COMPETITION AND PRICING IN THE CREDIT CARD MARKET

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Abstract—Many credit card issuers charge ''fixed rates'' that remain the same for three to five years, while the rest charge ''variable rates'' that are indexed to market rates. The presence of these two distinct rate types forces prices at firms selling an otherwise identical product to move asynchronously; variable rates move one-for-one with the index, while fixed rates stay constant. Empirical and theoretical analysis shows that this pricing structure provides an explanation for the simultaneous (yet seemingly contradictory) existence of high rate-cost margins and aggressive non-price competition for new customers, a phenomenon that existed in the credit card market in the early 1990s.

I. Introduction

CREDIT card issuers have traditionally charged ''fixed rates'' that change infrequently (once every three to five years on average. Since 1991, however, a significant percentage of credit card firms have switched to ''variable rates,'' which most often adjust quarterly using the prime rate as an index. In 1994, for example, 57% of credit cards charged variable rates and 43% still charged fixed rates. This somewhat unique pricing structure forces interest rates offered by different firms to move asynchronously, because some follow the index and some do not. Moreover, because movements in the index parallel movements in the cost of funds for banks, relative markups at the two types of firms vary with movements in the index.

Does this pricing structure in which some firms offer fixed rates and some offer variable rates materially affect the competitive environment of the market? This is particularly relevant in the credit card market, which has been prominent in policy discussions regarding its competitiveness since the mid-1980s. The market has also drawn a good deal of attention from researchers since the late 1980s, primarily because it seems to be noncompetitive despite a market structure that, in prima facie terms, fits the competitive paradigm exceedingly well. Ausubel (1991) brought the issue into relief by providing several pieces of evidence suggesting that credit card issuers earn returns far above those in other banking sectors. Other work by Calem and Mester (1995) and Stango (1999b) provides empirical evidence supporting the explanations suggested by Ausubel as plausible sources of market power for card issuers: that consumers face search and switching costs of moving from one firm to another.

This first question leads naturally to another. Regardless of any changes in the competitive environment of the market following the advent of variable rates, why did the shift in pricing occur so swiftly and when it did? Variable-rate loans have been legal since the early 1980s, and they became quite prevalent in the mortgage and personal loan market almost immediately following their legalization. Credit cards, however, were offered almost exclusively with fixed rates. It seems odd that we observe such a dramatic change in the pricing of credit cards without any overt regulatory regime change or change in the structure of the credit card industry.

Given that there is no clear theoretical background upon which to base an empirical examination of recent events in the market, I discuss in the paper a simple game-theoretic model of pricing and rate type choice with fixed and variable rates. While the model is very stylized, it nonetheless reveals some interesting differences between fixed- and variable-rate firms. One such difference is that volatile movements in the index (the prime rate for variable-rate credit cards) increase prices and profits at both types of firm, and have a greater effect on profits at variable-rate firms. Another prediction of the model is that prices and profits are positively correlated with market share, and this positive relationship is stronger for variable-rate firms. Thus, firms price more aggressively if they are small (to capture market share), and less aggressively if they are large (to exploit market share). This relationship is stronger for firms with variable rates.

The model also reveals some differences between competition when firms have different rate types and competition when firms have the same rate type. I consider the rate type choice when firms know the effect of this choice on second-stage prices and profits. The model predicts that a volatile index rate should encourage movement away from a ''fixed/fixed'' equilibrium toward a ''fixed/variable'' equilibrium. Also, the gains to switching to a variable rate grow as market share increases, suggesting that large firms might be more likely to choose variable rates.

