Reducing Switching Costs to Promote Competition: The Case of Mobile Number Portability

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September 2025

Abstract

In many markets, switching costs limit competition by allowing firms to retain "locked-in" customers and charge prices above competitive levels. We study the effects of a major policy intervention that reduced such frictions: the implementation of mobile number portability (MNP) in the U.S. in 2003. Using detailed data on cell phone plans and carriers, we find that average prices fell significantly after MNP, consistent with Adam Smith's insight that removing monopolistic barriers leads to lower prices. Price reductions were asymmetric: larger firms cut prices more aggressively, and market share shifted from lower- to higher-quality providers. Our findings highlight the dual benefits of switching cost reduction policies: lower prices and improved allocation of consumers to better-quality firms. These results underscore the enduring relevance of Smith's distinction between natural and monopoly prices and support the view that well-designed interventions can enhance both consumer welfare and market efficiency.

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1 Introduction

In his magnum opus *The Wealth of Nations*, Adam Smith articulated the fundamental danger of monopoly power to consumer welfare, observing that "The monopolists, by keeping the market constantly under-stocked, by never fully supplying the effectual demand, sell their commodities much above the natural price [. . .] The price of monopoly is upon every occasion the highest which can be got".[1] Smith's insight into how market power enables firms to extract excessive profits at consumers' expense remains profoundly relevant to modern industrial organization, where true monopolies may be rare but market power often persists through other mechanisms.

While antitrust laws in most jurisdictions have largely eliminated classical monopolies, consumers in many markets face significant switching costs—arising from contractual commitments, product-specific learning, search costs, network effects, and other barriers to mobility—that can severely restrict competition and confer monopoly or near-monopoly power over "locked-in" consumers. These switching costs create what economists recognize as a modern equivalent to Smith's monopolistic market structure: firms can exploit captive customers by charging prices above competitive levels, secure in the knowledge that high switching costs deter consumer defection even when superior alternatives exist.

To combat the anti-competitive impact of switching costs, regulators worldwide have implemented or proposed policies aimed at reducing the barriers consumers face when changing providers. These modern interventions represent direct applications of Smith's prescription for dismantling monopolistic barriers to restore competitive pricing. Examples span numerous industries: the European Competition Authorities' proposals for switching facilities and account number portability in EU retail banking markets, the US Federal Communications Commission's efforts to prohibit early termination fees by cable and satellite providers, and

[1] All quotes from Adam Smith in this paper are from Chapter VII ("Of the natural and market Price of Commodities") of Book I of *The Wealth of Nations* unless otherwise noted.

widespread governmental adoption of open standards and open-source software to prevent vendor lock-in. Each policy embodies Smith's fundamental insight that removing artificial barriers to competition benefits consumers through lower prices and improved service quality.

For a deeper understanding of how such switching cost reduction policies affect market outcomes, this study examines a prominent historical example: mobile number portability (MNP), which allows wireless subscribers to retain their phone numbers when switching carriers. Implemented nationwide in the United States in November 2003, MNP represents an ideal natural experiment for studying how the elimination of a specific switching cost reshapes competitive dynamics, firm pricing strategies, and ultimately consumer welfare.

The implementation of MNP provides a unique empirical opportunity for several reasons. First, the policy intervention was both simultaneous and comprehensive—all major markets adopted portability simultaneously, creating a clear before-and-after comparison. Second, the switching cost that MNP eliminated was substantial and well-defined: prior to portability, consumers who switched carriers faced the significant inconvenience of notifying all contacts about their new phone number, a barrier that effectively locked many subscribers to their incumbent providers. Third, the wireless industry's structure—with clear quality differences among carriers and variations in market shares across geographic markets—allows us to examine how firms with different competitive positions respond to the same regulatory shock.

Our empirical analysis leverages a rich dataset combining information from three complementary sources covering January 2003 through June 2004. This 18-month window was chosen to capture the immediate effects of MNP while avoiding confounding factors from subsequent market developments.[2] Detailed plan-level pricing data from Econ One Research tracks the characteristics and prices of cell phone plans offered by major carriers. Customer-level

[2]The study period ends in June 2004 to avoid complications from major industry changes in late 2004, including Sprint's acquisition of Nextel and the introduction of new network technologies. This focused timeframe allows us to isolate the MNP effect from other structural changes in the wireless industry.

information from Forrester Research, surveying approximately 60,000 households, provides market share data. Finally, service quality scores from *Consumer Reports* offer an independent assessment of network performance across carriers and markets. This multi-faceted dataset enables a comprehensive analysis of how MNP affected not just prices but also the relationship between pricing, quality, and market share—dimensions crucial for understanding the full welfare implications of switching cost reduction.

A key contribution of our study is the explicit consideration of service quality differences in evaluating MNP's effects, a dimension largely overlooked in prior research on switching costs and number portability. While previous studies have documented price and market share responses to MNP, they typically abstract from quality heterogeneity, potentially missing important aspects of how switching cost reductions reshape competition. Our analysis reveals that incorporating quality differences is essential for understanding firms' asymmetric responses and properly evaluating the policy's consumer welfare effects.

Drawing on Adam Smith's analysis of artificial barriers to competition, we examine how switching costs segment markets, enable supra-competitive pricing, and affect firms differentially based on their market position and service quality. Smith's insights generate testable predictions about post-MNP price cuts, their asymmetry across firm types, and customer migration patterns, all of which we examine empirically. Notably, while Smith did not use the modern term "switching costs," he understood how barriers to mobility could create market power. For instance, he observed how apprenticing in one trade for many years makes it difficult for workers to switch to something new, and how guilds made it difficult for new people to enter a profession—both proto-switching costs that limited competition and enabled supra-competitive pricing in labor and product markets.[3]

[3]In Book I, Chapter VII of *The Wealth of Nations*, Smith discusses how "The exclusive privileges of corporations, statutes of apprenticeship, and all those laws which restrain, in particular employments, the competition to a smaller number than might otherwise go into them [...] are a sort of enlarged monopolies." See also Book I, Chapter X (Part II) for Smith's broader discussion of corporate privileges and apprenticeship statutes as restraints on competition. These institutional barriers function similarly to modern switching costs by limiting mobility and competition.

Our empirical analysis proceeds through three stages, each addressing deeper questions about how MNP reshaped competition. First, we establish that average list prices fell significantly following MNP implementation, with a 5.4% decline in contract-normalized access fees representing approximately $130 in savings over a typical 24-month contract. This baseline result confirms Smith's prediction that removing monopolistic barriers leads to lower prices.[4]

Second, we examine heterogeneity in firms' responses based on market share, using a novel instrumental variable approach to address endogeneity concerns. Market share is likely endogenous because superior network quality, deeper retail penetration, or richer handset subsidies simultaneously raise a carrier's subscriber base and influence its pricing strategy. Other unobserved factors include brand capital, marketing effectiveness, and variations in device financing, all of which can affect both customer acquisition and pricing power. Unless such latent advantages are accounted for, the interaction coefficient would be biased upward, as firms with these advantages can maintain higher prices while still attracting customers, masking the true competitive pressure from MNP.

To address this endogeneity, we exploit the historical legacy of the 1984 Bell System divestiture, instrumenting for market share using whether a carrier's wireless operations overlap with its predecessor "Baby Bell" territory. After correcting for endogeneity, we find that larger firms cut prices more aggressively than smaller rivals; moving from the 25th to 75th percentile of the market share distribution predicts an additional 6.4% price reduction, consistent with Smith's insight that incumbents with larger installed bases have more to lose from customer churn.

Third, we investigate how service quality moderates firms' responses to MNP. Here our analysis reveals a nuanced two-dimensional pattern: Conditional on market share, higher-quality carriers temper their price cuts, relying on service superiority rather than exceptionally deep discounts. Meanwhile, lower-quality carriers reduce prices more aggressively but

[4] As shown in our robustness analysis presented in Appendix A, the post-MNP price decline persists whether prices are measured in levels (dollars) or logs, and when trimming edge months from the sample.

nonetheless lose substantial market share. For example, despite cutting prices by a slightly higher percentage, AT&T (the lowest-quality carrier in the data; reduced prices by 5.7%) experienced vastly different market share outcomes compared to Verizon (the highest-quality carrier; reduced prices by 5.6%). Post-MNP, averaging across the metropolitan areas in our data, Verizon's market share increased by 1.3 percentage points (a 4.1% average percentage increase), whereas AT&T's market share dropped by 4.2 percentage points (a 21.8% average percentage reduction). This evidence suggests that once switching frictions vanished, consumers who had previously tolerated inferior service to retain their phone numbers migrated away from low-quality networks toward higher-quality alternatives, even when the carriers offered comparable price discounts.

