operating profit of a firm is its revenues minus its costs, or $p \cdot q(p) - c(q)$, where the firm sets price p , sells $q(p)$ products, and pays costs $c(q)$. One motivation for two firms to merge is that the sum of present discounted post-merger profits of the combined company will exceed the sum of profits of the firms absent the merger. Mergers can have many effects on profits. We quickly overview some of them. We first list possible short term costs and benefits.

1. The company must pay explicit merger costs, such as costs to advisers and severance payments to displaced workers.
2. The company loses profits through underperformance. The company's strategy may be unclear to workers and affiliates such as independent dealers. Attention may be paid to integration rather than customer service, marketing and introducing new products. Consumers may be unsure about signing a two-year contract with an uncertain entity.
3. A possible benefit is when a firm can earn windfall profits by selling redundant assets.

We next list long-term costs and benefits.

1. The company eliminates the branding and retail products of one of the pre-merger companies, so the company occupies a narrower portion of product characteristic space than the sum of the product portfolios, and so may appeal to a narrower range of customers than both carriers operating independently.
2. The post-merger company may be unwieldy and unfocused.
3. The post-merger company may have lower costs through increasing returns to scale, both technologically and through greater bargaining power with subscribers.

4. The post-merger company may be able to raise product quality, both through offering a larger geographic coverage area and through paying greater fixed costs to offer new products and services.

5. The post-merger company may find it more profitable to advertise on a national scale, creating a perception of higher quality in the minds of consumers.

Many but not all costs may occur in the short run. Most of the benefits of a successful merger will occur over the long run.

This paper focuses on a subset of these costs and benefits: those appearing in prices and quantities.

3 Data Sources

Data collection for this project has been a multi-year effort. Most of the data sources were entered manually from historical records. Great effort was taken to standardize records from different sources to the best extent possible.

We collected subscriber data on an annual basis for 1995–2005. We believe we have data on most firms with a significant presence; there are always very small, rural carriers whose subscriber data are not publicly available. Subscriber data were obtained from primary sources, the Securities Exchange Commission 10-K and 10-Q filings and operators' corporate websites, and secondary sources, such as the Federal Communications Commission's (FCC's) Annual CMRS Competition Reports and RCR News. Subscriber numbers for a larger carrier such as Sprint do not include subscribers from affiliates that jointly market but independently operate networks, or mobile virtual network operators, which rent space on others' networks.

Price data were purchased from a research company, EconOne. EconOne records details on all calling plans offered by carriers in 20 major US cities. We have quarterly data from 1999–2005. To ease the analysis, we aggregate this data to a national level, and also create a single monthly price that uses the calling plan from each carrier that we deem most suitable to a user who needs to speak 500 minutes on the phone every month. Bajari, Fox and Ryan (2006) find that 450 minute plans are the most popular.

A carrier is legally required to own a FCC license in order to operate a wireless network in a given territory. After the spectrum auctions in the mid-1990s, there are a minimum of nine licenses per geographic territory. There are 734 officially designated Cellular Market Areas (CMAs), territories at the smallest boundary level. There can be more than nine licenses per designated territory (CMA) because of the option to split licenses both in terms of smaller geographic units and in terms of blocks of electromagnetic spectrum. In 2005, we have more than 15,000 licenses to track.

License data come from a great variety of sources. For 1995–1999 period, end-user guides about the cellular industry like the Cellular Travel Guide have been combined with resources for business analysts

from Kagan Research. For each CMA, we see the owner of the original wireline and nonwireline licenses initially awarded in the 1980's. Spectrum auctions during 1995 and 1996 issued new "PCS" licenses that slowly allowed new mobile phone networks to enter. The main problem with the 1995–1999 license data sources is that they do not cover the new PCS or "SMR" (Nextel, etc.) operators which had significant activity in the late 1990's. To fill in the missing data for newly issued licenses, we have used auction results data from the FCC and we have incorporated changes due to lost or returned licenses that were then re-auctioned. Our database does not consider the case of licenses sold or exchanged to other carriers between 1995–1999 because this information is not available. Considering press reports and legal restrictions on the transfer of newly purchased licenses, we believe that the non-merger exchanges of newly-issued licenses did not occur very often.