The second part of the paper contrasts these empirical predictions with some plausible alternative hypotheses and assesses the ability of the model above to explain both ex post pricing in a ''fixed/variable'' market and a sudden shift from a ''fixed/fixed'' pricing structure to a ''fixed/variable'' pricing structure. I first examine a sample of credit card solicitations to see if variable-rate and fixed-rate firms differ systematically in their attempts to attract new customers. I then undertake a more formal analysis, using a newly compiled panel data set of the 250 largest credit card issuers, covering the period 1989 to 1994. The data are strongly consistent with the qualitative predictions of the second-stage model of competition between issuers with different rate types, and are quite robust to changes in specification and variable definition. The results reconcile some recent evidence on competition between credit card issuers, which

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seems at first glance contradictory. The data are also consistent with the qualitative predictions of the model regarding the sudden shift to variable-rate pricing. However, I cannot rule out an observationally equivalent risk-based explanation for this empirical result. It also appears that political and institutional factors played a role in the sudden shift toward variable-rate pricing.

Although the paper primarily aims to describe competition in the credit card market, it conveys a more general intuition regarding multifirm competition. It identifies a situation in which firms that are ex ante identical find it optimal in a non-cooperative setting to commit to different pricing structures for their product, even if the product itself is perfectly homogeneous across firms. The model presented in this paper suggests that such commitment may attenuate competitive pressures between firms with different price types. In the conclusion to the paper, I discuss some other situations in which the intuition provided by the model might apply.

II. Credit Card Pricing in the 1990s

Over 6,000 banks and nonbank holding companies issue credit cards, each possessing discretion over their type and level of interest rate.[1] Of these 6,000, roughly fifty are nationally marketed issuers, and the market is fairly concentrated given the total number of firms; the ten largest issuers hold roughly 60% of total outstanding balances during the sample period. Although variable-rate loans have been legal since 1981, fixed-rate cards have been the dominant form of pricing in the market until very recently.[2] As late as 1990, variable-rate firms held less than 5% of the market, and there is no evidence that the percentage was higher than this between 1981 and 1988.[3] Beginning in late 1991, firms began switching from fixed rates to variable rates. Most of these variable rates use the prime rate as an index, although some use short-term treasury rates, and a few use LIBOR rates. Table 1 shows how the presence of variable rates in the market expanded in 1992 and 1993; variable rates grew from under 5% to over 50% of receivables and accounts.[4]

TABLE 1.—PRICING IN THE CREDIT CARD MARKET, 1989–1994

Year	1989	1990	1991	1992	1993	1994
Average interest rate	18.1	18.1	17.8	17.4	16.5	16.6
Prime rate	10.5	10.0	7.2	6.0	6.0	8.5
Difference (markup)	7.5	7.7	10.2	10.9	9.9	7.1
Average:						
Fixed rate	18.1	18.0	18.2	18.1	17.3	16.6
Variable rate	17.5	16.5	14.4	14.0	14.2	16.5
Margin between prime and average:						
Fixed rate	7.7	8.1	10.8	11.7	11.0	7.7
Variable rate	7.0	7.1	7.5	7.9	8.1	8.8
% of accounts with:						
Fixed rate	96.6	95.3	95.1	71.7	48.2	42.9
Variable rate	3.4	4.7	4.9	28.3	51.8	57.1
Number of issuers	223	222	236	194	222	215

Source: ***Card Industry Directory,*** 1990–1995. Averages exclude credit unions and firms listing more than one rate type. Number of issuers includes credit unions.

Table 1 summarizes pricing during the period 1989 to 1994.[5] The rapid decline in the prime rate led to notable differences between fixed rates and variable rates. The average variable rate fell dramatically, from 17.5% to a low of 14%. The average fixed rate, on the other hand, was 18.1% in both 1989 and 1992, and never differed from this figure by more than ten basis points in the intervening years. The last two rows of the table highlight the impact of these changes. These rows show the average margins between the two types of rates and the prime rate. In 1990, the margins were 7.6% and 7.0% for fixed and variable rates, respectively (a difference of 100 basis points). By 1992, the margins were 12.1% and 8.0% (a difference of 410 basis points).