These findings provide strong empirical support for Smith's analysis of how reducing monopolistic barriers benefits consumers. Our results demonstrate that MNP generated welfare gains through multiple channels: not only did average prices fall across the industry, but market share also shifted from lower-quality to higher-quality providers. This reallocation represents an additional welfare gain beyond simple price reductions, as consumers gained easier access to superior service quality—precisely the type of beneficial sorting that Smith envisioned would result from enhanced competition.

Related Literature. Our research contributes to several strands of the economic literature. First, it advances our understanding of the role of switching costs in industrial organization. Classical research in this area, including Beggs & Klemperer (1992) and To (1996), highlights the *harvesting incentive*—the capacity of firms to charge premium prices to captive consumers—suggesting that switching costs tend to elevate market prices. This perspective forms the foundation for numerous policy measures, including MNP, designed to lower switching barriers and enhance competition. However, more recent theoretical developments have identified the opposing *investment incentive*, where firms lower prices to expand their customer base for subsequent profit extraction, suggesting that switching costs could actually decrease rather than increase pricing levels (Arie & Grieco 2014, Cabral 2009, Doganoglu 2010, Doganoglu & Grzybowski 2013). Empirical research has produced similarly mixed findings, with some studies (Viard 2007, Park 2011) showing that switching costs increase prices, while others (Dubé et al. 2009) find the opposite effect.

Our study makes several novel contributions to this literature. While prior work has documented the price and market share effects of MNP (Park 2011, Shi et al. 2006), we are the first to explicitly analyze how service quality moderates these responses, revealing a crucial channel for welfare gains through quality-improving consumer reallocation. Methodologically, we introduce the historical Baby Bell territory overlap as a novel instrument for market share, providing a robust solution to the endogeneity concerns that are often unaddressed in prior work. Conceptually, we provide an explicit connection between Adam Smith's framework on monopolistic barriers and the modern economics of switching costs, showing how his foundational insights illuminate contemporary policy interventions.

Furthermore, we contribute to the debate on how switching costs affect market structure. The literature offers competing predictions: some theories suggest that reduced switching costs lead to higher market concentration as dominant firms compete more aggressively (Beggs & Klemperer 1992, Chen & Rosenthal 1996, Taylor 2003, Chen 2018), while others suggest they can deconcentrate markets (Chen 2016). We introduce a novel channel for this process: a flight-to-quality mechanism, where newly mobile consumers migrate to higher-quality providers. This can increase concentration, though in our specific case the effect is nuanced because a large, low-quality incumbent (AT&T) lost substantial market share, illustrating a complex interaction between size, quality, and market structure.

Second, our paper contributes to the literature on number portability across various industries. Viard (2007) examines number portability in toll-free services, finding that portability reduces prices charged to new customers but may increase prices for existing customers. Park (2011) studies wireless number portability using similar data to ours but focuses primarily on average price effects without considering quality heterogeneity or using instrumental variables to address endogeneity concerns. Shi et al. (2006) examine MNP's effects on market concentration in Hong Kong, while Aoki & Small (2010) and Buehler & Haucap (2004) provide theoretical analyses of welfare effects. Our study extends this literature by providing a comprehensive analysis of how quality differences moderate both price and market share responses to number portability.

Third, our research speaks to the broader policy literature on regulatory interventions designed to promote competition. By documenting both price reductions and quality-improving market share reallocations, we provide evidence that switching cost reduction policies can generate substantial consumer welfare gains. This finding is particularly relevant given ongoing policy debates about similar interventions in related contexts, such as proposals in Japan to slash mobile contract cancellation fees by 90% to facilitate carrier switching.[5]

Finally, our methodological contributions include the novel use of Baby Bell territory overlap as an instrument for market share in the wireless industry, which we believe provides a useful exogenous source of variation for future research on telecommunications markets.

The remainder of this paper proceeds as follows. Section 2 motivates our empirical analysis through Adam Smith's framework for understanding how artificial barriers to competition affect market outcomes. Section 3 describes the data sources and key variables. Section 4 presents our empirical analysis in three stages, examining overall price effects, firms' differential responses by market share, and consumer reallocation based on service quality. Section 5 concludes with policy implications and suggestions for future research.

[5] https://mainichi.jp/english/articles/20190610/p2a/00m/0bu/012000c.

2 Switching Costs as Modern Monopolistic Barriers: A Smithian Perspective

2.1 Smith's Framework: Natural vs. Monopoly Prices

Adam Smith's analysis in *The Wealth of Nations* provides a powerful lens for understanding how switching costs distort competitive outcomes. In Chapter VII of Book I, Smith distinguishes between a commodity's "natural price"—determined by the ordinary rates of wages, profit, and rent in competitive markets—and its "market price," which may deviate from this natural level due to temporary imbalances or artificial restrictions on competition. Most relevant to our analysis is Smith's discussion of monopolistic barriers, which he argues allow firms to charge prices persistently above their natural levels. As Smith observes: "A monopoly granted either to an individual or to a trading company has the same effect as a secret in trade or manufactures. The monopolists, by keeping the market constantly under-stocked, by never fully supplying the effectual demand, sell their commodities much above the natural price."

Crucially, Smith emphasizes that such price distortions persist only when artificial barriers prevent the normal competitive process. He contrasts monopoly pricing with competitive pricing, noting that "The price of monopoly is upon every occasion the highest which can be got. The natural price, or the price of free competition, on the contrary, is the lowest which can be taken, not upon every occasion, indeed, but for any considerable time together."

2.2 Switching Costs as Artificial Barriers to Competition

Consumer switching costs represent a modern manifestation of the monopolistic barriers Smith identified. Like the "exclusive privileges of corporations" and "statutes of apprenticeship" that Smith criticized, switching costs create artificial segmentation that prevents markets from operating according to competitive principles. In Smith's framework, effective competition requires that consumers can readily shift their purchases toward suppliers offering better value. When switching costs are high, this reallocation mechanism breaks down. Firms can exploit "locked-in" customers by charging prices above competitive levels, secure in the knowledge that the cost of switching deters customer defection even when superior alternatives exist. This creates a parallel to Smith's monopolists: firms with captive customers can keep their local markets "constantly under-stocked" in the sense that they need not fully satisfy consumer demand for value, since high switching costs protect them from competitive pressure. The switching cost effectively grants each firm a degree of monopoly power over its existing customer base.

2.3 Mobile Number Portability as Barrier Removal

The implementation of mobile number portability represents precisely the type of barrier removal that Smith argued would restore competitive pricing. Before MNP, wireless subscribers faced substantial costs when switching carriers: they had to notify all contacts of their new number, update business cards and advertisements, and risk missed calls during the transition period. This number-related switching cost functioned as an artificial restriction on competition, segmenting the market and allowing firms to charge prices above their natural competitive levels. MNP eliminated this artificial barrier by allowing customers to retain their phone numbers when switching carriers. In Smith's terms, this policy intervention removed an "exclusive privilege" that had protected incumbent firms from full competitive pressure. Once this barrier was eliminated, Smith's framework predicts that market forces would drive prices toward their natural competitive levels.

2.4 Predictions from Smith's Framework

Smith's analysis generates clear predictions about the effects of removing artificial barriers to competition:

Price Reduction: Smith argues that when monopolistic barriers are removed, prices gravitate toward their "natural" competitive levels. He describes this as a gravitational process: "The natural price, therefore, is, as it were, the central price, to which the prices of all commodities are continually gravitating." Removing switching costs should therefore lead to industry-wide price reductions as firms can no longer exploit captive customers.

Asymmetric Responses Based on Market Share: Smith's framework suggests that firms with larger customer bases have more to lose when barriers are removed. These firms had been able to exploit more customers through supra-competitive pricing, so they face greater pressure to cut prices defensively when switching costs disappear. Smaller firms, having fewer captive customers to begin with, face less pressure to adjust their pricing strategies dramatically.

Quality-Based Reallocation: Smith emphasizes that removing artificial barriers allows consumers to pursue better value, leading to beneficial reallocation toward superior suppliers. In his words, competitive markets ensure that "The whole quantity of industry annually employed in order to bring any commodity to market, naturally suits itself in this manner to the effectual demand." When switching costs disappear, consumers previously locked into inferior service quality can migrate toward higher-quality providers, improving overall market allocation.

The Role of Quality in Competitive Responses: Smith's analysis suggests that when artificial barriers are removed, firms with genuine competitive advantages (such as superior quality) need not reduce prices as aggressively as those lacking such advantages. This prediction aligns with modern economic theory: if prices perfectly reflected quality differences before MNP, leaving no differential surplus between high and low quality carriers, then both types would need similar price cuts. However, if high-quality carriers provided more consumer surplus (quality-adjusted value) to their customers pre-MNP, their customers would have less incentive to switch even when it becomes easier. Our implicit assumption, consistent with the data, is that high-quality carriers indeed provided more surplus to their customers after adjusting for price, allowing them to retain customers with smaller price cuts.[6]

Our interpretation rests on the assumption that high-quality carriers provided greater consumer surplus (quality-adjusted value) even before MNP, creating a "buffer" that allowed them to retain customers with smaller price cuts.[7] While this assumption is consistent with our empirical patterns, we cannot directly test it with our data. Alternative mechanisms could potentially generate similar patterns. For example, high-quality carriers might have faced less elastic demand due to stronger brand loyalty, or they might have served customer segments with different price sensitivity. Our analysis focuses on the surplus-based explanation because it aligns most naturally with Smith's framework and the observed market share reallocations (as we discuss further in Section 2.5), but we acknowledge these alternative interpretations merit consideration.