For the period 2000–2005, we use data from Kagan, the Wireless Travel Guide, and RCR News that include both the original licenses from the 1980's and the auctioned PCS licenses. The data cover geographic information, legal owner, trade name, block and bandwidth. During this period, precise geographic information can be important because it is frequent for companies to split licenses, as discussed above.

SMR licenses were originally targeted towards paging and taxi dispatch. These licenses were not included in the data sources we have used. Although there were many small operators in the SMR band that provided non-voice services such as paging, there were only three operators that had significant importance in the mobile phone industry: Nextel, its affiliate Nextel Partners and SouthernLinc. We included those three operators in the database. To obtain the SMR license data, we used SMR auction data as well as 2002 license information at county level. Combining these sources, we believe have obtained accurate information on the licenses controlled by Nextel and the other SMR carriers. Because of the technological incompatibility of these licenses with the more standard ones, we believe that transactions between carriers occur much more infrequently.

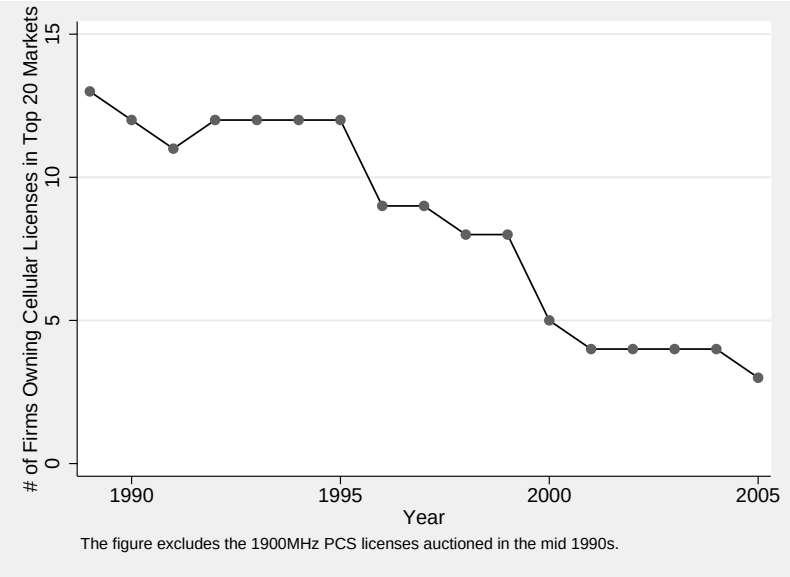
We use some limited firm quality data from customer surveys reported in the magazine Consumer Reports.

4 History of Mergers

As of September 2005, Cingular, Verizon, Sprint Nextel and T-Mobile dominate the wireless phone service industry in the United States. The industry was not always so centralized. Figure 1 demonstrates the consolidation of the industry by presenting the number of distinct firms owning at least one of a balanced panel of the two original cellular licenses awarded for the Top 20 US geographic markets (for a total of 40 licenses). In 1989, 13 separate firms together owned the 40 licenses, while at the start of 2005 only three firms control those licenses, and two of those three, Verizon and Cingular, together own 39 of the 40 licenses.

The initial dispersion of control in Figure 1 can be traced to regulation by the Federal Communications

Figure 1: Number of Distinct Firms Owning Original Cellular Licenses in the Top 20 US Markets by 1989 Population