To many industry observers, the most striking event of the early 1990s was the decline in average credit card rates from 18.1% in 1990 to a low of 16.5% in 1993. Given the extreme stickiness of rates during the 1980s, and particularly during the period from 1986 to 1991, the fall seemed swift and dramatic. Other changes in nonprice competition occurred concurrent with the decline in rates. The annual number of mailout credit card solicitations exploded, from 1 billion in 1989 to 2.4 billion in 1994.[6] As the number of solicitations grew, firms began to offer increasingly varied and substantial inducements for consumers to switch cards. Annual fees

[1] I use the term ***credit card*** to refer only to those cards valid for purchase at any retailer on the VISA and Mastercard networks. The paper does not consider pricing of retail and gasoline credit cards, or of charge cards such as American Express.

[2] Technically, credit card issuers are free to change their "fixed rates" or variable-rate margins at any time. Any distinction between the two types of rates is only meaningful, then, if these rates and margins actually stay fixed for significant periods of time. Using a subsample of those firms that were present in the data for every year, I find that fixed-rate firms change their rates once every three to five years, depending on which of two measures of stickiness is used. Variable-rate firms change their margins every 2 to 2.5 years. The two measures of the timing of rate changes are the average duration of rate "spells," which follows exactly the methodology of Carlton (1986), and the number of times a firm had an opportunity to change its rate/margin divided by the number of changes. The infrequent adjustment of rates/margins is apparent from the average interest rate figures for fixed and variable rates in table 1. As the prime rate fell in 1991 and 1992, variable rates fell, but margins on variable-rate cards remained roughly the same, while fixed rates remained virtually constant.

[3] It appears that data on variable-rate credit cards was not collected prior to 1987, which probably stems from the fact that they were considered an insignificant part of the market.

[4] The firms were classified as offering a fixed or variable rate based on the rate listed in the Card Industry Directory. A few (less than 5%) firms listed more than one rate, or listed both a fixed and a variable rate; these firms were dropped. There may also be some firms that list only one rate (their most common) but offer another rate to a smaller segment of their customer base. Unfortunately, there is no way to identify these firms. It should be pointed out that the firms that offer both rate types typically extend only one type of offer to each customer; this suggests that they are using different rate types as a means of price discrimination.

[5] These averages do not include credit unions, which differ systematically from the commercial banks in the sample (primarily in that they offer lower rates). Credit unions also are more likely to have fixed rates than variable rates.

[6] Source: Behavioral Analysis' ***Mail Monitor.***

fell by 50% between 1989 and 1994.[7] In addition, many firms began to offer "switching checks" to make transferring balances from another card easier. A significant number of firms even began to offer cash rebates for transferring balances. Affinity cards, which link the credit card to some group or professional organization, grew in popularity as well. Many of these affinity cards offer discounts and other benefits to their customers, with airline frequent flyer cards being the most visible. In concert, these developments led some industry observers to conclude that the industry was becoming more competitive:[8] "Cutthroat competition among issuers . . . is bringing the card industry's run of lush profits to an end." (***The Wall Street Journal,*** 6/22/94).

Several pieces of evidence contradict this conclusion. For example, the shift to variable rates drove more than 70% of the decline in average rates between 1991 and 1993.[9] More importantly, while credit card interest rates were falling, the prime rate was falling even more rapidly; consequently, during 1992 and 1993, margins on credit cards reached their highest levels since the deregulation of credit card interest rates.[10] Table 1 illustrates this trend. In 1989, the margin between the average credit card interest rate and the prime rate was 7.5%; by 1992, it was 10.9%. Recent accounting evidence also belies the claim that the market has become more competitive. Ausubel (1995) and Meyercord (1994) both show (using different data) that credit card profitability remained exceedingly high during the early 1990s.[11]

There is, therefore, no clear empirical evidence regarding the evolution of competition in credit cards during the 1990s. On one metric—aggressiveness in courting new customers, particularly through nonprice means—competition may have intensified. On the other hand, markups on credit cards remain high, as do accounting profits. Amidst this conflicting evidence lies the new pricing structure of the market, which may signal any number of things about competition. As an attempt to fill this void, I discuss in the next section a model of firm interaction with fixed and variable rates.

