Price Discrimination amid Heterogeneous Switching Costs: A Competitive Tactic of the Telephony Resale Fringe

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Abstract

This paper explores competition in the post 1996 long distance telephony market by employing an unusually detailed data set. New evidence of third degree price discrimination is found with rural and low income customer groups facing higher prices. Results indicate that individuals who are less willing to switch carriers frequently pay significantly higher prices. A multi-dimension mixture model is used to characterize switching behavior and finds significant heterogeneity in subscriber switching costs. The switching behavior model provides insight into price differential ranges which support resale firm survival. These findings can be useful for determining optimal firm response as well as optimal telecommunications market policy.

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1 Introduction

Since 1984, AT&T's market share of long distance telephony has decreased from 90.1% to 37.9%. This dramatic decrease in market share has gone hand in hand with antitrust legislation and the resulting competitive opposition of smaller, new entrants. Entrants are essential for checking the behavior of an incumbent — often by providing lower priced alternatives. Consequently, it is in the interest of policy makers to sustain the presence of these new contributors. This paper examines the competitive device of price discrimination that may enhance the sustaining power of new entrants in the current long distance telephony market. Using an unusually detailed original dataset, this paper uncovers new evidence of third degree price discrimination. Because disincentives to switch carriers provide market power that complicates competitive action, this paper also models heterogeneous switching costs for subscribers. Characterizing heterogeneous switching costs across subscribers enables better understanding of the shape of market power in the industry and better determination of the effect of different price discriminatory policies.

This paper begins the inquiry by reviewing certain salient attributes of long distance telephony after the 1996 Telecommunications Act. This legislation allows new entrants to purchase facilities, to lease lines or facilities, and to purchase resalable voice minutes for a reasonable wholesale cost. The resulting reduction in cost of capital lowers barriers to entry. The subsequent ease of market entry following 1996 paved the way for many new entrants, including a certain interesting subset of aggressive new firms. This subset makes up what I call the competitive resale fringe. These resellers lease time from other carriers' networks for resale on the retail market. Practically nonexistent seven years ago, resale firms have become a major influence in increasing competition within the market. The new environment has been unusually favorable for new entrants — at least for the short term. Even though both consumer price and wholesale cost of long distance service is temporarily declining, retail prices have been sticky and have decreased at a slower rate. This unique combination has provided a convenient disguise for certain competitive devices.

One of those devices, which has enabled resale firms to compete so effectively in the current market is price discrimination. This first paper finds new evidence of price discrimination. The paper explains findings that may only be uncovered by utilizing a data set that contains individual prices, costs, and a large number of observations. An original detailed data set from a proprietary company is used. The company data set contains retail price, cost, and consumer characteristics for each and every phone call from over 180,000 customers during 1998 to 2000. Zip Code census data are added to enhance demographic characterization. Price dispersion is analyzed in a heteroskedastic-consistent fixed effects model against subscriber demographics, while accounting for cost effects, time effects, and individual credit records. Results indicate that price variation is partially due to customer demographics, such as income and location, and therefore imply 3rd degree price discrimination. Interviews with firm management corroborate the empirical results by explaining that the long distance resale segment has a well-established mechanism for price discrimination among prospective subscribers. Here, sales agents telemarket. They offer different prices based upon location demographics, as well as upon answers given to telemarketing questions (including willingness to pay and ability to search for alternative carriers).

Once the customer is signed up, switching costs discourage subscribers from leaving, even as market-wide prices decrease. In an environment of decreasing costs, it is unnecessary to raise prices for tenured subscribers in order to create price discrimination. Carriers need only offer prospective subscribers a lower price (while sustaining stable price levels for old subscribers). In addition, because small resale firms have a lower profile than do major carriers, resale subscribers are generally less informed about their carrier's pricing than are subscribers of major carriers. This circumstance gives resale firms an advantage for price discrimination. As a result, price discrimination is an important tactic contributing to a small resale firm's ability to extract the profits necessary to stay in business and to compete effectively against the much larger incumbents.

The literature on the telecommunications market is extensive. However, literature on price discrimination within telephony is somewhat sparse. A handful of papers discuss nonlinear tariffs (sometimes considered a means of second degree price discrimination). These papers include: Bousquet and Ivaldi [1997], and Wilson [1993]. The latter provides

a good review of nonlinear pricing theory. Nonlinear tariffs describe a pricing structure where per-unit price is dependent upon quantity purchased. A large number of telephone companies employ nonlinear tariffs by charging a monthly service fee, a call connection fee, and a per minute rate for calls. Another portion of the literature discusses non-price discrimination. This literature includes: Weisman and Williams [2001], and Weisman and Kang [2001]. These papers cover discrimination of upstream monopoly firms, and of RBOCs (Regional Bell Operating Companies) entering the long distance market within their own local region. Third degree price discrimination at the retail level of the telephony market, however, has not, to my knowledge, been studied. The model I ultimately employ to capture third degree price discrimination in the telephony market draws from price discrimination models of other industries (such as Scott Morton et al. [2002]).

Section 5 of my paper develops a model of subscriber switching behavior. Each individual subscriber's departure is used to predict the price differential necessary to lure subscribers away, or alternatively, to prevent subscribers from leaving (given subscriber specific cost factors, demographics, and credit history). Subscribers optimize each period as both market-wide costs and market-wide prices change. I develop an original method (called switch indexing) to account for the effects of separate price differentials in various sectors of the telephony market (knowing that some subscribers will look to premium prices, like AT&T's, as a possible alternative, while other subscribers will look to other small resale firm prices as possible alternatives). Since I observe subscriber movement to and from the observed firm, but do not observe specific originations or destinations of subscribers, I adapt the likelihood framework to optimize over the binary actions I do observe. The model has the unique advantage of being able to focus more on time-specific cost differentials, rather than being constrained to assume a parametric function in order to characterize expected change in the environment. This time flexibility feature is important for the long distance telephony market, where cost and relative price velocity are quite volatile. In addition, this framework allows for more facile forecasting in a market with environmental volatility. More accurate forecasting can enable both better public policy analysis and more effective individual firm response.

Section 5 then captures switching cost heterogeneity among subscribers. Here the paper introduces a mixture model. I begin by modeling consumers as one of two types: (1) a

subscriber with low switching costs or (2) a subscriber with high switching costs. Two separate sets of parameters are recovered, as well as the distribution probabilities.

There is a literature on switching behavior in telecommunications markets. A couple of papers, Galbi [2001], and Gans et al. [2001], model switching behavior for local phone choices. Knittel [2001] discusses pre-1996 switching among long distance carriers. Moshkin and Shachar [2000] differentiates between switching and searching costs in television programming. Klemperer[1995] is a helpful theory paper on competition and switching. Rysman [2002] provides a good survey of the economics of network industries.

My paper utilizes a utility structure consistent with the literature. Seminal papers in this area include: McFadden [1973, 1976, 1978], and Domencich and McFadden [1975]. Amemiya [1981] is good survey article on qualitative choice models. Berry [1994] and BLP [1995] also provide insight. My paper also draws on previous uses of mixture models in the literature. One of the earliest papers accounting for unobserved heterogeneity is Blumen et al. [1955]. Numerous papers have utilized mixing models since. Lancaster [1990] provides a useful development of the theory.

Results from my paper show that demographics such as income and location face third degree price discrimination. However, the greatest determinant of price differentiation among consumers lies in how frequently they are willing to switch carriers. Estimates of the switching behavior model indicate that factors such as price, language operator service, and inherent switching costs are most likely to contribute to a subscriber's leaving a competitive carrier. Finally, the paper uncovers evidence of significant switching cost heterogeneity in the sample. The analysis of market activity and consumer behavior provided by this paper can point to optimal firm action and optimal public policy.

The remainder of this paper is organized as follows. Background on the telecommunications market is discussed in section 2. Section 3 describes the data and descriptive statistics. Section 4 contains the price discrimination model, results and discussion. Section 5 covers the consumer switching behavior model, empirical implementation, results and discussion. Section 6 concludes with a summary, and future work.

2 Background on the Telecommunications Market

The telephony market has changed drastically since 1984. Before 1984 we faced the regulated monopoly of AT&T . During the deregulation beginning in 1984, we observed the break-up of AT&T in its local service. Local telephony was partitioned into regions — each served by a single baby bell. AT&T was forced to provide only long-distance telephony service.

In 1996 federal legislation took things a bit further. The Telecommunications Act of 1996 mandated three important activities. First, long distance incumbents were forced to provide bulk minutes at a reasonable discount rate to new firms. Second, incumbents were required to lease telephone lines, as well as other facilities, at a reasonable rate to firms on demand. Third, this legislation allowed any new entrant to build complete facilities for themselves. Now all firms, including the baby bells (if they allow reciprocal availability in their local markets), are no longer restricted and can feasibly compete with AT&T in the long distsance market. Originally, the main vehicle targeted by the FCC to foster competition was the entry of incumbent local exchange companies into the long distance market. However, telephony resale firms now represent a large competitive force in and of themselves.

Resale firms comprise a competitive fringe for the telecommunications market. These resale firms have flooded the telecommunications market since the passing of the Telecommunications Act of 1996. Because resale firms in the long distance telephony market have only existed in large quantities since 1996, and because their data are difficult to obtain, there have not been (to my knowledge) any studies on the resale fringe. However, I have been able to obtain very detailed data from an undisclosed resale firm headquartered in California.

The network structure within the market has become more complex over time. What was formerly owned solely by a monopoly, now is owned by many. Each individual long distance call requires cooperation between different owners. First, an LEC (local exchange

carrier) controls the origination of the call. Second, the call must leave the local network for the long distance trunk via a switch. Third, a long distance trunk owner controls the movement of the call along the long distance trunk running from city to city. Fourth, the call must leave the long distance trunk for the terminating local network via a second switch. Finally, a second LEC controls the termination of the call on its local network.

There are many options for entrants to obtain access to needed capital. In this new network environment, entrants can purchase or lease facilities, lines, equipment, or minutes to participate in any part of the long distance call process. A firm might choose to rent facilities which could add to a carrier's local or long distance structural network. A firm might also choose to rent or purchase a useful piece of equipment called a switch. These switches are composed of computers that function to move a call from a local network to a long distance trunk or vice versa. It is a common practice for firms to lease or resell local and long distance facilities, yet own a computer switch to cut down on marginal cost. Finally, a number of new entrants simply purchase long distance calls from start to finish at a wholesale cost and resell them at a final retail rate. These firms that purchase resalable minutes from other carriers for some or all of their calls are referred to as resale firms.