Dynamic Adjustment Process: Smith describes the adjustment to barrier removal as a dynamic process where competitive forces gradually drive prices toward their natural levels: "But whatever may be the obstacles which hinder them from settling in this center of repose and continuance, they are constantly tending towards it." This perspective suggests that the effects of MNP should unfold over time, with our analysis of the immediate post-MNP period capturing the initial phase of this adjustment process during which firms with the most to lose from customer churn respond most aggressively.

[6]This quality-based pricing dynamic depends critically on whether quality is fixed or adjustable. We treat quality as quasi-fixed in the short run following MNP implementation, which is reasonable given that network infrastructure investments and coverage improvements require substantial time and capital. If quality were easily adjustable, firms might compete on quality improvements rather than price cuts, but the short timeframe of our analysis (7 months post-MNP) makes major quality adjustments unlikely.

[7]In a fully competitive equilibrium, quality-adjusted price differences should be eliminated through competitive pressure. However, switching costs can prevent this equilibration mechanism from operating effectively. MNP restores the competitive process by allowing quality-based consumer migration that has been suppressed by switching barriers.

2.5 Welfare Implications

Smith's framework implies that removing artificial barriers generates welfare gains through multiple channels. Beyond simple price reductions, barrier removal enables the natural process whereby "The whole quantity of industry annually employed in order to bring any commodity to market, naturally suits itself in this manner to the effectual demand," allowing consumers to migrate toward suppliers that best meet their needs. This reallocation represents an additional welfare gain beyond price effects, as it improves the matching between consumer preferences and supplier characteristics.

In the context of mobile number portability, Smith's analysis suggests that consumer welfare should improve not only through lower prices but also through enhanced access to higher-quality service providers. Consumers who had previously tolerated inferior service to avoid switching costs can now migrate toward networks offering better coverage, reliability, and customer service.

2.6 Testable Hypotheses

Smith's framework for understanding artificial barriers and their removal generates three main testable hypotheses about the effects of mobile number portability:

H1 (Price Reduction): Removing switching costs should lead to industry-wide price reductions as firms can no longer sustain monopoly pricing over captive customers.

H2 (Asymmetric Responses by Market Share): Firms with larger installed customer bases should reduce prices more aggressively than smaller competitors, as they have more captive customers to defend.

H3 (Quality-Based Reallocation): Market share should shift from lower-quality to higher-quality providers as consumers become free to pursue better value, with higher-quality firms able to temper their price cuts relative to lower-quality competitors.

These predictions flow directly from Smith's insights about how removing artificial barriers to competition affects pricing behavior and market allocation. The remainder of our analysis tests these hypotheses using the natural experiment provided by the implementation of mobile number portability in the U.S. wireless industry.

3 Data

Having discussed Smith's framework and its predictions about asymmetric price cuts following MNP, we now turn to describing the policy intervention and the data that allows us to test these hypotheses empirically. The FCC's mobile number portability (MNP) mandate required all wireless carriers to implement number portability by November 24, 2003, following a 16-month preparation period. The technical infrastructure relied on a centralized database system, enabling carriers to coordinate porting requests, which were typically completed within 2 to 3 hours under normal conditions (Federal Communications Commission n.d.). This industry-wide coordination was essential, as no single carrier could unilaterally offer portability; the system required mandatory participation from both the losing and gaining carrier to function. Consumer awareness campaigns by the FCC, along with industry publicity, drew substantial public attention, and MNP saw significant early adoption, with carriers reporting steady porting activity in the initial months (Bryan 2004).

To analyze the effects of this policy intervention, our empirical analysis draws on a monthly panel that tracks cell phone plans and competitive conditions in the U.S. wireless industry from January 2003 through June 2004, a horizon that straddles the late–November 2003 introduction of mobile–number portability. All the markets in the sample implemented number portability simultaneously in November 2003, and there were no new entrants during this time period. We merge three data sources to generate our dataset.

Econ One Pricing data comes from Econ One and records every single–line, post–paid tariff advertised on each carrier's website for 26 major U.S. metropolitan statistical areas (MSAs).

For every plan–month observation the file reports the monthly access fee, activation charge, bundled anytime minutes, off–peak allowances, contract length, national–coverage flag, and an array of promotional add–ons such as 7 p.m. nights, rollover minutes, Push–to–Talk, free long–distance, and PCS data service. After filtering out prepaid products, family buckets, and plans with incomplete price fields, the tariff file supplies roughly 64,000 observations in the eleven pre–MNP months and another 46,000 in the seven post–MNP months, providing both the dependent variable—log of the contract–normalized access fee—and the full set of plan–level controls used in later regressions. More detailed description about the Econ One data can be found in Park (2011).

Forrester Research Tariff information alone cannot reveal how many customers each carrier serves in a given market, so the study pairs the Econ One file with a contemporaneous consumers survey from Forrester Research that queried roughly 60,000 households in 25 of the 26 MSAs in the Econ One data about their technology consumption. Each wireless-subscriber respondent reports his or her carrier and location, enabling the construction of carrier–specific subscriber counts. Aggregating over individuals and averaging over January–November 2003 yields our baseline *pre–MNP market share*, for every carrier–market pair.

Consumer Reports Our research hinges on having an *independent, ex-ante* measure of network quality to disentangle price movements driven by number portability from those reflecting intrinsic service differences across carriers and markets. A nationally consistent source of such information in our period is the annual *Consumer Reports* wireless survey, which we merge into the the combined Econ One–Forrester panel. The *Consumer Reports* National Research Center polls its magazine and website subscribers on their wireless experience. For the 2003 wave, *Consumer Reports* collected on-line questionnaires covering 20 of the nation's major MSAs. 17 of those MSAs also appear in our merged Econ One–Forrester panel, allowing the quality scores to align directly with the pricing and market-share data used in the regressions.

Respondents were asked to give their carrier an *Overall Satisfaction* rating on a 0–100 scale, where 0 means "completely dissatisfied" and 100 "completely satisfied." Industry-wide, the average rating hovered around 65 in the mid-2000s. Additionally, the survey also asks four call-quality questions—how often the user experiences no service, dropped calls, static, and circuits-full events. Our regression analyses rely on these four-item quality scores on the carrier-market level, which offer finer cross-market variation and map directly onto network reliability. Each item is coded from 1 = worst to 5 = best. We construct a composite *quality index* by taking the arithmetic mean, so the resulting quality index inherits the same 1–5 scale. Because the survey precedes portability by approximately six months, both the pre-MNP market shares and the quality scores are predetermined with respect to the policy shock, satisfying a key identification requirement.

Table 1 shows that the mean price of plans offered after number portability is lower than the mean price of plans offered before number portability. In addition, post-MNP plans offer more minutes than pre-MNP plans on average. Table 2 summarizes subscriber penetration and leading–firm dominance: Chicago, for example, exhibits 69.9 percent penetration, with Cingular the largest provider at 28.4 percent in 2003, whereas Verizon overtakes the lead at 29.4 percent in 2004. Such information reveals substantial cross–market diversity in both size and quality, variation that is crucial for identifying the asymmetric price responses.

It is worth noting that contract length remained remarkably stable across the MNP implementation. As shown in the data, 1-year contracts comprised 45.7% of plans before MNP and 45.3% after, while 2-year contracts increased only marginally from 54.2% to 54.7%. This stability suggests that contract duration was an entrenched industry practice tied to the handset-subsidy model rather than a margin of immediate competitive adjustment to portability.[8]

After matching the data from the three sources and filtering for complete observations

[8] The minimal change in contract length distribution (less than 0.5 percentage points) indicates that carriers did not view shorter contracts as a competitive response to MNP. This may reflect the fact that contracts served primarily to recoup handset subsidies rather than to lock in customers per se.

across all variables used in the analysis, 35,765 observations remained for the regression analyses. The merged dataset links month–by–month pricing decisions to contemporaneous market structure and perceived service quality, providing a rich empirical platform for investigating how number portability reshaped both prices and customer allocation.