III. Modeling Price Competition with Fixed and Variable Rates

In this section, I discuss a model of competition between firms that may have either fixed rates or variable rates. The focus is illustrative rather than formal, and the primary intent is to highlight differences between competition with identical rate types and competition with different rate types. I first discuss competition with different rate types, and then make some comments regarding the rate type choice. I refer to (but do not present) the duopoly model of competition with consumer switching costs in Stango (1999a), which is similar to that in Klemperer (1989) but for the fact that firms may have different rate types.[12] Rather than argue that this model is a perfect characterization of competition in the credit card market, I emphasize how its intuition would extend to an analysis of competition between credit card issuers.

A. Competition with Fixed and Variable Rates

The most salient aspect of competition with fixed and variable rates is that prices move asynchronously based on movements in the index. These movements introduce a stochastic element into the pricing decision, because credit card issuers change their rates/margins so infrequently.[13]

[7] The average fee fell from roughly $12 to roughly $6 between 1989 and 1994. Most of this decline was due to an increase in the percentage of cards with no annual fee. Frequent-flyer cards still consistently charge annual fees, as do some others that offer other inducements for repeat purchases (and can use the opportunity cost of switching cards incurred by the repeat purchase plan to extract higher annual fees).

[8] Previous academic research also supports the contention that these events would foster competition between card issuers. Work by Calem and Mester (1995) and Stango (1999b) indicates that search and switching costs contribute significantly to market power. As it happens, the events described above significantly reduce major sources of both search and switching costs. Mailout solicitations are the best source of price information for most credit card issuers, and they also affect switching costs; indeed, Stango (1999b) finds a significant negative relationship between interest rates/margins and the number of mailout solicitations. Similarly, annual fees and liquidity constraints are commonly cited as sources of consumer switching costs; both the fall in annual fees and the inclusion of "switching checks" to overcome liquidity barriers would presumably reduce switching costs.

[9] The average rate is the average of rates on fixed- and variable-rate cards, weighted by the percentage of cards with each type of pricing; thus, when variable rates are very low, an increase in the percentage of variable-rate cards will reduce the average interest rate even if interest rates stay constant.

[10] Many states removed their interest rate ceilings between 1981 and 1983. The most notable of these is Delaware, the state from which most credit cards are issued, which eliminated its 18% ceiling effective 6/1/81.

[11] Ausubel's data shows that the return on assets (ROA) for credit card operations remained over 4% in 1992 and 1993, close to the average from 1983 to 1991. Meyercord's data shows a sharp increase in profitability between the late 1980s and the early 1990s; she estimates an average ROA of roughly 2% from 1989 to 1991, and ROAs of 2.5%, 3.5% and 4.1% in 1991, 1992, and 1993.

[12] The model examines competition between two firms, each of which may offer either rate type. If a firm has a fixed rate, it chooses its rate (f), and, if it has a variable rate, it chooses a margin (m) over the index. Each firm possesses endowed market share, normalized to sum to 1. Customers view the products as identical, but must pay a switching cost (s) to switch firms.

When the firms have different rate types, they set prices based on their knowledge of the distribution of the index, which corresponds to marginal cost. The realization of the index determines the variable rate, market shares, and profits.

A complete summary of the model is contained in the working-paper version of Stango (1999a), which is available from the author upon request.

[13] Due to the fact that the data contain only six observations on the time dimension, this paper does not explicitly examine the sources of infrequent adjustment of rates/margins or any asymmetries in rate adjustments following changes in costs; it treats these as exogenous. However, the pattern of credit card pricing conforms with the results of studies from other banking sectors. Rate stickiness could be the result of adjustment costs; in the credit card market, adjustment costs exist because rate changes are typically applied to all outstanding debt as well as future balances. Thus, cutting rates foregoes the future income on outstanding debt. Mester and Saunders (1995) find evidence of adjustment costs in rate adjustment in other banking sectors. The adjustment costs of changing rates would also imply asymmetric adjustment costs; raising rates increases the future income stream from outstanding debt. Work by Berger and Hannan (1991), Neumark and Sharpe (1992), and Mester and Saunders (1995) finds substantial evidence of stickiness in deposit rates

Issuers will form expectations of future movement in the index movement based on their beliefs about its distribution, but they will realize that ex post rates may differ widely. These ex post rates may leave an issuer with a rate that lies above or below the rate of its competitors, and will consequently affect market share and profits. Moreover, there is an important asymmetry between fixed and variable rates. Variable rates have an ex post margin that is certain, while fixed rates have an ex post margin that is uncertain. This difference directly enters the profit function, which is written to maximize ex post profits.