Decreases in barriers to entry have paved the way for numerous new entrants of various types. The market has changed dramatically as a consequence. By the year 2000, 782 long distance service providers reported to the FCC. It is expected that many more exist (particularly small, non-reporting resale firms). 482 of the 782 reporting firms are resellers — indicating that over half of the reporting firms in the long distance market are resale firms. The long distance resale firms make up just under 30% of the market share of revenues — qualifying these resale firms as a significant fringe in the market.

Change in the long distance telephony market has certainly altered AT&T's position. In 1984, AT&T held 90.1% of the market. By the year 2000, that market share decreased to 37.9%. However, despite the substantial decrease in market share, AT&T's revenues have actually increased over that same time period. This increase in revenue, despite a dramatic decrease in market share, and despite a significant decrease in price, is a testament to the large increase in consumer volume and in wholesale demand.

3 Data

The primary data source comes from an undisclosed resale firm headquartered in California. This data reports the actions of subscribers during a 30 month period. The data shows when the customer subscribes and if, or when, that customer switches to another firm. The data lists each phone call that each consumer places down to the exact origination number and termination number. Retail price, marginal cost, and length of each call are also reported. In addition, the data also provides some consumer characteristics that are observed by the firm before it offers a price to the targeted consumer. These consumer specific descriptors include measures such as expected: estimated monthly usage, an identifier for language translation operator usage, and an identifier for whether the subscriber is a credit risk. The firm data spans the period of July 1998 to December 2000.

I also utilize additional consumer descriptor information found in the 1990 US Census. The firm data gives the street address of each subscriber. I then match the subscriber's zip code with the characteristic descriptors found in the 1990 US Census. Through this added data I was able to further define the characteristics of the subscribers in dimensions such as their: median income, indicator if over 60 years of age, indicator if they live in a rural area, indicator if they own their own house, and likelihood of being born over seas.

Finally, to approximate a measure for competitor prices, I construct two separate benchmarks. The first benchmark consists of a representative high volume plan offered by AT&T. Here we observe per minute rates as well as fixed monthly charges for long distance calls terminating in each state or country. This first benchmark represents the general movement of major carrier long distance rates.

The second benchmark consists of wholesale costs for long distance calls. Here we observe the per minute marginal cost to resellers for long distance calls terminating in each state or country. Because wholesale costs are essentially homogeneous across the industry, this second benchmark represents the general movement of discount resale carriers.

3.1 Descriptive Statistics

Wholesale costs and resale prices have decreased over time. In the resale segment, wholesale costs have declined more rapidly than have resale prices. The statistical snapshots in the appendix show these declines. They also show disproportionate rates of decline. Figure A1 maps wholesale cost for evening calls to Japan during the month of July in years 1998, 1999, and 2000. With 1998 setting the benchmark, I measure wholesale price movement in each of the next two years. The figure shows a decrease in median wholesale cost (from 22 cents/minute to 10 cents/minute) in the first year (July 1998 to July 1999). The decrease continues into year 2000, but at a reduced rate (from 10 cents/minute to 7 cents/minute). Both movements are large. However, the difference in their magnitude is significant. This volatility in the velocity of cost movement suggests there is a value to modeling costs so that they account for variable stochastic downturns in cost structure. The models in sections 4 and 5 provide frameworks that allows for this kind of volatile movement.

As with wholesale costs, retail prices have declined over the same period, but at a slower rate. Even though both consumer price and wholesale cost of long distance service are declining, prices have been sticky and have decreased at a slower rate than wholesale cost. This differential in the rate of decrease between prices and costs seems to be driven by management's choice to pass on decreases in costs only discriminatively and incompletely to their retail consumers. Appendix Figure A2 shows the decrease in retail price over time for the same group of evening calls to Japan. Again 1998 sets the benchmark. I use the month of July to give us a statistical snapshot of retail prices in 1998, 1999, and 2000. Similar to wholesale costs, retail prices decrease in both years, and they decrease more dramatically (from 25 cents/minute to 16 cents/minute rather than from 16 cents/minute to 13 cents/minute) between the years 1998 and 1999. One difference in retail price movement, as opposed to wholesale cost movement, is that variation increases much more drastically over time. We start at almost a homogeneous retail price in 1998 and end with much larger variation by 2000. This increase in variation over time may result from a firm's employing a particular method of effective price discrimination (which will be

discussed more thoroughly in the following section). The change in variation over time also compels us to account for heteroskedasticity in the price dispersion model (which is also discussed in section 4).

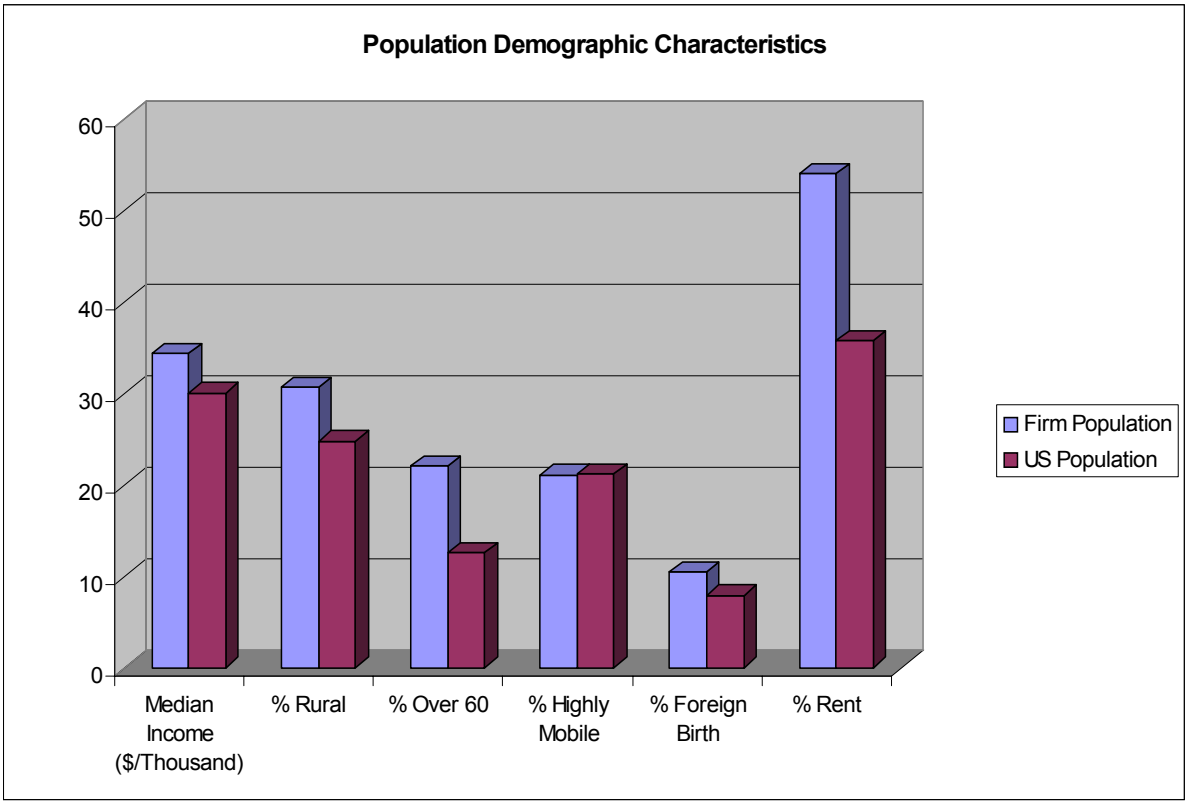
Percentage markup movement over time is shown in Figure A3 in the appendix. Median markup increases over time. This trend results from cost decreasing at a more rapid rate than price over time. Figure A3 describes the upward movement in percentage markup for customers in the month of July during each of the years 1998-1999 and 1999-2000. During the first year, median markup increases from 14% to 45%. During the second year, median markup increases from 45% to 57%. Not only does median markup increase over time, but markup (excluding one small set of outliers in 1998) also gains in variation over time. This increase in variation of markup is due to an increase in price variation, while cost variation increases to a lesser degree.

Markup also varies quite a bit based upon the country in which each call is terminated. Figure A4 in the appendix shows the average percentage markup for each of 14 most frequently called countries. Again, the month of July is shown for the years 1998, 1999, and 2000. Such large variation in average markup per country, in each period, could indicate that competitiveness for some country markets differ. For example, it may be that a number of companies frequently service some country markets (like Mexico which is a popular call destination and a country for which there are an unusually large number of charges yielding negative markups), and drive down the price for that market. Additionally, it could be that companies take advantage of the bundled nature of their product. Firms may offer a good rate for calls to certain frequently called countries, yet offer very high markups on other less frequently called countries. Firms may follow this policy because callers to the less frequently called countries may be less likely to ”shop” and find lower rates. Such differentiation in markups over the portfolio of each individual caller provides the firm with two major advantages. First, it provides the carrier with higher returns. Second, it provides the ability to advertise a low, competitive price for specifically desired countries.

We also see that average percentage markups generally increase in magnitude. The median of the average country markups increase from 17% to 34% in the first year, and from 34% to 53% in the second year. This type of movement indicates that over time, as

costs decrease (and a number of consumers fail to switch), profits increase as the firm is able to extract further rents.

While the data provides insight at an unusually datailed level, one concern is that information has been obtained from only one firm. Understanding the limitations of this partial view and selection bias, I have compared the demographics of customers (zip codes) of the observed carrier to the demographics over the entire US population. Median measures can be found in Figure 1.



Figrue 1

Figure 1 shows that most population demographics are similar. ”Median Income”, ”Rural”, ”Highly Mobile”, and ”Foreign Birth” are close in value between the two populations. There are a few more individuals likely to be over 60 years of age in the observed firm population. However, the greatest differentiation lies within the percentage of individuals likely to rent housing. Individuals in the observed firm population are more likely to rent. It is logical that those more likely to rent housing would be selected into the observed firm pool. Those who rent are usually less stable and perhaps more likely to have a lower aversion to switching carriers (and to using competitive carriers) due to the lack of permanency in residence. Selected individuals who are more likely to rent housing may be living farther beyond their means (may be farther from owning housing — a major contributor to personal welfare). This effect may make the individual more discount conscious, and therefore, more likely to use a discount carrier to save money.