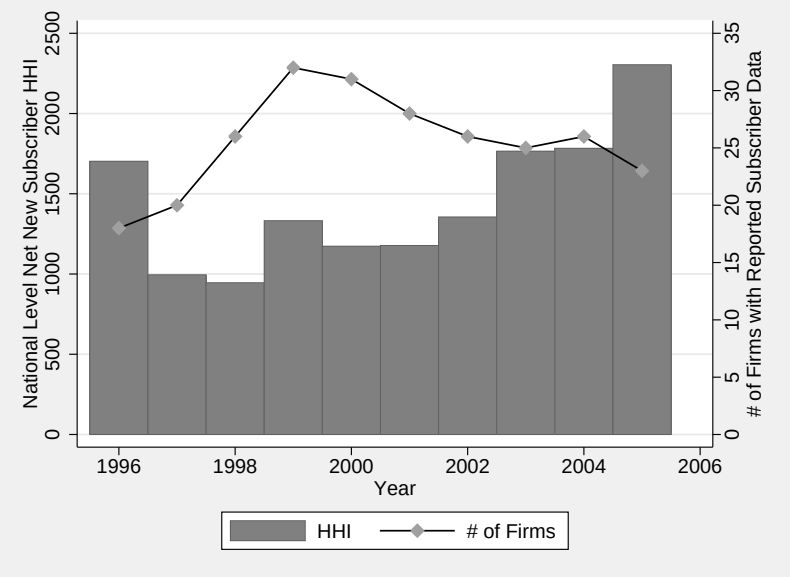
Commission (FCC). The FCC issues licenses for the exclusive use of blocks of radio spectrum in designated geographic markets.[1] Between 1982 and 1986, the FCC planned to use comparative worth regulatory hearings to assign licenses. However, the FCC did not have the engineering resources to evaluate the many proposals, so the FCC awarded licenses for smaller cities and rural areas using a passive mechanism: lotteries. The lottery assignment mechanism attracted entrepreneurs with very little capability to operate a wireless phone carrier.

The FCC's licensing schemes created an industry with a large number of players. In a world without transactions costs, management of licenses should shift to those companies best capable of operating a wireless phone carrier. The FCC placed few restrictions on the ability of firms to merge across markets. The most famous aggregator of wireless phone licenses was McCaw Cellular, which grew to a national wireless phone carrier that was sold to AT&T for $17.3 billion in 1993.

In late 1994, the FCC began a process of auctioning new radio spectrum, the Personal Communication Services (PCS) licenses, for mobile phone use. AT&T Wireless (the former McCaw) was able to fill in holes in its burgeoning national network, a new national carrier (Sprint) was created, and the forerunner of another new carrier (today's T-Mobile USA) entered the industry. In 1993, Nextel surprisingly won FCC approval to use licenses it had purchased from paging and taxi dispatch companies to provide wireless phone service. Nextel soon became a new national carrier.

[1] Spectrum regulation prevents interference from multiple users transmitting on the same radio frequency.

Figure 2: National Market Concentration (HHI) and the Number of Significant Carriers by Year



The regulated entry encouraged the FCC to raise the amount of spectrum that a company can own in one market, the spectrum cap.[2] The spectrum cap originally limited a carrier to owning no more than 35 MHz worth of mobile phone spectrum in a given geographic area. The FCC raised the spectrum cap to 45 MHz in 1996, 55 MHz in 2001, and eliminated the cap altogether in 2003. Today major companies with much overlap in coverage areas, such as Cingular and AT&T, can merge.

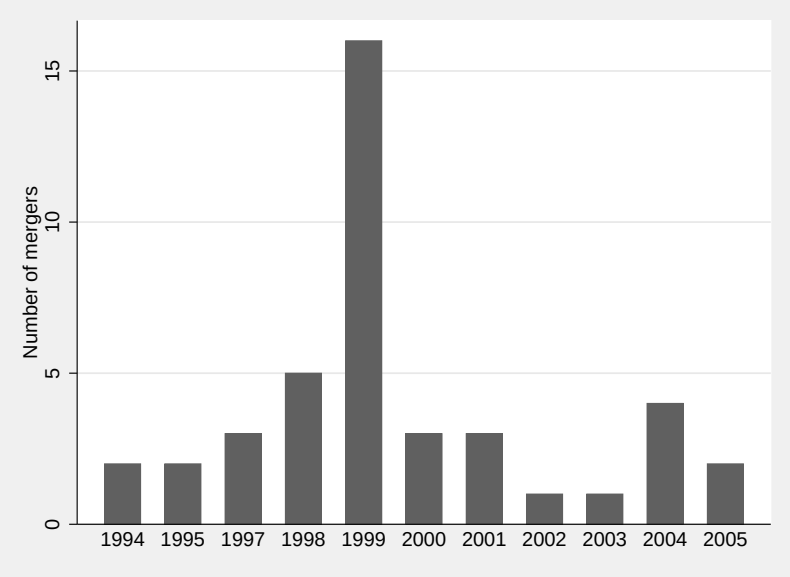
Figure 2 shows the evolution of national-level market concentration from right before the spectrum auctions until today. The right axis reports the number of distinct carriers that are large enough for our data sources to record subscriber data for. The middle 1990s saw new carriers entering through spectrum auctions and signing up new subscribers. The number of significant independent firms peaks in 1999 at 32. By 2005, the number of carriers has dropped to 23, largely though mergers.