Table 1: Summary Statistics from Econ One Data

Variable	Before MNP	After MNP
Price ($)	100.12	96.45
Activation Fee ($)	24.67	23.01
Monthly Access Fee ($)	87.63	81.11
Unlimited Anytime Minutes (%)	0.27	0.86
Unlimited Peak Minutes (%)	0.00	0.00
Unlimited Night & Weekend (%)	4.49	4.50
Anytime Minutes (min)	1427.03	1910.51
Peak Minutes (min)	177.22	318.45
Night & Weekend Minutes (min)	5668.81	6868.04
Coverage: National (%)	32.32	34.54
Coverage: Network (%)	8.98	5.00
Coverage: Regional (%)	1.53	1.80
Coverage: Local (%)	23.09	17.81
Coverage: Missing (%)	34.07	42.46
Contract Length – No Contract (%)	0.08	0.04
Contract Length – 1 Year (%)	45.71	45.30
Contract Length – 2 Year (%)	54.21	54.66
Cancellation Fee ($)	172.73	170.06
Availability of Promotion (%)	7.54	10.19
Per-Minute Charge – Peak ($)	0.35	0.33
Per-Minute Charge – Evening ($)	0.35	0.33
Early Nights (7 PM) (%)	6.00	15.00
Rollover (%)	11.62	10.29
Push2Talk (%)	0.96	0.40
PCS (%)	47.59	47.68
Number of Observations	64041	46154

Table 2: Summary of Forrester Consumer Survey

Market	**Respondents**	**Pen. 2003 (%)**	**Largest 2003**	**Share 2003 (%)**	**Largest 2004**	**Share 2004 (%)**
Atlanta	920	77.28	Cingular	38.7	Cingular	37.8
Boston	1,144	68.97	Verizon	39.0	Verizon	43.8
Chicago	1,738	69.85	Cingular	28.4	Verizon	29.4
Cincinnati	525	63.24	Verizon	39.8	Verizon	33.0
Cleveland	957	63.43	Verizon	41.5	Verizon	42.4
Dallas	1,096	71.90	Cingular	35.2	Cingular	41.7
Denver	692	71.24	Verizon	36.7	Verizon	38.5
Detroit	1,051	72.12	Verizon	34.1	Verizon	33.4
Houston	924	75.97	Cingular	35.6	Cingular	36.1
Kansas City	524	73.47	Cingular	27.3	Cingular	29.2
Los Angeles	2,313	72.33	Verizon	36.2	Verizon	39.0
Miami	566	78.09	Cingular	33.9	Cingular	32.1
Minneapolis	941	68.01	Qwest	23.1	Verizon	26.1
New York	3,466	69.59	Verizon	38.8	Verizon	42.2
Philadelphia	1,504	68.75	Verizon	35.3	Verizon	38.0
Phoenix	735	72.65	Verizon	29.3	Verizon	30.6
Pittsburgh	949	62.91	Verizon	53.5	Verizon	57.0
Portland	787	65.44	AT&T	41.2	Verizon	34.6
Sacramento	702	72.93	AT&T	36.8	AT&T	29.9
San Diego	555	63.06	Verizon	39.4	Verizon	40.4
San Francisco	1027	67.08	AT&T	36.3	Verizon	31.3
Seattle	884	66.63	Verizon	43.8	Verizon	41.8
St. Louis	610	68.36	Verizon	34.1	Cingular	36.4
Tampa	877	65.11	AT&T	21.3	AT&T	20.0
Washington, D.C.	1,144	70.02	Verizon	36.8	Verizon	35.6

4 Empirical Analysis

Our empirical analysis proceeds in three steps, each aimed at answering a deeper question about how mobile–number portability reshaped competition. **Stage 1** estimates a baseline model that asks the simplest question: *did average list prices fall once switching costs disappeared?* The specification controls for a comprehensive vector of plan attributes—bundle size, contract length, coverage, and promotional features—together with market and carrier fixed effects and a linear calendar trend. Establishing an unconditional price drop furnishes the benchmark against which all subsequent asymmetries are judged. **Stage 2** examines heterogeneity based on market share. We add a dummy for the largest carrier in each MSA during the pre–policy window and interact it with the MNP indicator to test whether incumbents with the biggest installed bases reacted differently from smaller rivals. Because market share may be endogenous to unobserved quality or cost advantages, we instrument this interaction with a historical *Baby–Bell overlap* measure. **Stage 3** shifts the lens from size to service quality. The quality index and its interaction with the portability dummy reveal whether higher–quality providers can temper discounts, while accompanying market–share movements document the customer migration that portability enables. Across all three stages we maintain identical plan controls, fixed effects, and a common time trend, so any differences we uncover are attributable to strategic dimensions—price, size, quality—rather than to shifts in product mix or shared shocks.

4.1 Overall Impact of Number Portability on Prices

This section documents how the nationwide introduction of mobile number portability (MNP) in November 2003 altered the pricing of postpaid wireless tariffs. We begin by motivating the dependent variable, then present graphical evidence of a level shift that coincides with the policy, and finally quantify the magnitude of that break in a two–way fixed–effects framework.

Following the procedure in Park (2011), we define the *contract-normalized effective access fee* as

$$\text{Price}_{ipmt} = \frac{F_{ipmt}L_{ipmt} + A_{ipmt} - R_{ipmt}D_{ipmt}}{L_{ipmt}}, \tag{1}$$

where F_{ipmt} is the posted monthly access charge, L_{ipmt} the contractual term (months), A_{ipmt} a one-time activation fee, and $R_{ipmt}D_{ipmt}$ the cumulative value of any temporary promotional rebate for plan p offered by carrier i in market m during month t. Equation (1) converts all up-front payments into an equivalent constant monthly obligation, permitting direct comparisons across plans with heterogeneous contract structures. Throughout the analysis we work with $\ln(\text{Price}_{ipmt})$ so that coefficients are interpretable as semi-elasticities.

We use the *contract-normalized effective access fee*—the posted monthly access charge adjusted for activation fees, promotional rebates, and contract length—as our dependent variable because it is the only tariff component that is simultaneously (i) **publicly observable** at monthly frequency for every plan in the sample, (ii) **directly set by carriers at the moment of acquisition**, and (iii) **immediately salient to prospective switchers** once number portability removes the non-price cost of changing providers. Converting all up-front transfers into an equivalent constant monthly obligation yields a price measure that is comparable across markets, carriers, and contract structures, allowing us to track month-by-month adjustments around the policy shock and to isolate exactly the margin on which competitive pressure is expected to appear first.

Alternative constructs are either unobservable or conceptually ill-suited for identifying a portability effect. Nominal per-minute list rates reveal little about economic costs because the vast majority of subscribers remain within their bundled allowance, so those rates seldom bind. Average realized monthly bills would be preferable in principle, but they require micro-level usage records that carriers do not disclose and would confound price changes with heterogeneous demand shocks. Handset-inclusive total cost of ownership, in turn, is dominated

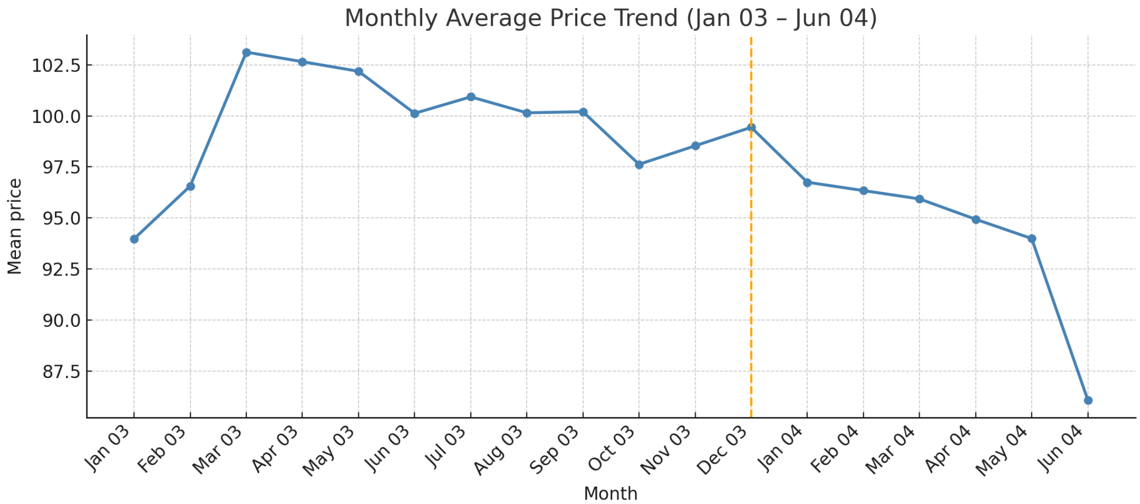

Figure 1: Monthly average contract-normalized access fee, January 2003 – June 2004
Dashed vertical line marks December 2003, the first month after nationwide mobile-number portability (MNP) was implemented.

by device subsidies and financing terms that fluctuated in 2003–2004 for reasons unrelated to MNP (e.g., the GSM/CDMA technology race) and are not archived in tariff databases. Employing the adjusted access fee therefore avoids measurement error, data gaps, and extraneous supply shocks while capturing the price dimension on which carriers can—and did—compete immediately after portability.