4 Price Discrimination

This section explores third degree price discrimination in the long distance telephony market. The first subsection describes the unusually favorable market circumstances which enable firms to more easily sustain and profit from price discrimination. The second subsection describes the model. The final section presents the results.

4.1 A Facilitating Market Environment

The long distance telephony industry is characterized by a combination of decreasing wholesale cost and decreasing retail price. Prices fell at a faster rate than costs. A possible explanation is that some consumers look primarily to price and are not perfectly informed about costs. Heterogeneity in the information available to consumers, as well as the differing ability among consumers to negotiate new prices, allows the firm to tailor plans and charge distinct prices to consumers.

Managers have two different methods of implementing price discrimination among retail consumers. The first method utilizes information extracted from customers by telemarketers and used to tailor specific service packages. These telemarketers evaluate willingness to pay among new customers. They offer different prices based upon location demographics, as well as upon answers given to other telemarketing questions regarding willingness to pay, ability to search for alternative carriers, and special service needs.

The second method exploits the heterogeneity in the frequency with which subscribers are willing to switch carriers. In the majority of cases, the observed firm retains the original quoted price over a fairly long term. The firm quotes a certain set of rates at the time customers subscribe and does not change them over time. The consumer often has high actual or perceived costs associated with switching carriers. As the prices of other carriers decrease over time, each customer does have the opportunity to switch. If they do so, they generally obtain a price that more closely reflects the decreasing market price. However, if customers have a high switching cost or inertial unwillingness to switch

carriers, they will remain and pay a higher relative price.

While relatively limited in most competitive tactics available to larger firms, small resale firms have an advantage in implementing price discrimination through tailoring of individual service plans. Because small resale firms have a lower profile than do major carriers, resale subscribers are generally less informed about their carrier's pricing than are subscribers of major carriers. This relative anonymity gives resale firms an advantage for price discrimination because their customers must work harder to obtain information about the relative market price among competitive firms.

4.2 Price Discrimination Model

This subsection presents a framework to test for the presence of price discrimination, and to discern the type of price discrimination employed. The framework follows a number of steps to reach its goal. First, it is important to deduce whether or not price discrimination exists. To do so, I include control factors in the model to account for idiosyncratic costs among customers. I also include country fixed effects and premium price movements to control for differences in market competitiveness in calls to separate countries. Second, I characterize the type of price discrimination. Customer demographics are included in the model in order to test for third degree price discrimination. Significance of demographic variables indicate that firms offer higher or lower prices based upon whether a potential customer is part of a specific demographic. Finally, I include the time each customer signs on as a subscriber to the observed firm. If a customer who subscribed to the firm at an earlier date pays a higher price, it is an indicator that price discrimination adversely affects those who are not willing to switch frequently.

The empirical specification is as follows:

$$\ln(p_{itk}) = X\beta + \epsilon_{itk}$$

Here, a price for a specific individual, in a specific time period, calling a specific country is denoted by p_{itk}. i denotes the individual customer. t indicates the month of the call. And k refers to destination country of the call. β is the linear coefficient on variables,

X. X contains information on demographics, control factors (such as cost and equivalent pricing with AT&T), and country fixed effects. All non-dummy variables are calculated in natural logs. The error term, ϵ_{itk}, is iid and varies over individuals i, time t, and countries k.

A functional form for prices is chosen to pattern the price dispersion observed. It is likely that firms use individual plan tailoring and price discrimination to recover as much as they believe a customer is willing to pay. One difference among prospective subscribers is the information they have available to them. There is a great variety of carriers — each offering different prices. Some prospective subscribers, usually high volume international users, are targeted more heavily by advertisements from alternative carriers. Other prospective subscribers, usually higher income individuals, have greater access to technology such as the internet where they can more easily and comprehensively search for better rates offered by alternative carriers. Hence, one can think of prices, p, being a function of information, I. Then in turn, one can think of information, I, as a function of demographics and other measures of the data: p(I(demographics) , control factors).

Consumer Characteristics

The subscribers in the data set can be described by a number of exogenous characteristics. These characteristics include credit class, mobility within region, rural location, need for foreign language operator, age above 60 years, and income. The data also observe the cost for the carrier to service each individual call.

Subscribers are also differentiated (and specific service packages tailored) based upon answers to the telemarketer's questions. Among other questions, each prospective subscriber is asked for his total expected monthly expenditure. The answer to this question (Estimated Usage) has two implications. First, it provides a rough indication of total volume/services used by the individual. Second, it suggests what a prospective subscriber expects or is willing to pay.

In addition, we observe two characteristics: (1) which month the prospective consumer subscribes, and (2) the current monthly time period. This data allows us to account for downward pressure in prices to new customers due to the monotonically decreasing structure of cost over time. Here, we expect the carrier to effectively price discriminate by simply keeping the prices for existing customers unchanged, while decreasing prices for

prospective new subscribers (allowing the firm to be competitive on the open market). These variables determine a more specific characterization of prices for each consumer over time: p(t, time subscribed, start month, cost, demographics).

Heteroskedasticity

The movement of the data necessitates that I control for heteroskedasticity. As was demonstrated in subsection 3.1 (Descriptive Statistics), variance in price increases over time. Consequently, the variance parameter of the price distribution changes over time as well. This change in the distributional variance parameter requires the estimate errors to be adjusted. I employ White's Heteroskedastic-Consistent Errors to correct for the problem.

Fixed Effects

Fixed effects are used to control for variation in competition among different country markets. It is likely that high frequency markets, such as Mexico and Puerto Rico, are very competitive and provide lower markups for the firm. To capture the difference in competitiveness of individual country markets, fixed effects are used. Fixed effects are chosen over random effects because it is expected that there may be correlation between the country effects and the remaining variables in the model. In particular, country effects may be correlated with the measure of individual value for premium quality. Alternative call prices should account for movement due to individual country market competition levels. This premium price should capture individual market competition levels among premium carriers (which should be correlated with, yet distinct from) the price levels among competitive carriers.

4.3 Price Discrimination Results

The results from the price discrimination estimation model suggest: (1) the existence of price discrimination, (2) the third degree price discrimination form, and (3) the relationship of switching to price paid. The results can be found in tables 1 and 2 on the following two pages. Table 1 reports the estimates when no country fixed effects are employed. Table 2

gives the estimates taken from regressions including country fixed effects. All reported errors are White's Heteroskedastic-Consistent Standard Errors. Note: the non-heteroskedastic-consistent standard errors provide estimate significance of at least the level of the White's Heteroskedastic-Consistent Standard Errors.

Table 1: Price Regressed with No Fixed Effects
Heteroskedasticity-Consistent Errors

Number of Observations = 101,277

	Cost	Cost and Premium Pr.	Excluding Time	Complete
CONST	-2.1213 (0.0031)***	-1.9372 (0.0022)***	-0.9449 (0.0369)***	-0.8267 (0.0367)***
Cost	0.0239 (0.0006)***	-0.0019 (0.0004)***	-0.0015 (0.0004)***	-0.0018 (0.0004)***
Premium Price		0.4803 (0.0016)***	0.4844 (0.0016)***	0.4850 (0.0016)***
Time in Months				-0.0091 (0.0002)***
Month Subscribed			-0.0112 (0.0002)***	-0.0064 (0.0002)***
Estimated Usage			-0.0020 (0.0002)***	-0.0005 (0.0002)*
Language Operator			0.0266 (0.0005)***	0.0184 (0.0026)***
Rural			0.0352 (0.0047)***	0.0392 (0.0047)***
Mobility in Region			-0.1158 (0.0112)***	-0.1113 (0.0112)***
Income			-0.0746 (0.0034)***	-0.0752 (0.0033)***
Over 60			-0.1636 (0.0149)***	-0.1571 (0.0149)***
Low Credit			-0.0106 (0.0031)***	-0.0155 (0.0031)***
R-Squared	0.025	0.625	0.646	0.651

* indicates significance at the 10% level
** indicates significance at the 5% level
*** indicates significance at the 1% level

Table 2: Price Regressed with Country Fixed Effects
Heteroskedasticity-Consistent Errors

Number of Observations = 101,277

	Cost	Cost and Premium Pr.	Excluding Time	Complete
CONST	0.0000	0.0000	0.0000	0.0000
	(0.0009)	(0.0009)	(0.0008)	(0.0008)
Cost	-0.0072	-0.0073	-0.0068	-0.0070
	(0.0003)***	(0.0003)***	(0.0003)***	(0.0003)***
Premium Price		-0.1013	-0.0197	0.0307
		(0.0073)***	(0.0072)***	(0.0073)***
Time in Months				-0.0068
				(0.0002)***
Month Subscribed			-0.0117	-0.0083
			(0.0001)***	(0.0002)***
Estimated Usage			-0.0010	0.0001
			(0.0002)***	(0.0002)
Language Operator			0.0100	0.0061
			(0.0021)***	(0.0021)***
Rural			0.0613	0.0645
			(0.0040)***	(0.0038)***
Mobility in Region			0.0106	0.0156
			(0.0081)	(0.0080)*
Income			-0.0381	-0.0384
			(0.0024)***	(0.0024)***
Over 60			0.0048	0.0091
			(0.0106)	(0.0106)
Low Credit			0.0027	-0.0005
			(0.0023)	(0.0023)
FE R-Squared	0.811	0.811	0.811	0.811
R-Squared	0.813	0.813	0.833	0.835

* indicates significance at the 10% level
** indicates significance at the 5% level
*** indicates significance at the 1% level

The price discrimination results reveal a relationship between firm pricing and consumer demographics. Rural location and income each have significant effects. Those living in a rural area pay an estimated 6.64% more for the same service. Since I control for

cost in the study, it is apparent that the premium to rural customers is not cost-driven. Consequently, it is likely that competitive forces are responsible for the rural premium. Because fewer companies service rural areas, it is likely that the less competitive environment enables firms to price higher yet still obtain the same response from consumers. Income has the opposite effect. Individuals pay an estimated .0384% less for each additional percentage of income earned. For example, someone who earns twice the average income will pay an estimated 3.84% less than the average subscriber. To a social planner, this income discount may seem unfavorable. The income discount allows those who can afford to pay more to pay less. It is likely that perceived enhanced information for high income individuals motivates the firm to offer this income discount. Increased access to information (through internet connections and/or greater transportation ease) allows high income individuals to locate additional information on long distance rates and to have a better understanding of a carrier's lowest bound when negotiating their price. Again, it seems that pricing is motivated by competitive leverage of subscribers as signaled by their demographics.