Figure 2 also measures concentration using market share data. We compute the Herfindahl-Hirschman Index (HHI), which is $\sum_i m_i^2$, where m_i is market share in the total number of customers multiplied by 100. Entry through spectrum auctions reduced the national level HHI from 1700 in 1996 to a low of 940 in 1998. By 2005, a series of mergers raised the national level HHI to 2300, which is equivalent to 4.3 equal sized firms operating nationally. The four national carriers that dominate the industry are Cingular, Sprint Nextel, T-Mobile and Verizon.

Figure 3 shows the number of mergers per year. A merger of two or merger carriers into one combined

[2]The licenses issued in the 1980's are for 25 MHz worth of spectrum, and the more recent PCS licenses auctioned in the mid 1990's were originally for either 30 MHz or 10 MHz.

Figure 3: Number of mergers by year



company is counted as the number of firms involved minus one, so a merger of three carriers is two mergers. There are a total of 42 mergers from 1995 to 2006. We see that a large number of mergers occurred in 1999. That was the year of the creation of three national operators currently providing service: Cingular, T-Mobile and Verizon.

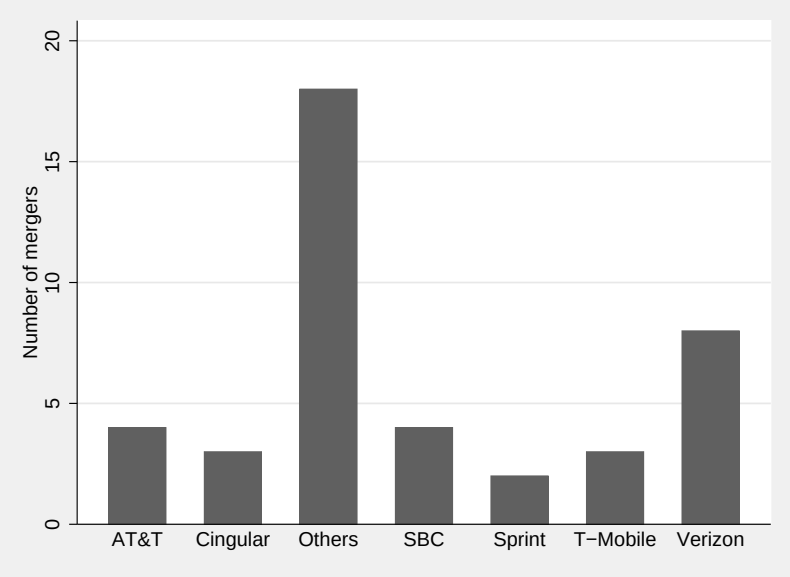
By a merger we refer to the acquisition of all the assets of one firm (including spectrum licenses) by another firm. Merging with another carrier has historically been the most important expansion method, but there are other, less extreme methods for a carrier to expand. For example, operators have frequently exchanged or sold groups of licenses without merging. As mergers are the most important form of expansion, we focus on mergers rather than sales and exchanges in this paper.

Seventeen of the mergers involve three or more firms combining in the same year. The most famous example is the creation of Verizon from the merger of five carriers. Figure 4 breaks out the number of mergers by the identity of the post-merger firm. As merging is the main strategy used by carriers to expand, it is not surprising that the four national operators in 2005 have an important share of the total number of mergers. Note also that AT&T and SBC are now part of Cingular.

5 Before and After Mergers

This section examines whether post-merger firms increase or decrease their market shares. We aggregate the share of net new subscribers of the merged companies before each merger and we compare this share

Figure 4: Number of Mergers by Post-Merger Carrier



to the share of net new subscribers of the post-merger firm. Figure 5 reports the pre-merger shares on the horizontal axis and the post-merger shares on the vertical axis. A 45 degree line is plotted; mergers above the line had more subscribers after than before, and points below the line lost shares of new subscribers during the merger.