Figure 1 suggests a discontinuity coincident with the introduction of portability. During the pre-policy window (January-October 2003), average prices fluctuate between \$94 and \$103 without a clear directional trend.[9] The series then shows a decline beginning around the time of the regulatory intervention and continuing throughout the first half of 2004.

While Figure 1 suggests a downward shift when the intervention took effect, we recognize that visual inspection alone cannot definitively establish a structural break. To address this concern, we conducted robustness checks examining whether the apparent discontinuity might be driven by edge months (January-February 2003 and June 2004) or by the choice to

[9] *Notes:* Each dot represents the cross-market mean of the dependent variable defined in Equation (1). The vertical dashed line denotes December 2003, the first full month in which mobile-number portability (MNP) was in force following its nationwide launch on 24 November 2003.

display prices in logs rather than levels. We find that the price decline remains statistically significant in both log and level specifications, and persists even when excluding the potentially influential edge months, though with reduced magnitude (from 5.4% to 2.1% in logs and from \$7.6 to \$4.4 per month in levels). The complete robustness analysis is presented in Appendix A. These results confirm that the observed price decline reflects a genuine market response to MNP rather than a statistical artifact, thereby motivating the formal econometric analysis that follows.

To quantify the magnitude of the break suggested by Figure 1, we estimate the fixed-effects specification

$$\ln(\text{Price}_{ipmt}) \;=\; \alpha + \delta\, MNP_t + \mathbf{X}'_{ipmt}\boldsymbol{\theta} + \beta t + \mu_m + \gamma_i + \varepsilon_{ipmt}, \tag{2}$$

where $MNP_t = 1$ for December 2003–June 2004 and 0 otherwise; $\mathbf{X}_{ipmt}$ contains plan attributes (bundled anytime, peak, weekend minutes; 24-month contract flag; national coverage; 7 p.m. off-peak window; rollover; Push-to-Talk; PCS; free national and in-network long-distance); $t \in \{1, \ldots, 18\}$ indexes calendar months; and (μ_m, γ_i) are exhaustive MSA and carrier fixed effects. Standard errors are clustered at the carrier–market level to account for the fact that pricing decisions are made at the portfolio level, and unobserved shocks affect all plans offered by a carrier in a given MSA simultaneously.[10]

Table 3 reports regression results for the stage I empirical analysis. The coefficient of interest, $\hat{\delta} = -0.054$ (s.e. 0.012), implies a 5.4% decline in the effective access fee immediately after portability. At the pre-policy mean of \$100.12, this amounts to a \$5.4 reduction per subscriber per month—roughly \$130 over a standard 24-month contract. The other estimates are also intuitive – the better the product features, the higher the plan price.

The fixed-effects framework provides a transparent first pass at the policy effect but

[10]Clustering at the carrier-market level allows for arbitrary correlation of the error structure within these economically meaningful groups while maintaining independence across them.

Table 3: Regression Results for Stage I Empirical Analysis

Variable	**Estimate**	**Std. Error**
MNP dummy	-0.054***	0.012
Anytime Minutes	0.534***	0.002
Peak Minutes	0.501***	0.002
Weekend Minutes	-0.026***	0.001
Contract 24	-0.039***	0.004
7PM	-0.061***	0.018
National	0.072***	0.004
Rollover	-0.0003	0.010
PushToTalk	0.161***	0.018
PCS	0.017**	0.007
Free National LD	0.200***	0.010
Free In Network LD	-0.085***	0.010
Time Trend	0.002***	0.001
Observations		35,765
R-squared		0.77

Notes: Significance level: * = 10%, ** = 5%, *** = 1%. The same significance notation applies to all subsequent tables. Coefficients for carrier dummies and market dummies are not reported. Standard errors are clustered at the carrier-market level.

abstracts from heterogeneity in firm size and perceived service quality. These issues are addressed in subsequent sections, where we introduce firm-level moderators and employ instrumental-variable techniques.

4.2 Differential Impact for Firms with Different Market Share

To illustrate how market share influences responses to MNP, we begin with a detailed examination of the Dallas metropolitan area, which provides a particularly clear example of how pre-portability market share influences wireless pricing. Dallas is not only one of the largest markets in our panel—hence rich in plan–month observations—but it also exhibits a conveniently asymmetric structure: before MNP, Cingular, AT&T, and Sprint PCS each had 19% or more of the Dallas market, while Verizon and T-Mobile each had 10% or less. This stark asymmetry makes the market an ideal testbed for the hypothesis that larger incumbents will defend share through price concessions when customers can port their numbers. Moreover, the 2003–04 horizon witnessed no Dallas-specific spectrum releases, network outages, or headline handset launches; thus, the tariff movements documented below can be interpreted as genuine portability effects rather than responses to local supply shocks.

Table 4: Dallas MSA: Pre-MNP Share and Average Log Price Response

Group / Carrier	**Pre-MNP Market Share**	**Pre-MNP Average ln(price)**	**Post-MNP Average ln(price)**	**Δ (%)**
High-share (Cingular + AT&T + Sprint)	**78%**	4.413	4.345	**–6.6**
Cingular	35%	4.489	4.386	–10.3
AT&T	24%	4.475	4.429	–4.6
Sprint PCS	19%	4.274	4.219	–5.5
Low-share (Verizon + T-Mobile)	**19%**	4.244	4.337	**+9.8**
Verizon	10%	4.447	4.571	+12.5
T-Mobile	9%	4.040	4.102	+6.2

Notes: Market shares are Forrester 2003 subscriber shares. Δ (%) is computed as $(e^{\text{Post}-\text{Pre}} - 1) \times 100$.

As we can see in Table 4, during the pre-MNP periods in our dataset, the high-share trio quoted an average contract-normalized log price of 4.413 (about $82), compared with

4.244 (about \$70) for the two smaller carriers. The price premium is consistent with their broader menu depth and stronger brand recognition. The introduction of portability flipped those dynamics. By June 2004 the dominant group's average log price had fallen to 4.345, a 6.6 percent reduction. The cut was driven mainly by Cingular's 10.3 percent decrease and Sprint's 5.5 percent reduction, with AT&T dropping a more modest 4.6 percent. In contrast, the low-share cohort's mean log price rose to 4.337 (a 9.8 percent increase), led by Verizon's 12.5 percent hike and T-Mobile's 6.2 percent rise.[11]

Although confined to a single market, the Dallas evidence encapsulates the central empirical claim of Section 4.2: carriers with larger installed bases respond more forcefully to the portability shock. The panel-wide econometric analysis that follows generalizes this negative relationship between pre-MNP share and post-MNP price change across all twenty-five metropolitan areas in the dataset.

To examine whether the above price pattern is borne out in our data, in stage II of our analysis, we incorporate the market share and the interaction between market share and the number portability dummy to see the asymmetric responses between different types of firms. We estimate the following pricing equation of wireless carriers:

$$ln(PRICE_{ipmt}) = \alpha_1 + \delta_1 MNP_t + \beta_1 MS_{mi} + \beta_2 MNP_t MS_{mi} + \theta X_{ipmt} + t + \epsilon_{ipmt}, \qquad (3)$$

where MS_{mi} is the market share of firm i in market m. All the other variables are defined as in stage I . We also include markets dummies and firms dummies in the regression.

Table 5 shows the regression results. The main effect of share is weakly positive, reflecting the modest premium enjoyed by large firms before portability. However, the interaction term is positive and statistically insignificant ($\hat{\beta}_2 = +0.049$, $t \approx 1.0$). Its lack of statistical significance

[11] The price increases for Verizon and T-Mobile in Dallas may reflect strategic repositioning by smaller carriers who, after the removal of switching barriers, chose to target higher-value customer segments, potentially leveraging their service quality advantages to justify premium pricing. We explore the issue of quality differentials in the next subsection.

Table 5: Regression Results for Stage II Empirical Analysis, without Instrumental Variables

Variable	**Estimate**	**Std. Error**
MNP dummy	-0.054***	0.011
Market Share	0.265***	0.029
MNP x Market Share	0.049	0.033
Anytime Minutes	0.534***	0.002
Peak Minutes	0.501***	0.002
Weekend Minutes	-0.026***	0.001
Contract 24	-0.039***	0.004
7PM	-0.061***	0.018
National	0.072***	0.004
Rollover	-0.0003	0.010
PushToTalk	0.161***	0.018
PCS	0.017**	0.007
Free National LD	0.200***	0.010
Free In Network LD	-0.085***	0.010
Time Trend	0.002***	0.001
Observations		35,765
R-squared		0.78

Notes: Standard errors are clustered at the carrier-market level.

points to the likely presence of simultaneity bias, where price and the endogenous regressor are determined jointly.