The country fixed effects fit the data well. Country fixed effects explain 81.1% of the variation in price. Country effects also seem to overshadow the effect of premium price. Premium price is included to capture a combination of cost and competition among premium carriers for the country market at a certain period in time. Premium price holds the logical positive sign in Table 1 where no country fixed effects are used. However, in two of the three regressions in Table 2 (where country fixed effects are included), premium price is negative. Also affected is cost. Cost has an intuitive positive sign (implying firms charge a higher price for calls with a higher marginal cost) in the first regression of Table 1 (where no country fixed effects are used, and premium price is not included). Consequently, it seems that the combination of country fixed effects and premium price account for significant competitive variability between country markets as well as cost movement.

The "Time", "Month Subscribed", "Estimated Usage", and "Language Operator" coefficients each hold intuitive signs. The "Language Operator" coefficient is positive and significant, yet small. This coefficient seems appropriate for representing subscribers who utilize the foreign language operator service. However, the carrier does not charge an

unreasonable rate for the added service. The ”Estimated Usage” coefficient is negative when significant. ”Estimated Usage” is the expected per month charge that individuals report before subscribing to the carrier. ”Estimated Usage” is a proxy for volume. Unlike volume, ”Estimated Usage” is not endogenous to the price of the call. ”Estimated Usage” controls for discounts high volume users might receive without introducing an endogeneity problem. Consistent with the descriptive statistics that describe prices sluggishly following decreasing costs, the ”Time” coefficient is negative. The ”Month Subscribed” coefficient is also intuitive and negative, implying that those who have stayed with the carrier longest are most likely to pay more for the same service. Prices decrease by an estimated .83% for customers who subscribe just one month later. After a year of staying with the same carrier, a subscriber pays an estimated 9.96% more than a new subscriber. It seems that the largest predictor of abnormally high rates is the unwillingness of the individual subscriber to switch carriers.

Certain individuals benefit from this policy of price discrimination: those living in non-rural areas, those with high income, and those with a greater willingness to switch carriers. Others (often those with less ability to pay) are adversely affected by the price discrimination policy. Firm policy seems to result from competitive forces. Those customers with greater leverage (stemming from having superior information, negotiation skills, and/or willingness to switch carriers frequently) are better able to procure a more favorable price. Most importantly, willingness to switch carriers frequently has the largest effect on price paid.

5 Consumer Switching Behavior

This section discusses the switching behavior of consumers subscribing to the observed firm. The first subsection describes the role of heterogeneous switching costs in allowing the firm to price discriminate in ways other than demographic targeting. The second subsection develops a model of consumer switching behavior. The third subsection outlines the empirical implementation. And the fourth subsection displays the results.

5.1 Heterogeneous Switching Costs: A Facilitator of Price Discrimination

If frequent switching allows consumers to obtain lower prices, why doesn't every customer switch periodically? Primarily, because there are costs associated with switching, and these switching costs vary over individuals. First, there is a transaction cost incurred when switching. Transaction costs include: (1) the time spent with the telemarketer agreeing on service and price, (2) time spent arranging for and hosting an in-house visit with the new carrier if equipment needs to be installed, and (3) time spent waiting for the new service to take effect. Second, there is uncertainty about the quality of the new firm. Some firms may have superior or unique customer service. This customer service is only evident after a customer subscribes. Both the cost of uncertainty and the cost of poor customer service vary over individuals. Some customers are quite risk averse while others consider it less significant to take a chance on a new firm. Similarly, some customers value customer service more highly than others. The result of each force adds to the heterogeneity in switching costs across individuals. Third, there is a cost (albeit quite small for some) associated with learning to use a new long distance telephone system. Some customers are concerned about learning a new billing system or a new method of dialing the phone to reach the call's destination. However, others find learning a new method of use to be either interesting or insignificant. Finally, there is a relationship cost associated with switching. Over time subscribers may develop a relationship with a phone company or

a customer service representative from the company. Here personal attachment (or sometimes a sense of tradition or habit) may inhibit a subscriber's decision to switch. Whatever the reason, each individual has a personal cost associated with switching carriers.

The firm data reveals that there is a large variation in how long subscribers stay with the company. However, there seems to be a fairly low average length of stay within the company. This low average length of stay is intuitive considering the selection of the observed firm's customers. The observed firm is very competitive and small; it draws heavily from individuals who are willing to switch to lower quality firms to save on price. The percentage of subscribers staying over a given number of months (broken down by those subscribing in any of the first seven months) is listed in the following table.

Table 3: **Customer Length of Stay Summary**

Number of months at which customer is still present	Month Customer Subscribed							
	%	Jul-98	Aug-98	Sep-98	Oct-98	Nov-98	Dec-98	Jan-99
	2 months	0.975294	0.973375	0.978995	0.966395	0.930902	0.964129	0.978681
	3 months	0.94998	0.935656	0.939498	0.929077	0.881718	0.925161	0.941993
	6 months	0.598218	0.829598	0.837215	0.753272	0.572697	0.638452	0.704264
	1 year	0.304779	0.322831	0.384247	0.323665	0.263436	0.223484	0.363659

As can be seen in Table 3, average length of stay with the carrier is around ten months. In addition, only approximately 30% of subscribers stay with the firm over a year. These length of stay figures indicate that there is unusually high switching among subscribers of the observed firm. Such figures are expected given the selection process.

The observed firm seems to reward individuals for switching more frequently. Consumer prices stay steady as long as the consumer continues subscribing to the same company and does not call to negotiate a new price. As soon as the consumer switches or negotiates, his new price portfolio (on average) will move toward the market level. Over the observed period, market prices have decreased. An overview of the firm data in Figure

2 shows the relationship between price paid and month subscribed (most recent switching period). Figure 2 depicts the median charge per minute (on evening calls to Japan during September 2000) for four separate groups. The first group contains those who subscribed in May 1997 (having tenure of three years and four months). The second group includes those who subscribed in May 1998 (having tenure of two years and four months). The third group holds those who subscribed in May 1999 (having 16 months of tenure). Finally, the fourth group contains those who subscribed in May 2000 (having only four months of tenure). The figure shows an uneven yet marked decrease over the period.

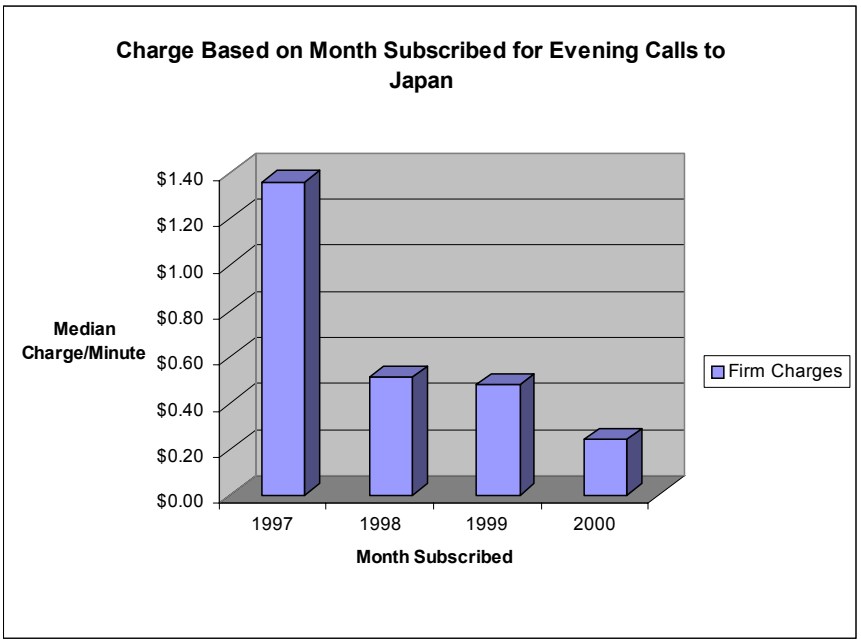


Figure 2

5.2 Consumer Switching Behavior Model

The price discrimination results indicate that differentiation in switching behavior is the leading facilitator of price discrimination. This section models switching behavior in an effort to more specifically capture the switching cost heterogeneity across consumers and understand the factors behind consumer decisions to switch carriers. By understanding

more about switching cost heterogeneity and consumer switching behavior, one can better determine the nature of potential market power among the observed demographic. More specifically, modeling switching behavior can shed light on three major areas. First, the switching model can determine the degree of customer loyalty over the population of consumers. Second, the switching model can measure price sensitivity in the market. Finally, the switching model can characterize how preferences vary over consumers.

Modeling of switching behavior is initiated by characterizing an environment of price dispersion leading to the corresponding choice of consumers to stay with or leave their current carrier. I represent the cost environment with the same properties we see in the data. Resale firms face a somewhat homogeneous cost structure. Over the period of the data, these homogeneous costs decrease sporadically, but do not increase at any point. Consequently, I represent costs as monotonically decreasing, but do not attempt to provide full parametric form. Again patterning after the data, I also model prices as monotonically decreasing. Prices, however, are not expected to decrease as quickly or as uniformly as costs.

A mixture model is chosen to represent departure decisions of subscribers as they depart from the observed carrier. The mixture model varies in two different dimensions. First, the mixture model characterizes heterogeneity in switching costs among subscribers (or subscriber types). Second, individual value of premium carriers is specified as λ_i. λ_i represents the value specific to each individual (or consumer type) of using a premium carrier such as AT&T, MCI-Wroldcom, or Sprint. Heterogeneity is introduced into the model, knowing that some subscribers will look to premium options (like AT&T) as possible alternatives, while other subscribers will look to other small resale firms as possible alternatives. Switching behavior thereby takes a form conditional on both individual switching costs and individual value for a premium carrier. The specification combines the portion of these two components that cannot be accounted for by the demographic or pricing data.

Departure decisions are specified as: $D(X \mid \lambda_i, \eta_i, \theta)$. Where $\lambda_i, \eta_i,$ and θ represent the parameters and X contains data on price differentials and demographics. Departure decisions are observed in each monthly period in the sample. The switching costs section develops an empirical form for these departure probabilities.

One difficulty in valuing price alternatives in the market is that a near infinite number of alternatives exist. Over 700 companies report to the FCC as long distance telephony carriers. Many more are expected to exist. Each firm, then, offers numerous different plans – each providing a different bundling of goods (priced uniquely to each customer). To approximate movement in the distinct markets of premium carriers and competitive carriers, I create an index (or approximate average), providing a benchmark for price movement in each area. Deviations from the mean resulting from unexpected advertisements and promotions are accounted for in the error term.