Figure 5 shows that only four mergers are noticeably above the 45 degree line. These companies were more successful enrolling new subscribers one year after the merger. By contrast, many more points are below the line: during the year after the merger, the combined carrier underperformed its predecessors. Some of the underperforming is quite substantial. Sprint merged with Nextel in 2005; the combined share of net new subscribers dropped from 0.35 before the merger to 0.1 after the merger.

Figure 6 updates Figure 5 by looking at market shares of net new subscribers two years after the original merger. Many mergers are excluded because a new merger occurs with the same firm. For example, T-Mobile was created in 2000 as a result of the combination of Omnipoint, VoiceStream and Aerial. In 2001 T-Mobile merged with PowerTel, so it is difficult to separate the effect of the 2000 mergers from the 2001 merger. This aside, Figure 6 shows that slightly more mergers are above the 45 degree line: the market share of the combined company is greater than the combined shares before the merger. This is the first piece of evidence suggesting that the merger costs in terms of organizational performance may occur mainly in the short term.

We choose to not follow carriers three or more years after a merger, as many carriers undertake another merger during that period. It is not possible to distinguish the effects of the first merger from the more recent

Figure 5: Before and After Mergers: National Shares of Net New Subscribers

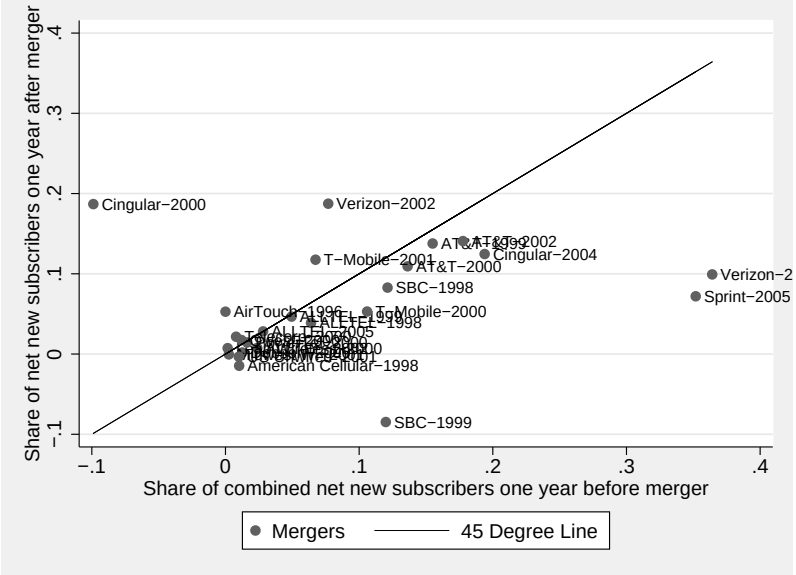
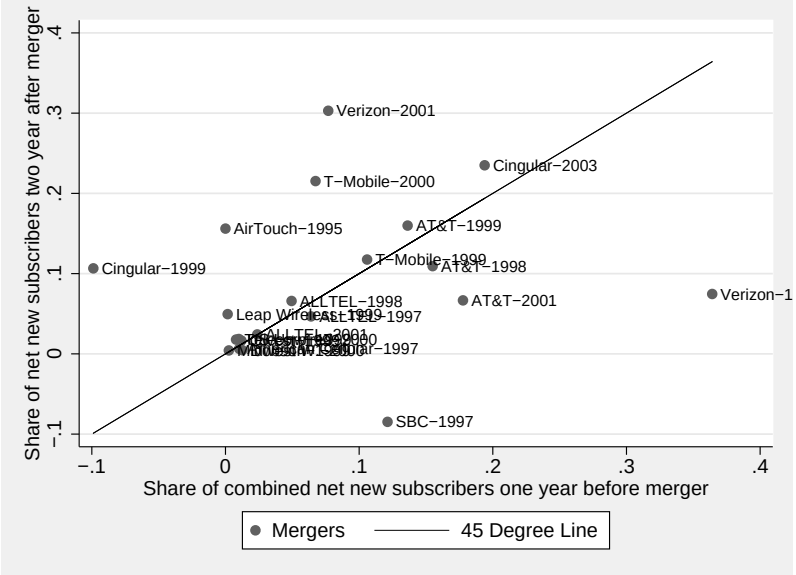


Figure 6: Before and Two Years After Mergers: National Shares of Net New Subscribers



second merger. Looking at one and two years after a merger, we find that firms that merged firms generally underperform their predecessor companies. This is what a model of removing horizontal differentiation or a model of merger costs would suggest.