Market share is unlikely to be exogenous. Superior network quality, deeper retail penetration, or richer handset subsidies simultaneously raise a carrier's subscriber base and influence its pricing strategy. Unless such latent advantages are accounted for, the interaction coefficient is biased upward, masking the true heterogeneity in post-MNP price cuts.

To address this endogeneity, we exploit a historical regulatory intervention of U.S. telecommunications—the 1984 divestiture of the Bell System. The break-up created seven regionally exclusive local-exchange companies, colloquially known as Baby Bells.[12] Each Baby Bell inherited a statutory wireline monopoly, built dense retail infrastructure and accumulated durable brand capital inside its legacy footprint. When these firms (or their wireless successors) entered cellular markets during the 1990s, they enjoyed ready-made customer bases precisely where their wireline licenses lay, leveraging existing billing relationships, retail presence, and brand recognition to systematically capture higher mobile market shares within their historical territories.

We therefore construct an indicator equal to one when a carrier's wireless license overlaps its Baby-Bell territory in a given MSA. This instrument satisfies both requirements for validity. First, it passes conventional relevance tests: the first-stage F-statistic is 24.3, comfortably above the Stock–Yogo critical threshold, confirming that Baby-Bell territorial overlap provides strong predictive power for pre-MNP market share. Second, the exclusion restriction is satisfied because territory assignments represent legal artifacts fixed nearly two decades before number portability was implemented and before nationwide mobile competition fully matured. While wireless markets evolved competitively after 1984, the initial subscriber acquisition advantages from existing customer relationships and retail infrastructure created persistent market

[12]The Regional Bell Operating Companies resulted from the 1984 AT&T divestiture following *United States v. AT&T*. AT&T's local operations were split into seven independent companies. We assign the value of 1 if a wireless carrier operates in a market that falls within its associated Baby Bell's historical territory (e.g., Verizon in former Bell Atlantic territory). Among 164 provider-market combinations, 25 receive the value of 1.

share differences that are plausibly orthogonal to the unobserved cost or demand shocks driving 2003–04 pricing strategies.[13] Importantly, because the instrument varies only at the carrier–market level and is time-invariant, it cannot be affected by contemporaneous strategic price setting during the MNP implementation period. To our knowledge, this Baby-Bell instrument provides a novel and powerful source of exogenous variation for market share in telecommunications research, addressing a key identification challenge in the switching costs literature.

Table 6: Regression Results for Stage II Empirical Analysis, with Instrumental Variables

Variable	**Estimate**	**Std. Error**
MNP dummy	0.048**	0.025
Market Share	0.412***	0.046
MNP x Market Share	-0.358***	0.093
Anytime Minutes	0.534***	0.002
Peak Minutes	0.502***	0.002
Weekend Minutes	-0.026***	0.001
Contract 24	-0.039***	0.004
7PM	-0.087***	0.019
National	0.077***	0.004
Rollover	0.001	0.010
PushToTalk	0.144***	0.018
PCS	0.021***	0.007
Free National LD	0.199***	0.010
Free In Network LD	-0.087***	0.010
Time Trend	0.002***	0.001
Observations		35,765

Notes: Standard errors are clustered at the carrier-market level.

Table 6 reports regression results for the stage II empirical analysis. The coefficient for the interaction term is negative and significant, which means that the larger firms cut prices more

[13]Potential concerns about the exclusion restriction might include whether Baby Bells developed systematically different cost structures or strategic approaches that could independently affect pricing. However, such effects would need to operate through channels other than market share (which we control for directly) and would need to manifest specifically during the brief MNP implementation window to threaten identification. The substantial temporal distance between the 1984 divestiture and our 2003-04 analysis period, combined with the competitive evolution of wireless markets, makes such violations unlikely.

than the smaller firms after the implementation of number portability. A movement from the 25th to the 75th percentile of the share distribution—about an eighteen-point increase—now predicts an additional **6.4 percent** price reduction once portability arrives, closely mirroring the six-to-one gap observed in Dallas. After correcting for endogeneity, the econometric evidence aligns with intuition: when switching frictions vanish, incumbents with the largest installed bases deploy the sharpest headline discounts. Therefore, our empirical finding appears to be consistent with the prediction in existing literature in terms of whether the larger firm or the smaller firm lowers its price more significantly when switching costs are reduced.

4.3 Impact on Firms with Different Quality Levels

The welfare impact of mobile number portability cannot be assessed solely through prices and market shares, because portability alters not just the cost of switching but also the way consumers trade off price against service quality. Once the burden of changing providers is removed, subscribers are free to re-optimize in a multidimensional product space: users who formerly tolerated inferior call reliability simply to keep their numbers can now defect to networks offering clearer connections, fewer dropped calls and wider coverage. For firms this re-optimization reshapes demand elasticities in a quality-specific fashion: a carrier enjoying a reputational advantage can afford to concede less on price, whereas a lower-quality rival must discount more aggressively to stem potential churn. Any empirical evaluation of MNP that neglects explicit quality heterogeneity therefore risks conflating the price-competition channel with a quality-sorting channel and understating the full reallocative effect of the policy.

To support this intuition, we consulted with *Consumer Reports* about consumers' overall satisfaction in major markets in the year of 2003. As mentioned earlier, *Consumer Reports'* wireless survey did not merely tabulate network–quality problems; it also asked each respondent for an *Overall Satisfaction* rating on the same 0–100 scale used in its well-known product ratings. These satisfaction ratings capture perceived service performance and, while subjective, map onto the network dimensions that matter most for day-to-day voice use (coverage, reliability, clarity).

Among the nationwide operators, Verizon and AT&T furnish the sharpest test of the quality channel. According to the reports, the average rating for Verizon was 72.75 for 2003 while the average rating for AT&T was 62.33 for the same year. Verizon's mean satisfaction rating was fully ten points above AT&T's average—a large gap that placed Verizon at the top of the national rankings and AT&T at the bottom. This stark divergence in subscribers' self-reported experience reinforces the premise that Verizon entered the portability era with a distinctly higher perceived quality, and it provides a natural behavioral check on the call-quality index we use in the regressions.

We further run the regression in the previous section for Verizon and AT&T individually, taking out the firm dummies. Table 7 reports Verizon and AT&T' price responses to the implementation of number portability. Both carriers cut their prices, with Verizon cutting its price by 5.6% while AT&T cutting its price by a slightly larger 5.7%.

Table 7: Verizon and AT&T Price Response to MNP

	Verizon: ln(Prices)		**AT&T: ln(Prices)**	
Variable	**Estimate**	**Std. Error**	**Estimate**	**Std. Error**
MNP dummy	-0.056**	0.005	-0.057**	0.009
Anytime Minutes	0.705**	0.001	0.578**	0.002
Peak Minutes	0.661**	0.001	-0.035**	0.004
Contract 24	-0.043**	0.002	-0.047**	0.013
National	0.155**	0.002	-0.050**	0.004
PushToTalk	0.123**	0.007	0.104**	0.006
Free National LD	0.103**	0.005	0.255**	0.010
Free In Network LD	-0.069**	0.006	-0.200**	0.011
Time Trend	0.004**	0.001	-0.003**	0.001
Observations	25,927		23,478	
R-squared	0.93		0.85	

Note: This table uses only the Econ One pricing data, without requiring matches to the Forrester or Consumer Reports datasets.

In contrast, we can see from Table 8 that after MNP, averaging across the 25 MSAs with equal weighting, Verizon's market share went up by 1.3 percentage points, for an average percentage increase of 4.1%, while AT&T's market share went down by 4.2 percentage points, for an average percentage reduction of 21.8%. This finding indicates that AT&T, being the firm with a lower quality, lost a significant portion of their market share following MNP, whereas Verizon's market share saw an increase.

The implication is clear: once switching frictions vanished, subscribers who had previously tolerated AT&T's lower call reliability in order to retain their numbers migrated toward the higher-quality network even though both carriers offered comparable discounts. Verizon was thus able to defend—and modestly expand—its base without an exceptionally deep price concession, whereas AT&T's matching discount proved insufficient to offset its quality handicap. This case study reinforces the broader message that by removing monopolistic barriers, MNP generally prompts firms to lower their prices and enables consumers to migrate away from low-quality firms.