A second difficulty arises from the nature of the data. Though the micro level data has the benefit of being very detailed in describing each individual call, it unfortunately only contains observations from within a single firm. When a subscriber's decision to leave is observed, however, the data does not contain information about the firm to which the subscriber is switching. This lack of information is unfortunate because the final destination of the switching customer has significant implications for price sensitivity and individual preferences. To make up for this lack in the firm data, I exploit information on price movement among high end carriers vs. competitive smaller carriers to infer more precisely why each consumer leaves. I develop a new technique called switch indexing. Here, each index (premium and competitive) is included and given different weight in determining decisions to leave based on individual consumer type. Each consumer type is described by both switching propensity and preference for premium carrier quality. It is then possible to employ a binary logit form, yet still account for alternative price movement – each encouraging its own separate destination after a customer leaves the carrier.

Consumer Preference Structure

The model starts by utilizing a traditional McFadden utility structure in which individual utility is a function of prices and characteristics. This utility function can then be broken down into a mean component and a random component.

$$U_{it}^{0} = V_{it}(f_0) + \varepsilon_{it}^{0}$$

The random component varies over individuals and is unobserved by consumers, firms, and the econometrician. ε_{it}^{0} captures the specific idiosyncratic utility of carrier, 0, for individual, i, during period, t. This idiosyncratic utility is likely to stem from the idiosyncratic in price differences which vary from the individual specific quality adjusted price index.

Here, f_0 contains prices, firm characteristics, and consumer characteristics associated with a particular carrier, f_0. i indicates the subscriber, while t indexes the month, and 0 indexes the firm.

I identify the baseline or mean valuation function of staying with the given carrier as:

$$V(f_0) = -\beta G(p_{0it}, v_{0it}) + \theta_0 \lambda_i$$

Here, β represents the impact of price on valuation of the carrier to the subscriber. The p_{0it} vector represents the price portfolio offered by firm, 0, to individual, i, during time, t. The v_{0it} vector represents the volume schedule individual, i, purchases from firm, 0, during time, t. The function, G, calculates price effects that the consumer likely observes and utilizes to make switching decisions. For example, a price effect may encompass total monthly charge from the previous period or the per minute price of the country called most often in the previous period.

θ_0 is an indicator of firm quality. θ_0 takes on the value of "1" if the firm is a premium carrier and takes on the value of "0" when the firm is a non-premium or competitive carrier. λ_i is the value of premium quality for individual, i. λ_i takes on one of two values (each value representing a consumer type). The higher value represents the common worth of well-known premium carriers such as AT&T and MCI-Worldcom. The lower value is associated with discount carriers (including resale firms like the one represented in our data). Each value represents the utility of a different type of consumer. Over the observed offers, price varies over individuals, while λ_i shifts the distribution for all subscribers. A mixture model is used to identify the upper and lower values for λ_i, as well as the probability that a subscriber can be characterized as having a high or low appreciation of high quality carriers.

$\Pr(\lambda_i = \underline{\lambda}) = \rho_{\lambda_i}$

$\Pr(\lambda_i = \overline{\lambda}) = 1 - \rho_{\lambda_i}$

$\underline{\lambda}$, $\overline{\lambda}$, and ρ_{λ_i} are each determined within the likelihood function. Consequently, I am able to uncover both the variation in subscriber appreciation value of alternative premium carriers as well as the probability of observing each type in the distribution.

Switching Costs

Offers from the external market trigger decisions of subscribers to leave their carrier. Each period, the subscriber receives offers and decides whether or not to accept or reject. This framework is similar to a search model, but differs in that it assumes that offers arrive exogenously. These offers reflect advertisements, mailings, recommendations from friends, and most appropriately, telemarketing. Each offer is comprised of both a draw of quality, θ_0, and price portfolio, p_{0it}.

An offer, f_1, is rejected iff:

$U(f_0) + SC_i > U(f_1)$

Here, the offer, f_1, is accepted only if its utility exceeds the cost of switching, SC_i, in addition to the utility of the current firm, $U(f_0)$. Under this specification, the new prospective firm must overcome the switching cost for the specific individual in order for the subscriber to break the relationship with the existing carrier.

Switching costs are characterized as the combination of demographic effects and the unobserved individual willingness to switch, η_i.

$SC_i = \eta_i + X\alpha$

where

$X\alpha = \alpha_1 Inc_i + \alpha_2 Lang_i + \alpha_3 O60i + \alpha_4 Rural_i + \alpha_5 Own_i + \alpha_6 EstUsage_i + \alpha_7 Credit_i$

Each individual consumer has an inherent propensity for switching, η_i. For simplicity, we assume two distinct values, $\underline{\eta}$ and $\overline{\eta}$. These inherent propensities for switching define two different types of consumers: consumers with less aversion to switching and consumers with higher aversion to switching. We expect that each subscriber type enters our distribution with the following probabilities.

$$\Pr(\eta_i = \underline{\eta}) = \rho_{\eta_i}$$
$$\Pr(\eta_i = \overline{\eta}) = 1 - \rho_{\eta_i}$$

$\underline{\eta}$, $\overline{\eta}$, and ρ_{η_i} are each determined within the likelihood function. Consequently, I am able to uncover both the difference in switching behavior over the two types of subscribers as well as the probability of observing each type in the distribution.

Utility theory indicates that a consumer will choose alternative, 0, and stay with the current carrier when:

$U(f_1) < U((f_0) + SC_i$

or: $\varepsilon_{it}^1 - \varepsilon_{it}^0 < V(f_0) + SC_i - V(f_1)$ for $1 \neq 0$

Implying that the subscriber will stay with the current carrier iff:

$$\varepsilon_{it}^1 - \varepsilon_{it}^0 < -\beta G(p_{0it}, v_{0it}) + \theta_0 \lambda_i + \eta_i + X\alpha + \beta G(p_{1it}, v_{1it}) - \theta_1 \lambda_i$$

Now Pr(Subscriber Stays) is calculated using the value of a given offer:

$$\Pr[\varepsilon_{it}^1 - \varepsilon_{it}^0 < -\beta G(p_{0it}, v_{0it}) + \theta_0 \lambda_i + \eta_i + X\alpha + \beta G(p_{1it}, v_{1it}) - \theta_1 \lambda_i]$$

$$\text{or } \Pr[\widetilde{V_{it}} < -\beta(G(p_{0it}, v_{0it}) - G(p_{1it}, v_{1it})) + (\theta_0 - \theta_1)\lambda_i + \eta_i + X\alpha]$$

$$= D(X \mid \lambda_i, \eta_i, \theta)$$

Assuming that the errors are distributed iid Weibull, the difference between ε_{it}^1 and ε_{it}^0 generates a logit model for the Pr(Subscriber Stays).

5.3 Empirical Implementation

In this section, the likelihood function of the transitional behavior of each subscriber is formulated. In so doing, I estimate the difference between the utility of each subscriber staying with their current provider and the utility of each subscriber leaving to some unknown alternative. I assume that the utility of the subscriber staying with his carrier is a function of his individual price and of his individual switching costs. To account for switching costs, I recover individual effects. I include subscriber demographics at the individual level as a proxy for individual fixed effects. By doing so, I uncover the difference in switching costs for separate demographic groups. This estimation uncovers the effectiveness of the observed firm's current pricing strategy on obtaining partial monopoly rents.

The switching behavior individual likelihood for each period is defined as:

$$L_{it}|\lambda_i, \eta_i = F(X_{it}\beta|\theta, \lambda_i, \eta_i)^{y_{it}} + [1 - F(X_{it}\beta|\theta, \lambda_i, \eta_i)]^{(1-y_{it})}$$

where $y_{it} = 0$ if i leaves in period t

$y_{it} = 1$ if i stays in period t

because the difference between residuals has a logit distribution:

$$F(X_{it}\beta|\theta, \lambda_i, \eta_i) = \frac{e^m}{e^m + e^n + e^p}$$

Here, m represents the utility of staying, n represents the utility of leaving and switching to a top long distance carrier, and p represents the utility of leaving and switching to another discount carrier.

$$m = \beta^1[\sum_k (\frac{v_{itk-1}}{\sum_{k'} v_{ik't-1}}) p_{0ikt}] + \beta^2 p_{0iFt} + \beta^3[\sum_k v_{ikt-1} p_{0ikt}] + SC_i + \theta_0 \lambda_i$$

where $\theta_0 = 0$ for the competitive observed firm.

* Note I allow:

$$SC_i = \eta_i + \beta^4 Inc_i + \beta^5 Lang_i + \beta^6 O60_i + \beta^7 Rural_i + \beta^8 Own_i + \beta^9 EstUsage_i + \beta^{10} Credit$$

$$n = \beta^1[\sum_k(\frac{v_{itk-1}}{\sum_{k'} v_{ik't-1}})p_{Aikt}] + \beta^2 p_{AiFt} + \beta^3[\sum_k v_{ikt-1}p_{Aikt}] + \theta_A\lambda_i$$

where $\theta_A = 1$ for the premium index designated by "A".

$$p = \beta^1[\sum_k(\frac{v_{itk-1}}{\sum_{k'} v_{ik't-1}})p_{Cikt}] + \beta^2 p_{CiFt} + \beta^3[\sum_k v_{ikt-1}p_{Cikt}] + \theta_C\lambda_i$$

where $\theta_C = 0$ for the competitive index designated by "C".

and p_{0ikt} is the price for consumer i to call country k for one minute using the observed firm

p_{Aikt} is the major carrier benchmark per minute price for a consumer i to call country k

p_{Cikt} is the discount carrier benchmark per minute price for a consumer to call country k

There are three different measures of price portfolio. The first measure, $\sum_k(\frac{v_{itk-1}}{\sum_{k'} v_{ik't-1}})p_{0ikt}$, calculates the average per minute price individual, i, is charged by carrier, 0. The second measure, p_{0iFt}, is the price paid to carrier, 0, by customer, i, to call the country or state location that individual calls most. Finally, the third measure, $\sum_k v_{ikt-1}p_{0ikt}$, is the entire monthly charge for individual, i, by carrier, 0.