A standard selection model predicts that the set of realized mergers are those mergers where the unobserved net gain to the firms involved is the largest. Firms sort on both observed and unobserved characteristics. Thus, examining only consummated mergers may overpredict the gains from mergers. However, we find that mergers in general did not have immediate benefits in terms of the market share of net new subscribers. Thus, our conclusions about the short run adjustment costs in terms of market shares are accentuated by considering that mergers that could have but did not occur may have performed much worse.

One possible caveat to the above is regulatory-induced divestiture. During some mergers, the FCC requires carriers to divest some overlapping territories, for anti-trust reasons. This currently unmeasured divestiture could produce a pattern where some carriers underperform during the year after a merger.

6 Size and Market Share

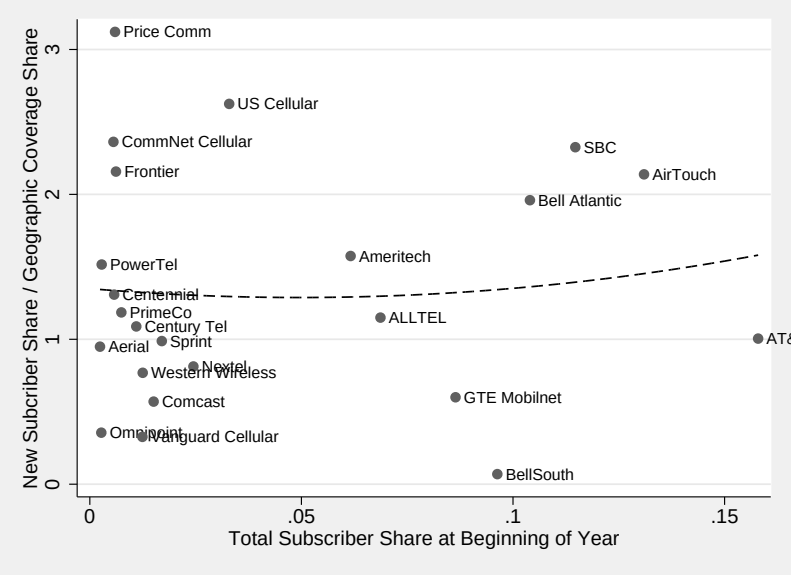
The main consequence of a merger is that combined firm is larger than its constituent parts. A possible forecast of the benefits of a merger can be seen by comparing the market shares of large and small firms in the cross section. If large carriers systematically have even larger shares than some baseline prediction, this suggests that there may be benefits from a merger.

As usual, we measure market share by the fraction of net new subscribes in a given year. We use two measures of carrier size: geographic coverage in terms of covered population and last year's total subscribers, not just net new subscribers. We convert both measures into within-year shares by dividing by the sum of each size measure over all carriers operating in a year. For a carrier that just completed a recent merger, last year's share of total subscribers is the sum of the constituent carriers' shares.

Our baseline framework is that if there are N carriers in a territory, then we should expect each carrier to sign up a share $1/N$ of all carriers. While we do not observe within-territory subscriber figures, we can approximate this baseline by suggesting that, in the absence of other effects, a carrier's share of net new subscribers should be equal to its share of geographic coverage. In other words, a carrier covering more territories should mechanically have a larger share. What is more interesting is if carrier has more new subscribers than this mechanical effect suggests.