To further investigate the role of service quality, we incorporate the four-item quality scores into our regression model; compared to the Overall Satisfaction ratings, these quality scores capture richer variation across markets and align more closely with objective network reliability. We proxy network quality with the four voice-performance scores reported in the April–June 2003 *Consumer Reports* survey: *no service*, *dropped calls*, *static*, and *circuits full*. In each of these four dimensions, each carrier–market combination is scored on a 1 (*poor*) to 5 (*excellent*) scale. Table 9 summarize the quality score data: the means cluster around 3.0 (No Service = 3.01, Dropped Calls = 3.01, Static = 2.89, Circuits Full = 3.02), medians are exactly 3, and the full 1–5 support is observed for nearly every dimension. Our composite quality index is the arithmetic mean of the four dimensions, thereby assigning equal weight to each aspect of perceived call reliability. Because the underlying metrics are contemporaneous and on a common scale, no additional normalization is needed. The quality index displays ample

Table 8: Effects of MNP on Verizon and AT&T Market Shares

Market	**Verizon**				**AT&T**			
	Before	**After**	**Diff**	**%Diff**	**Before**	**After**	**Diff**	**%Diff**
Atlanta	23.5%	26.0%	2.5%	10.6%	8.8%	5.9%	-2.9%	-33.0%
Boston	39.0%	43.8%	4.8%	12.3%	17.4%	11.1%	-6.3%	-36.2%
Chicago	28.2%	29.4%	1.2%	4.3%	11.8%	9.9%	-1.9%	-16.1%
Cincinnati	39.8%	33.0%	-6.8%	-17.1%	26.3%	25.8%	-0.5%	-1.9%
Cleveland	41.5%	42.4%	0.9%	2.2%	14.0%	10.0%	-4.0%	-28.6%
Dallas	10.4%	10.3%	-0.1%	-1.0%	24.2%	18.3%	-5.9%	-24.4%
Denver	36.7%	38.5%	1.8%	4.9%	26.4%	20.0%	-6.4%	-24.2%
Detroit	34.1%	33.4%	-0.7%	-2.1%	10.5%	8.0%	-2.5%	-23.8%
Houston	27.1%	27.4%	0.3%	1.1%	9.1%	8.8%	-0.3%	-3.3%
Kansas City	24.1%	20.5%	-3.6%	-14.9%	1.5%	1.8%	0.3%	20.0%
Los Angeles	36.2%	39.0%	2.8%	7.7%	25.0%	18.6%	-6.4%	-25.6%
Miami	12.1%	10.1%	-2.0%	-16.5%	20.6%	17.9%	-2.7%	-13.1%
Minneapolis	21.2%	26.1%	4.9%	23.1%	18.1%	15.1%	-3.0%	-16.6%
New York	38.8%	42.2%	3.4%	8.8%	21.8%	16.1%	-5.7%	-26.1%
Philadelphia	35.3%	38.0%	2.7%	7.6%	18.2%	13.0%	-5.2%	-28.6%
Phoenix	29.3%	30.6%	1.3%	4.4%	15.0%	9.2%	-5.8%	-38.7%
Pittsburgh	53.5%	57.0%	3.5%	6.5%	27.2%	24.1%	-3.1%	-11.4%
Portland	19.8%	34.6%	14.8%	74.7%	41.2%	32.3%	-8.9%	-21.6%
Sacramento	29.4%	29.9%	0.5%	1.7%	36.8%	29.9%	-6.9%	-18.8%
San Diego	39.4%	40.4%	1.0%	2.5%	14.0%	11.5%	-2.5%	-17.9%
San Francisco	31.2%	31.3%	0.1%	0.3%	36.3%	22.2%	-14.1%	-38.9%
Seattle	43.8%	41.8%	-2.0%	-4.6%	19.5%	14.1%	-5.4%	-27.7%
St. Louis	34.1%	36.4%	2.3%	6.7%	8.9%	7.0%	-1.9%	-21.3%
Tampa	14.4%	14.0%	-0.4%	-2.8%	21.3%	20.0%	-1.3%	-6.1%
Washington D.C.	36.8%	35.6%	-1.2%	-3.3%	12.6%	9.8%	-2.8%	-22.2%
Average	**31.2%**	**32.5%**	**1.3%**	**4.1%**	**19.5%**	**15.2%**	**-4.2%**	**-21.8%**

Notes: Table reports changes in carrier market shares before and after MNP. Each metropolitan statistical area (MSA) is given equal weight in the averages, so that all markets contribute one observation regardless of subscriber size. Results are robust to using subscriber-weighted averages. Changes are presented both as **percentage-point differences** (After-Before) to show the absolute magnitude of market share reallocation, and as **percent changes relative to the pre-MNP share** to show the change in proportion to the carrier's initial size. For example, a drop from 20% to 15% is reported as a -5 percentage-point change and a -25% relative change.

cross-sectional variation, sufficient to identify differential price responses by quality level in the subsequent econometric analysis.

Table 9: Summary Statistics of Quality Score Data

	Mean	Median	Min	Max
No Service	3.01	3	1	5
Dropped Calls	3.01	3	2	5
Static	2.89	3	1	5
Circuits Full	3.02	3	1	5

Subscriber-reported call quality is an advantageous metric for evaluating portability because it captures the network attributes that consumers actually consider when deciding whether to switch. Two peer-reviewed studies underscore its behavioral relevance. Genakos et al. (2018) show that JD Power survey scores—close counterparts to the *Consumer Reports* quality scores employed here—explain churn and price dispersion in European and U.S. mobile markets even after controlling for extensive engineering variables. Likewise, Czernich & Falck (2009) finds that broadband satisfaction indices outperform technical speed tests in predicting subscription choices. Grounding our quality variable in the same class of subscriber surveys thus aligns the analysis with the dimension along which portability is most likely to reshape demand.

The quality index also satisfies temporal-stability and exogeneity requirements. The *Consumer Reports* quality scores are collected six months before the November 2003 policy date, and our post-MNP window extends only to June 2004. Large voice-network upgrades—cell splits, MSC expansions, spectrum refarming—follow annual cycles, and FCC drive-test data indicate that nationwide dropped-call rates shifted by less than one percentage point between mid-2003 and mid-2004 (Federal Communications Commission (2004)). Because the quality measure precedes the policy, reverse causality from post-MNP price cuts to perceived service is ruled out, and any nationwide cost shock common to all carriers is absorbed by market fixed effects. Established precedent, behavioral relevance, temporal fixity, and orthogonality to immediate pricing shocks therefore make the *Consumer Reports* quality index a robust proxy for the service quality that conditions firms' responses to mobile number portability.

To isolate how service quality conditions the effect of mobile number portability, we augment the baseline pricing model by including each carrier's *Consumer Reports* quality index Q_{mi} and its interaction with the post-policy dummy. We estimate the following pricing equation:

$$ln(PRICE_{ipmt}) = \alpha_1 + \delta_1 MNP_t + \beta_1 MS_{mi} + \beta_2 MNP_t MS_{mi} + \gamma_1 Q_{fm} + \gamma_2 MNP_t Q_{fm} + \theta X_{ipmt} + t + \epsilon_{ipmt} \tag{4}$$

where Q_{fm} is the quality index of firm f in market m.

Table 10 shows the regression results. It shows a negative post-MNP constant effect ($\hat{\delta}_1 = -0.143$), confirming a baseline discount for a carrier. The interaction with market share remains negative but modest ($\hat{\beta}_2 = -0.113$), signalling that part of the earlier size effect reflects correlated quality. The portability–quality interaction is positive and statistically significant ($\hat{\gamma}_2 = 0.045$).

Treating market share as endogenous, we re-estimate by two-stage least squares, instrumenting both MS_{mi} and $\text{MNP}_t \times \text{MS}_{mi}$ with the historical *Baby-Bell* overlap indicator. The IV results (11) sharpen the asymmetry: the size interaction deepens and becomes highly significant ($\hat{\beta}_2 = -0.278$), while the portability–quality interaction increases in magnitude and attains clear significance ($\hat{\gamma}_2 = 0.057$). A move from the 25th to the 75th percentile of the quality distribution now raises the post-MNP price change by roughly three percentage points, whereas an equivalent move in market share lowers it by about six points. The evidence therefore reveals a two-dimensional pattern: larger firms still discount most aggressively, but—conditional on size—higher-quality incumbents temper their price cuts, relying on service superiority rather than unusually deep discounts.

Table 10: Price Response to MNP, including Market Share and Quality Index and without IV for Market Share

Variable	**Estimate**	**Std. Error**
MNP dummy	-0.143***	0.017
Market Share	0.337***	0.03
MNP x Market Share	-0.113***	0.039
Quality Index	0.057***	0.004
MNP x Quality Index	0.045***	0.006
Anytime Minutes	0.537***	0.002
Peak Minutes	0.507***	0.002
Weekend Minutes	-0.025***	0.001
Contract 24	-0.051***	0.004
7PM	-0.040**	0.018
National	0.071***	0.004
Rollover	-0.122***	0.006
PushToTalk	0.172***	0.018
PCS	0.010*	0.006
Free National LD	0.205***	0.01
Free In Network LD	-0.072***	0.01
Time Trend	0.003***	0.001
Observations		35,765
R-squared		0.79

Notes: Standard errors are clustered at the carrier-market level.