The final form of the likelihood function accounts for the mixture of four different consumer types: (1) low value of premium quality and low switching costs, (2) high value of premium quality and low switching costs, (3) low value of premium quality and high switching costs, and (4) high value of premium quality and high switching costs.

$$\Pi_{it=1}^{NT} L_{it} =$$
$$\rho_\lambda\rho_\eta L(\underline{\lambda},\underline{\eta}) + (1-\rho_\lambda)\rho_\eta L(\overline{\lambda},\underline{\eta}) + \rho_\lambda(1-\rho_\eta)L(\underline{\lambda},\overline{\eta}) + (1-\rho_\lambda)(1-\rho_\eta)L(\overline{\lambda},\overline{\eta})$$

5.4 Switching Behavior Results

The results from the switching behavior estimation isolate three major contributors to the switching decision. The exact values can be found in Table 4.

Table 4: Stay Maximum Likelihood with Switching Cost and Premium Preference Mixing

Number of Observations = 6874

Highest Freq Price	-0.3087 (1.0120)
Monthly Charge	-0.5288 (0.2588)*
Income	0.0692 (0.1314)
Over 60	-0.0551 (0.6262)
Language Operator	0.5999 (0.1843)*
Rural	-0.0858 (0.3209)
Low Credit	0.0790 (0.1759)
Switching Constant	-2.8465 : 0.9584 (1.8706)*
Switching Constant Probability	0.9220
Premium Preference Constant	0.0491 : 0.1212 (2.0480)
Premium Preference Constant Probability	0.6085
Mean Log-Likelihood	-0.3527

* indicates significance at the 5% level

”Monthly Charge”, ”Language Operator”, and ”Switching Constant” are all significant. First, a negative coefficient on ”Monthly Charge” indicates that the higher the relative monthly charge of the observed carrier (as compared to the monthly charge for the equivalent service provided by either an average competitive carrier or an average premium carrier), the more likely the subscriber is to switch. The negative relationship between relative price and staying with the carrier is logical because it is expected that consumers prefer to pay lower monthly fees for the same service. The second significant coefficient is on subscriber use of a foreign language operator. The foreign language operator coefficient is positive and significant. Such a coefficient indicates that foreign language operators provide a reason to stay for those who use them (foreign language operators provide a useful service for non-English-speaking customers, and not all carriers perform this service). It is therefore intuitive that those who value using a foreign language operator face fewer equivalent alternative services elsewhere. The final significant coefficient is on the inherent switching propensity type of the individual. Given the same prices and quality of the service, and the same demographics of the individual, subscribers with higher inherent switching propensity will switch more frequently. The mixing of two different switching propensity types yields a large and significant variation of 3.8049. The estimation indicates that 92.2% of the observed population has a high switching propensity. Such a breakdown with a heavy proportion of high switching propensity individuals is expected in the observed population. Since everyone that is observed is pre-selected as someone willing to switch at least once to a small competitive carrier, it is likely that a large proportion of them have a high switching propensity.

Unlike the large and characterizable variation in switching propensity, the model estimates do not support two distinct levels of premium preference in the sample. The difference in premium preference between the two modeled types (those who have the high value for premium quality and those who have a low value for premium quality) is only 0.0628 and is statistically insignificant. Each individual constant is also low (0.0503 and 0.1212). The low and narrow estimates of premium preference within the sample is not surprising. The sample is comprised of data from individuals already having subscribed at one highly competitive, lower quality firm. It is logical that within this sample, there would be a universally low value for premium quality.

While the coefficient estimates of ”Low Credit”, ”Income”, and ”High Frequency Price” are not significant, they do support intuitive expectation. First, the coefficient on ”Low Credit” is positive, indicating that subscribers with a poor credit history are likely to stay with the firm longer. Low credit individuals may have incentive to stay with a carrier longer because they have fewer equivalent alternatives, due to their negative credit ratings. The insignificance of this variable, however, indicates that the effect is not strong. Perhaps a number of small competitive carriers are quite willing to service low credit individuals. The price discrimination results for the observed firm indicate that this carrier does not even charge a higher price to low credit individuals. Second, the income effect is positive and insignificant. It is likely that higher income individuals are less price sensitive and have a higher opportunity cost of time. These qualities make an individual less willing to switch. However, there may also be an opposing effect. High income individuals may have better information than low income individuals. This second factor may apply negative pressure on the positive income coefficient and may prevent the effects from showing to be significant. Finally, the ”High Frequency Price” coefficient is negative but insignificant. ”High Frequency Relative Price” is the per minute price of calling the country that the individual called most frequently during the previous month (compared with alternative premium and competitive per minute prices for calling the same country). Since the high frequency relative price coefficient represents a pricing effect we expect it to be negative. It is logical that individuals would prefer to pay a lower price for calls to the country they call most often, and would be more likely to leave a carrier if lower priced alternatives existed. However, because relative monthly charge is included in the model alongside ”high frequency relative price, it is likely that the high frequency relative price coefficient fails to be significant due to the fact that part of its effect is overshadowed by relative monthly charge. In fact, the relative monthly charge and the high frequency relative price variables turn out to be correlated. If I could more precisely isolate measures of price, it is likely that the high frequency relative price coefficient would be both negative and significant.

6 Summary and Conclusion

This paper finds new evidence of price discrimination. Price discrimination is found to be partially based on consumer demographics such as income and location, implying third degree price discrimination. Findings indicate that firms base demographic price discrimination on the information or alternatives they perceive each prospective subscriber possesses (not on prospective subscriber ability to pay). However, the greatest determinant of price differentiation among consumers lies in how frequently they are willing to switch carriers. I characterize switching behavior and find that price, foreign language operator service, and inherent switching costs are most likely to contribute to a subscriber leaving for an alternative carrier. Finally, I discover new evidence of switching cost heterogeneity in the sample. Such an understanding of market participants can shed light on optimal firm action and optimal public policy.

Work in progress utilizes a forward-looking decision model to explore tenure dependence in switching behavior and isolate its origin. Tenure dependence can result from two different causes: (1) relationship effects and/or (2) selection effects. First, tenure dependence can occur when a subscriber's preference for a carrier increases over time as a relationship is developed. Alternatively, the distribution of subscribers may shift over time to include more subscribers with either higher switching costs or a greater matching preference for the firm. Since these two separate causes have markedly different implications for consumer behavior, it is important to distinguish them empirically. Due to an unusual amount of variation in the data, this paper will be able to decipher between the two motivations by examining consumer reaction to time-varying relative prices (each producing differing patterns of movement over each consumer portfolio).

The estimated models allow examination of pro-competitive policies. The analysis of the survival tactics of small resale firms improves our understanding of the effectiveness of regulation such as the 1996 Telecommunications Act and the Robinson-Patman Act (which prohibits price discrimination for the purpose of competition enhancement). The paper also discovers how fringe firm competitive tactics may be fettered under a change in environment (like the inevitable stabilization of costs). As a result, this study of resale

fringe activity provides insights that are useful for both individual firm response and for telecommunications market policy.

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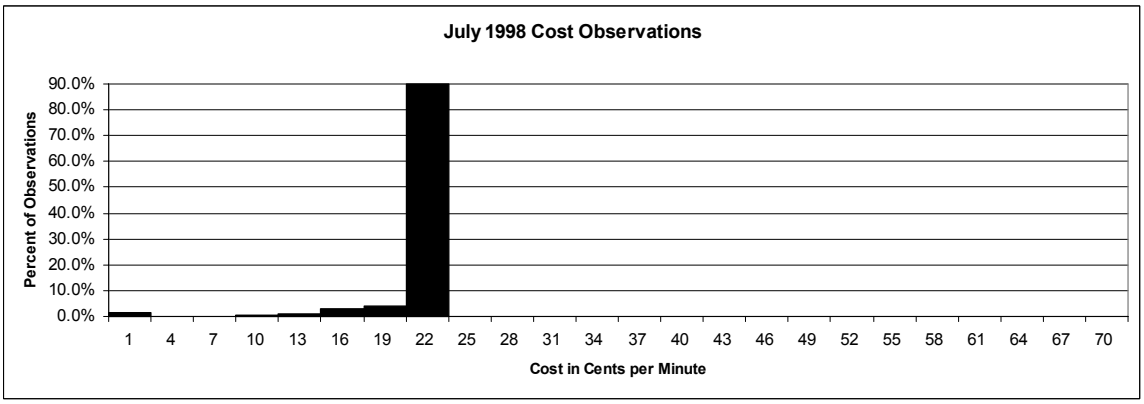
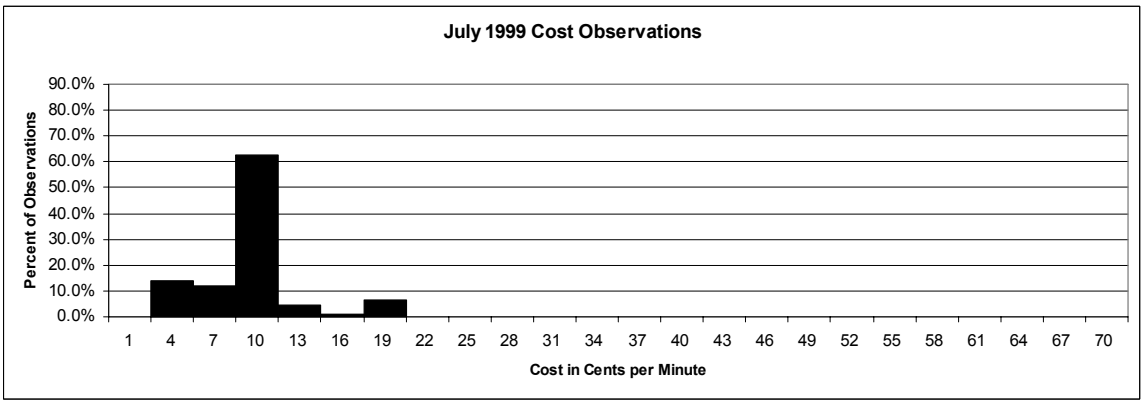
Appendix

Figure A1:

Frequency of Cost/Min for Evening Calls to Japan





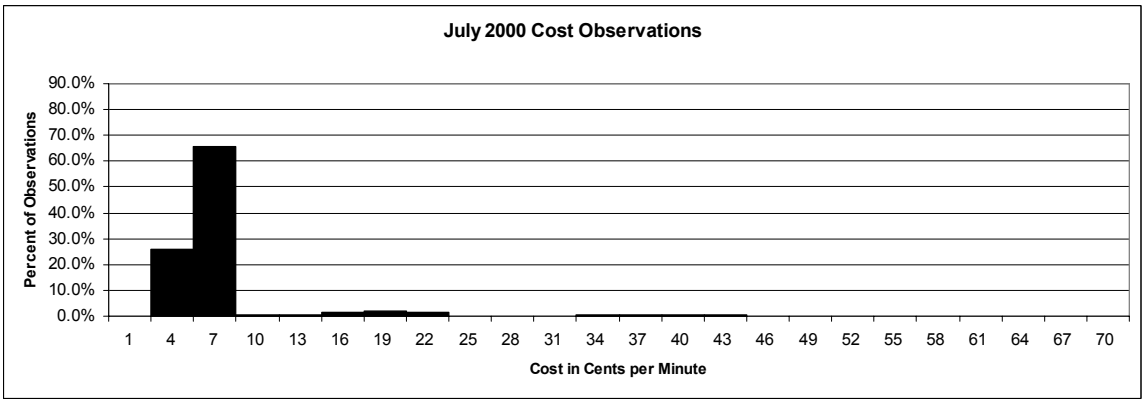
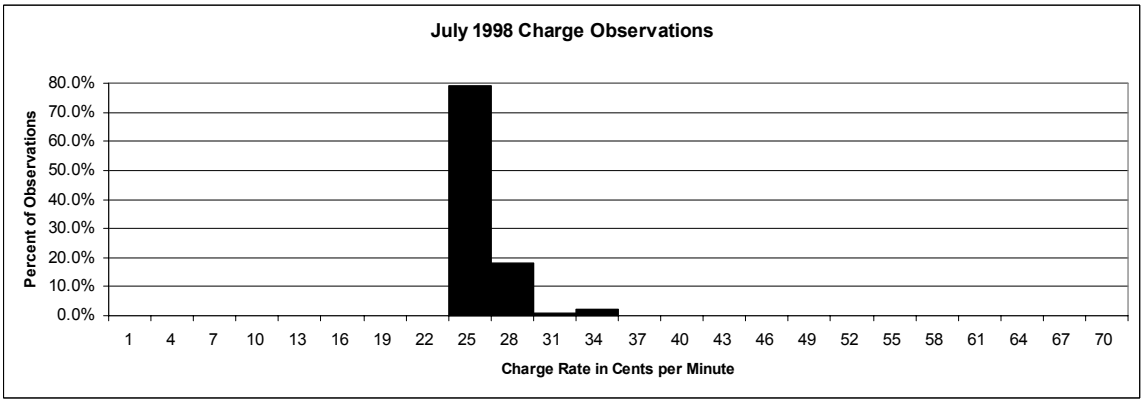
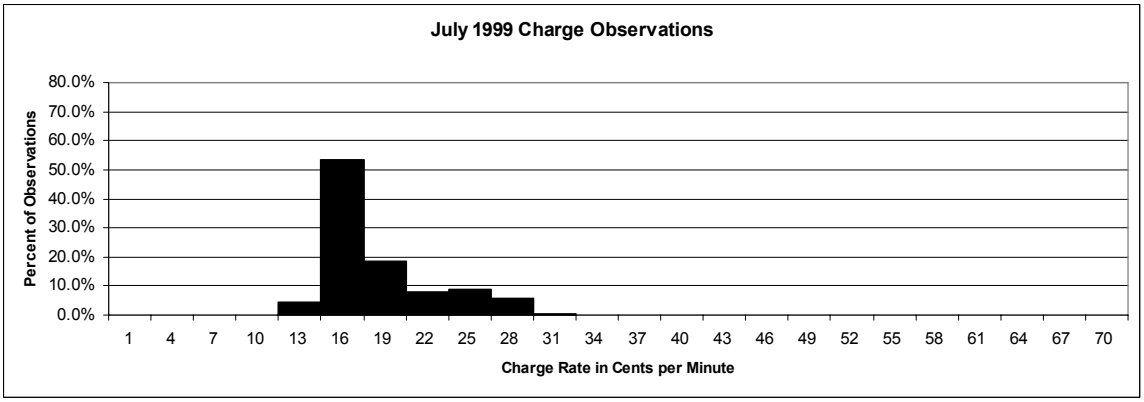


Figure A2:

Frequency of Charge/Min for Evening Calls to Japan





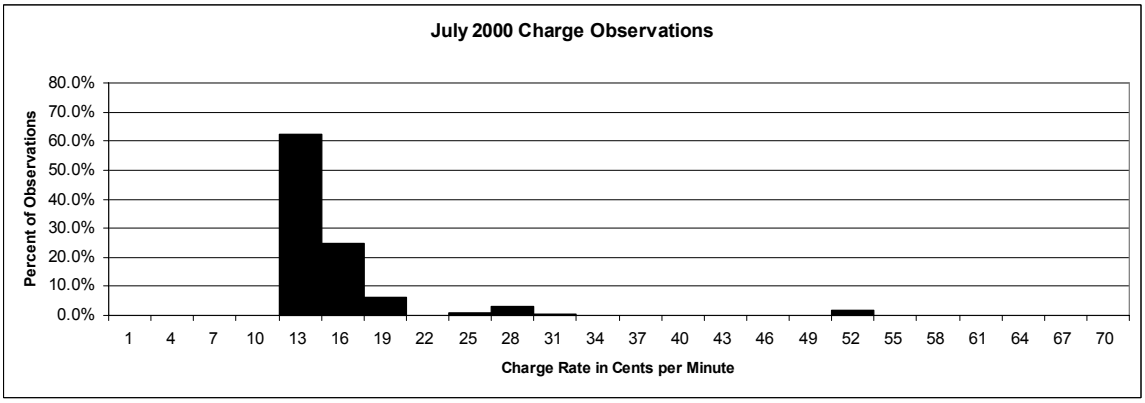
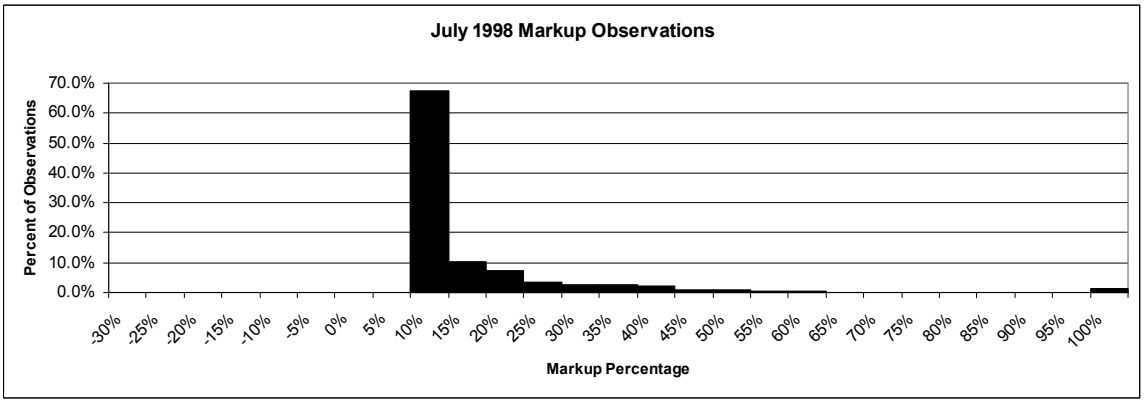
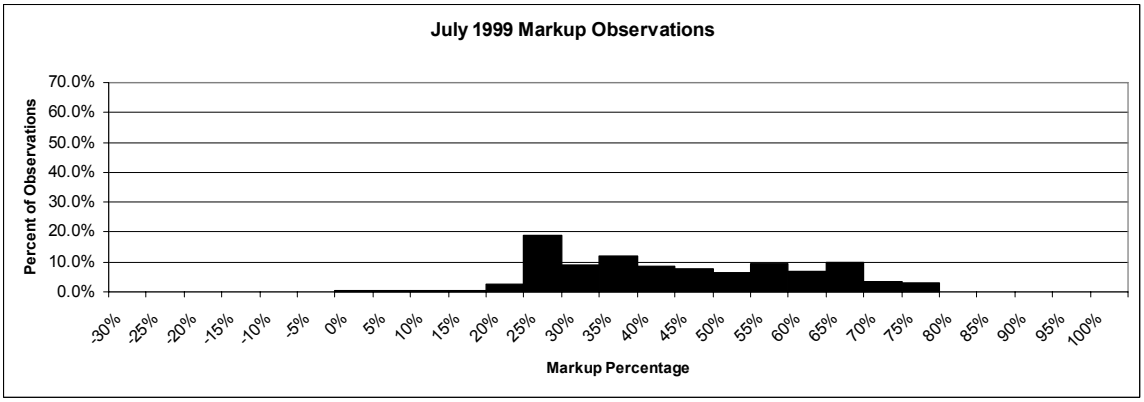


Figure A3:

Frequency of Markup Percentage for Evening Calls to Japan





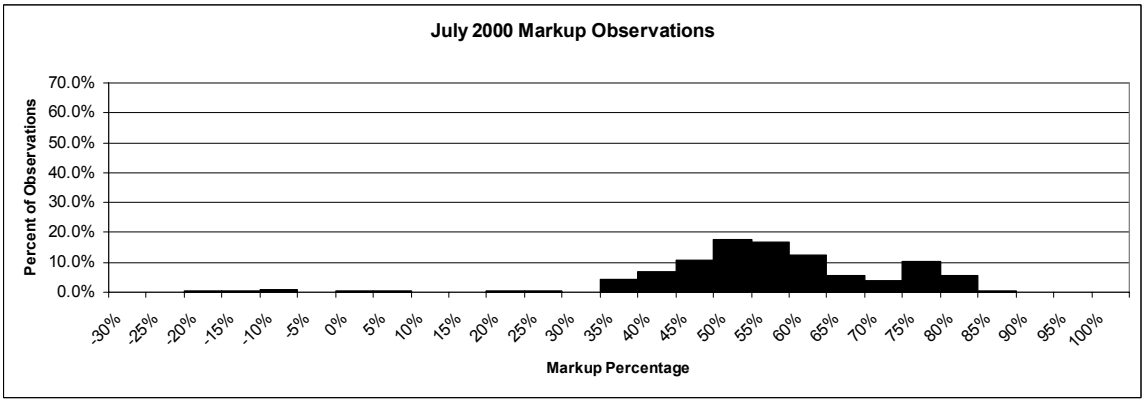
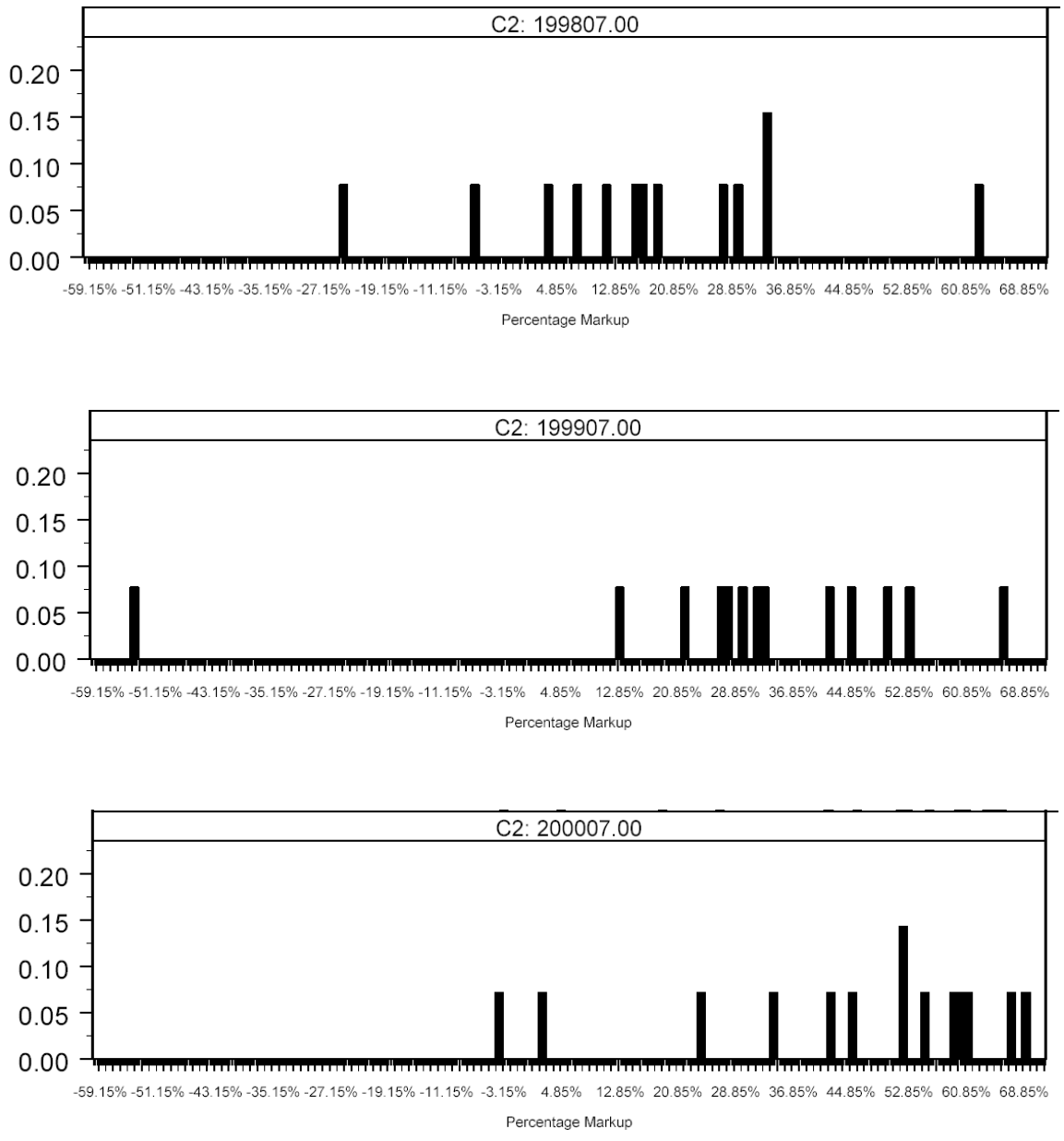


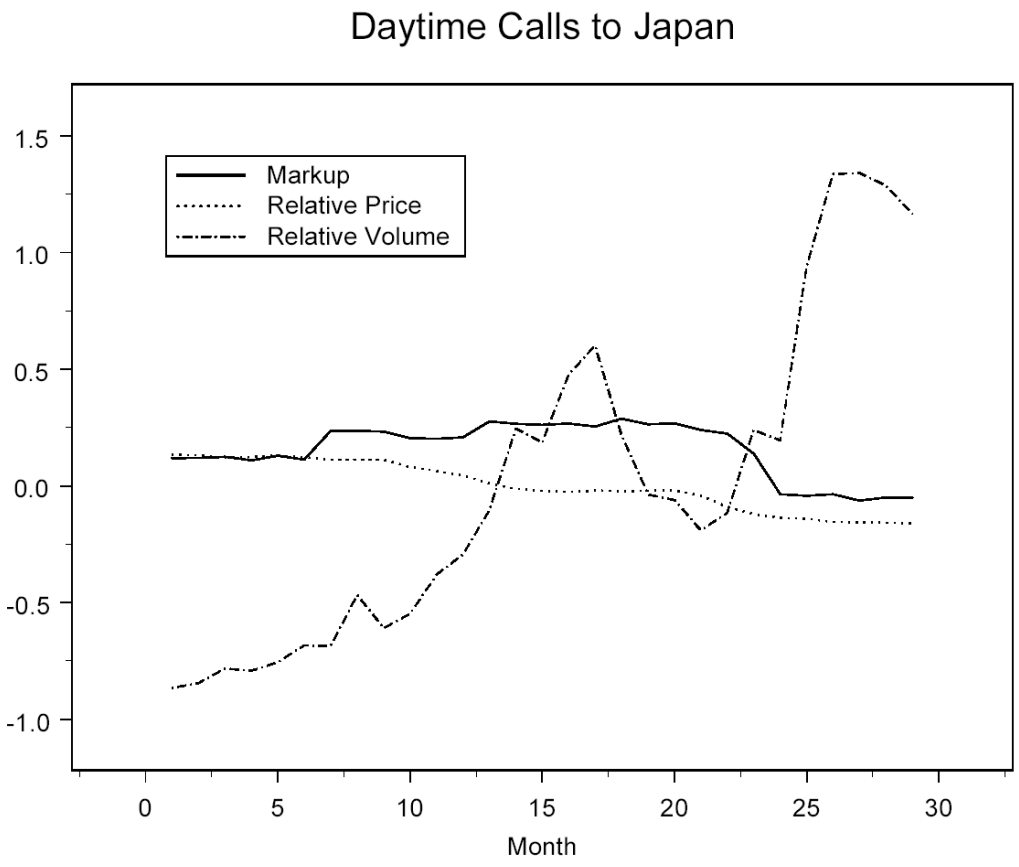
Figure A4:

Frequency of Markup Percentage Averages for 14 Frequently Called Country Destinations



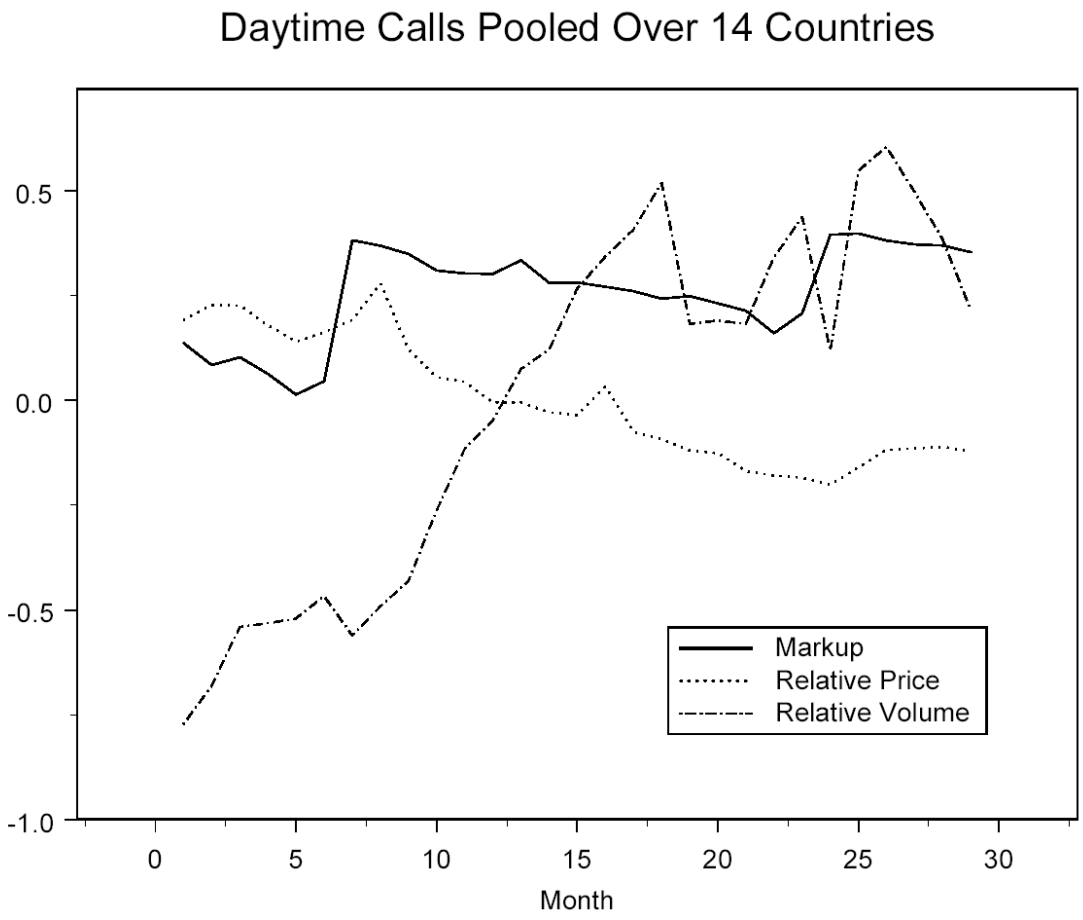
* Countries Include: Brazil, China, France, Germany, Hungary, India, Iran, Italy, Japan, Mexico, Myanmar, South Korea, Turkey, and Vietnam.

Figure A5:



*Note: Variables are an average over all daytime calls to Japan during the respective month. Markup is expressed as a percentage. Relative price and relative volume are each expressed as the percentage change from their mean.

Figure A6:



*Note: Variables are an average over all daytime calls to 14 countries during the respective month. Markup is expressed as a percentage. Relative price and relative volume are each expressed as the percentage change from their mean. Observed countries include: Brazil, China, France, Germany, Hungary, India, Iran, Italy, Japan, Mexico, Myanmar, South Korea, Turkey, and Vietnam.