For carrier i in year t, we form the statistic geographic-coverage normalized share of net new subscribers, or $s^g_{it} = \frac{s_{it}}{g_{it}}$, where s_{it} is the share of net new subscribers and g_{it} is the share of total geographic coverage. A carrier with a s^g_{it} of more than 1 has more new subscribers than our baseline model would predict. Likewise, a firm with a s^g_{it} of less than 1 has fewer subscribers than predicted. We then examine the regression

Figure 7: 1998: New Subscriber Share Normalized by Coverage Share and Firm Size Measured by Last Year's Share of Subscriber Stock



a

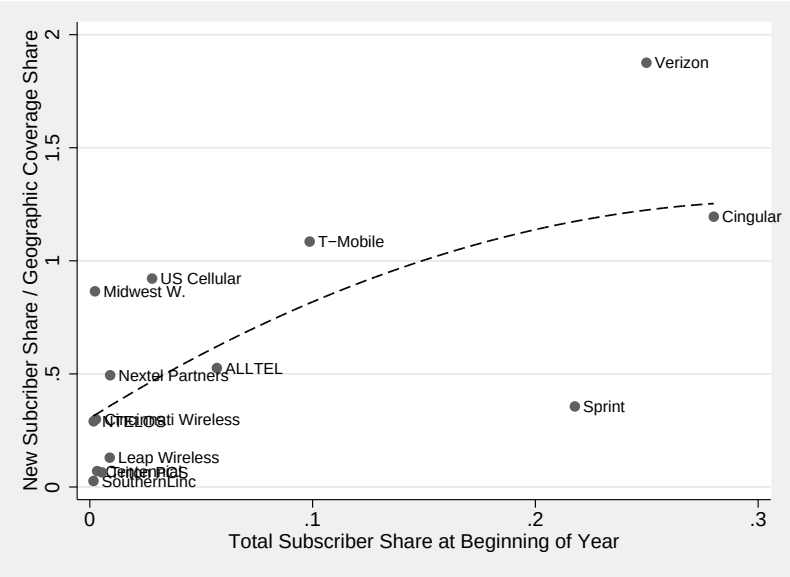
[a]Three tiny firms (at most a share 0.003 of geographic coverage) with valid new subscriber data are not on the graph because the observations are off the scale.

equation $s_{it}^{g} = b_0 + b_1 d_{i,t-1} + b_2 d_{i,t-1}^2 + \varepsilon_{it}$,where $d_{i,t-1}$ is the share of total subscribers in period $t-1$, another measure of size.

Figure 7 presents a cross-sectional scatterplot and quadratic regression of normalized new subscriber share on last year's total share. The figure presents data for 1998, a year before the flurry of mergers in 1999. We see that some firms are below 1 and some are above 1, but that there is no clear pattern where larger firms are above 1 and smaller firms are below 1. From this figure, it does not appear that there is evidence in favor of the conclusion that there is an extra benefit of size that would motivate a merger.

Over time, the pattern in Figure 7 changes. Figure 8 shows the same graph for the year 2005. Because of the mergers, most carrier names have changed since 1998. Figure 8 shows that all of the carriers outside of the four national carriers have normalized shares below 1: their shares of new subscribers are less than their geographic coverage shares would suggest. Only three carriers are above 1: T-Mobile, Cingular and, noticeably, Verizon, which has twice the number of new subscribers that it share would suggest. Sprint Nextel signed up fewer customers in 2005 than might be expected, as a possibly disruptive merger was undertaken during 2005. Figure 8 shows that, even accounting for geographic coverage, larger carriers

Figure 8: 2005: New Subscriber Share Normalized by Coverage Share and Firm Size Measured by Last Year's Share of Subscriber Stock



enroll more new subscribers.

The differences between 1998 and 2005 are not random noise: there is a gradual pattern of larger carriers receiving a higher share of net new subscribers, even when normalizing for geographic coverage. Table 1 shows this by including regressions with time trends and all years of data. We include results from both standard OLS and a weighted-least squares robust regression procedure, because of the presence of some extreme outliers in the dependent variable (small carriers with tiny geographic coverage shares but slightly less tiny shares of new customers). Typically, the coefficients are only statistically significant in the robust regressions. Consider the first coefficient. In the first year of the data, 1996, the time trend is 1. The coefficient on -5.28 on share and 0.913 on the time trend says that the largest carrier of the day, AT&T with a previous total subscriber share of 0.19, has a predicted normalized share of net new subscribers that is 0.823 units less than a company with near zero share, such as CommNet Cellular. According to the time trend, the coefficient on total lagged subscriber share becomes 0 around 2000, and becomes 4.8 in 2005. A very similar pattern is observed when geographic coverage is itself the measure of size. When including both measures, geographic coverage remains statistically significant and has similar coefficients, but the contribution of total subscribers becomes statistically indistinguishable from zero, with small in magnitude coefficients.