Table 11: Price Response to MNP, including Market Share and Quality Index and with IV for Market Share

Variable	**Estimate**	**Std. Error**
MNP dummy	-0.138***	0.017
Market Share	0.421***	0.048
MNP $\times$ Market Share	-0.278***	0.084
Quality Index	0.053***	0.004
MNP $\times$ Quality Index	0.057***	0.008
Anytime Minutes	0.537***	0.002
Peak Minutes	0.507***	0.002
Weekend Minutes	-0.025***	0.001
Contract 24	-0.051***	0.004
7PM	-0.044**	0.018
National	0.072***	0.004
Rollover	-0.120***	0.006
PushToTalk	0.169***	0.018
PCS	0.013**	0.006
Free National LD	0.206***	0.010
Free In Network LD	-0.071***	0.010
Time Trend	0.003***	0.001
Observations		35,765

Notes: Standard errors are clustered at the carrier-market level.

5 Conclusion

This paper studies the impact of reducing consumer switching costs on competition, using the 2003 implementation of mobile number portability (MNP) in the U.S. wireless industry as a natural experiment. We combine Smith's framework for understanding artificial barriers to competition with empirical analyses to show that MNP led to meaningful reductions in average prices, particularly among large and lower-quality carriers, and also prompted a shift in market share toward higher-quality providers. These findings suggest that enabling consumers to retain their phone numbers significantly increased their willingness to switch providers, compelling firms to compete more aggressively on price and enabling consumers to reallocate toward higher-quality networks.

Our results echo a central insight from *The Wealth of Nations*. Adam Smith emphasized that monopolistic frictions, such as legal or institutional barriers that inhibit mobility, allow firms to charge prices above their natural levels. In our setting, the inability to keep one's number functioned as such a barrier. By eliminating this friction, MNP improved market efficiency, bringing prices closer to their competitive—or "natural"—levels and enhancing consumer welfare.

The broader policy implications extend beyond telecommunications. Many contemporary markets, including banking, cloud computing, mobile ecosystems, and health insurance, feature switching frictions stemming from data portability limitations, platform lock-in, or bureaucratic hurdles. Our findings suggest that targeted interventions to reduce such frictions can deliver dual benefits: lowering prices and improving the allocation of consumers to higher-quality options. Nonetheless, the effectiveness of such policies is likely to depend on market structure, the degree of quality differentiation, and consumer responsiveness in a given market.

Several limitations remain. We have abstracted from consumer-level heterogeneity in switching costs and preferences, and our empirical analysis has focused on short-run price adjustments rather than longer-run firm dynamics. Our data on advertised plan prices also prevents us from observing whether carriers offered different prices to new versus existing customers.

Future research could explore how switching cost reductions interact with firms' incentives to invest in quality, or how consumer inattention and information frictions compound mobility barriers. Additionally, as regulatory discussions increasingly turn to data portability and interoperability, studying these mechanisms that reduce switching costs in digital and platform markets may yield further insights into the design of pro-competitive policy.

By linking a well-defined regulatory intervention in the wireless industry to changes in prices and market allocation, this paper contributes to the broader literature on consumer mobility, market frictions, and policy design. In doing so, it reaffirms the enduring relevance of Adam Smith's insights on competition, pricing, and the institutional foundations of market efficiency.

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A Robustness Checks for Figure 1 and Baseline Regression

This appendix presents four complementary versions of Figure 1 and a table of corresponding regression results. These figures and regression results examine whether the apparent break in Figure 1 coinciding with the implementation of MNP might be driven by particular months at the edges of the sample (January and February 2003 at the beginning and June 2004 at the end) or by the choice to display prices in logs rather than levels. While the visual evidence shows some sensitivity to these choices, the statistical analysis confirms that a significant price decline persists across specifications.

A.1 Graphical Evidence: Levels versus Logs and Full versus Trimmed Sample

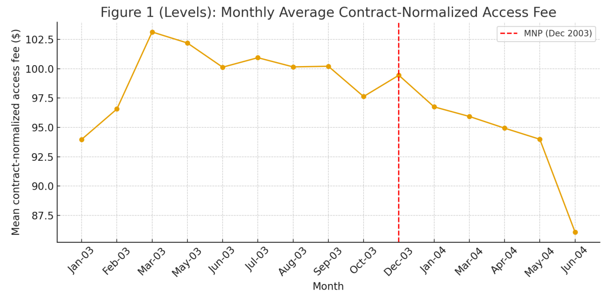
Figure 2 presents four versions of the price trend plot. Panels (a) and (c) use the full sample, displaying the monthly average contract-normalized access fee first in levels (dollars) and then in logs. In both versions, the same underlying pattern is evident: prices drift upward modestly during 2003, but a clear downward level shift begins in December 2003, which persists through the first half of 2004. This suggests that the finding is not driven by the log transformation.

Panels (b) and (d) replicate these figures after removing January–February 2003 and June 2004 from the sample. As expected, trimming these months smooths the series somewhat, but the overall pattern remains the same: a clear downward shift beginning in December 2003. This robustness check shows that the decline in prices is not dependent on those specific months.[14]

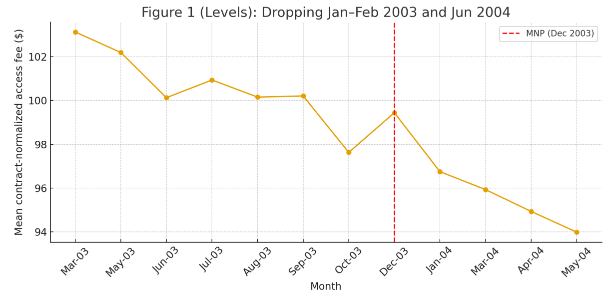
A.2 Regression Evidence

To formally test these visual patterns, we estimated four versions of our baseline specification from Equation (2), with the dependent variable in either logs or levels, using either the full or trimmed sample. Table 12 reports the coefficient on the post-MNP dummy.

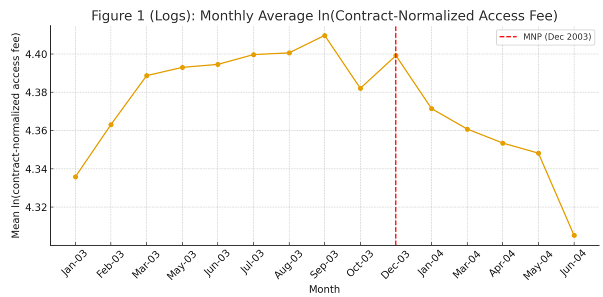
[14] The slight divergence between the trends in the log and level panels reflects the mathematical difference between arithmetic and geometric means. Level plots display the arithmetic mean of prices, while log plots display the mean of log prices (which equals the logarithm of the geometric mean of prices). These measures can differ when prices are dispersed, but both show the same timing of the downward shift coinciding with MNP implementation.



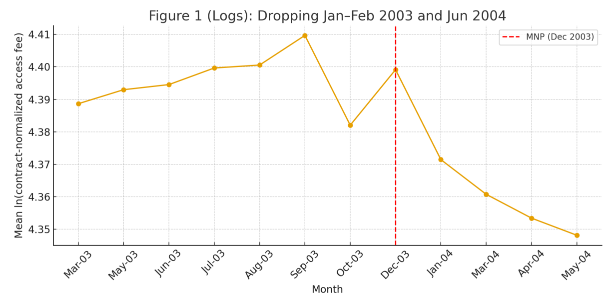
(a) **Levels, full sample.** Monthly average contract-normalized access fee ($). The dashed line marks Dec-03.



(b) **Levels, trimmed.** Same as (a), but excluding Jan–Feb 2003 and Jun 2004. The post-MNP decline persists.



(c) **Logs, full sample.** Monthly average ln(contract-normalized access fee). The downward shift in Dec-03 mirrors the result in levels.



(d) **Logs, trimmed.** Same as (c), but excluding Jan–Feb 2003 and Jun 2004. The break remains visible.

Figure 2: Robustness of Figure 1 to (i) displaying in levels versus logs and (ii) trimming Jan–Feb 2003 and Jun 2004. In all cases, a downward shift beginning in December 2003 is visible.

Table 12: Post-MNP Dummy (MNP_t): Full vs. Trimmed, Logs vs. Levels

	Logs: Dep. Var. = ln(price)		Levels: Dep. Var. = price ($)	
	Full Sample	Trimmed	Full Sample	Trimmed
MNP Coefficient	-0.0538^{***}	-0.0206^{**}	-7.63^{***}	-4.36^{**}
Std. Error	(0.0115)	(0.0104)	(1.65)	(1.82)
p-value	< 0.001	0.048	< 0.001	0.017
Interpretation	−5.4%	−2.1%	−$7.6/month	−$4.4/month
Observations	35,765	29,373	35,765	29,373

The regression results confirm the graphical evidence. With the full sample, the post-MNP effect is strong and highly significant: prices fell by about 5.4% or $7.6 per month. In the trimmed sample, the effect remains negative, economically meaningful, and statistically significant at the 5% level in both specifications (a 2.1% or $4.4/month reduction). This confirms that the downward repricing associated with portability is a robust feature of the data and not an artifact of the sample window or the log transformation.