Figure 7 suggests that large firms do have some advantage in the early years of the 21st century. Either they can compete by offering lower prices, better service, or better marketing. One story focuses on the web of dealers and the measure $s^g_{it} = \frac{s_{it}}{g_{it}}$. When two, large national carriers merger, g_{it} increases only a little, as

Table 1: Regression of Normalized Share of Net New Subscribers on Measures of Size

Coefficient	OLS	Robust	OLS	Robust	OLS	Robust
Total Subscriber Share at Beginning of Year	-19.72	-5.28			14.32	2.25
	(20.9)	(2.47)			(15.6)	(1.83)
" time trend	1.73	0.913			-0.238	-0.0078
	(3.06)	(0.361)			(0.123)	(0.0144)
Geographic coverage share			-22.34	-9.55	-31.3	-10.8
			(22.15)	(2.57)	(23.9)	(2.80)
" * time trend			1.50	1.43	6.20	1.48
			(3.38)	(0.393)	(4.20)	(0.490)
Time trend (not interacted)	-0.201	-0.175	-0.163	-0.199	-1.46	-0.235
	(0.263)	(0.031)	(0.267)	(0.0310)	(0.722)	(0.0844)
Constant	3.64	2.06	3.57	2.27	3.57	2.22
	(1.60)	(0.189)	(1.56)	(0.182)	(1.60)	(0.187)
R^2	0.01		0.01		0.03	
# of Carrier Years	215	215	215	215	215	215

there is a lot of overlap. So even a small decrease in the sum of the two $s_{i,t-1}$'s might be offset by a small increase in g_{it}. More practically, one suggestion is that the merged dealer network is not pruned, so that the combined company does not lose half of its market share, as a simple model of horizontal deviation might suggest. This effect would suggest that perhaps there is some benefit to size in the reduced form for market shares.

7 Measuring Firm Quality

We have found that, in recent years, larger firms disproportionately enroll new customers. One possibility is that this effect is orthogonal to mergers: the best companies were those involved in the merger, and the combined share of the pre-merger companies if they had not merged would be the same as the observed share of the combined company.

To understand better the effect of the unobserved quality variable on the share of new subscribers, we have used a survey by Consumer Reports with ratings about consumer satisfaction with mobile operators in 18 metropolitan areas in September 2005. Scores were from 0 to 100, where 80 means very satisfied, and 60 somewhat satisfied. Although we could not get data for other years, and the survey covers only a total population of about 102 million, these ratings numbers are usually a good approximation to the perceived quality of the operators by the customers.

We condense our market-level survey measures using population weights. The national values show that Verizon is the national operator with highest valuation (72.7 points out of 100) followed by T-Mobile

(65.8), Sprint (63.2) and Cingular (60.9). We have also values for two regional operators: Alltel (71) and US Cellular (74).

With six observations, any link between reported quality and market share is speculative. However, it is interesting that Verizon is the national operator with both the highest quality and the highest share of new subscribers. Similarly, Sprint Nextel is the national operator with the lowest share of new subscribers and one of the lowest perceived qualities. It is also interesting that two of the three carriers with the highest quality scores are regional carriers: Alltel and US Cellular. In Figure 8, Alltel has a very low share of net new subscribers compared to the population it covers, while US Cellular's market share and coverage share are about equal. For Alltel at least, its perceived quality by its subscribers is not translating into new subscriber market shares.

8 Conclusions

Our conclusions look over the short and long runs. Over the short run, a panel analysis of carriers before and after mergers show that post-merger carriers if anything have lower shares than the combined shares of the pre-merger carriers. However, in the cross section national carriers earn higher market shares normalized by coverage areas relative to smaller, regional competitors. If the cross section is interpreted as a long run, it does appear size has some benefits.

Examining survey measures of consumer quality suggest that subscriber satisfaction is not the only factor driving consumer choice. It is likely that marketing and other factors contribute to carrier market shares.