The model in Stango (1999a) makes a further simplifying assumption that the index corresponds exactly to marginal costs. This is not perfectly true in the credit card market, because the prime rate is fairly sticky relative to short-run movements in banks' cost of funds. In addition, there are other components of costs such as chargeoffs (default) that are not indexed. One could write the model as one of partial indexation to capture these factors, but the basic intuition of the model would remain the same.

The model yields three main results. The first is standard in most switching cost models: switching costs lead to higher prices, and large firms set higher prices than small firms. This result derives from the stronger incentive of larger firms to exploit their captive customers and forego competition for their competitor's customers.

The second implication of this model turns on the asymmetry between fixed- and variable-rate firms. In the model, when the fixed-rate firm raises its rate, f, it increases the range of costs over which it retains its customers, which reduces the increase in its expected margin.[14] This does not happen for the variable-rate firm. Thus, a variable-rate firm sees a greater incremental change in profit from a change in its margin than does the fixed-rate firm from a change in its rate. This marginal difference leads to asymmetries in equilibrium pricing decisions. One such asymmetry is that, because market share is valuable, prices (and profits) of variable-rate firms increase more as market share increases than prices of fixed-rate firms. Because there is an intertemporal aspect to competition when consumers have switching costs, we would also expect that variable-rate firms would compete more aggressively than fixed-rate firms for market share, because they can exploit captive customers at a greater gain.[15]

A third result of this model is that cost volatility relaxes competition. The intuition for this is that firms with different rate types find direct price competition more difficult when future costs are stochastic.[16] Increasing the volatility of costs reduces each firm's elasticity of expected demand, leading to higher prices and profits.

One can also use the model to examine the rate type choice, with two main results. First, given that the other firm has a fixed rate, switching to a variable rate becomes more attractive as the volatility of costs increases. Second, given that the other firm has a fixed rate, switching to a variable rate becomes more attractive the larger a firm is. These are, of course, partial equilibrium results, but one can also show that—in a simultaneous, two-firm, rate type choice game—having different rate types becomes the Nash equilibrium as volatility increases. There is also a large range of parameters for which the cell in which the larger firm has a variable rate and the small firm has a fixed rate is the unique Nash equilibrium.[17]

B. *Constructing Empirical Tests*

We can link the predictions of the model above to two sets of empirical tests. The first set of predictions describes how market share and the volatility of costs should influence firms' margins given their rate type. This suggests a regression with margin as the left-hand variable, and market share, rate type, and cost volatility as explanatory variables. The model predicts that each of these coefficients will be positive. I will also include the percentage of the market held by variable-rate issuers in this regression; we might expect that the composition rate types in the market would affect margins.

The intuition of the rate type choice suggests a regression with rate type as the (binary) dependent variable, and market share and cost volatility as explanatory variables. Again, these coefficients should be positive.

The null hypothesis in these regressions is a model of perfect competition. In such a model, all firms would charge the same margin. While the pattern of coefficients described in the previous paragraph represent the alternative hypothesis provided by the model described in this paper, other

and the prime rate, and suggests that rates adjust asymmetrically in response to external influences such as changes in costs. As a point of interest, the model discussed here yields a certain amount of price rigidity (in the sense that expected interest rates do not increase one for one with expected costs), although it does not yield any asymmetries in price adjustment.

[14] We know that the markup of the variable-rate firm is m, which can clearly rises on a one-for-one basis with the margin. The (expected) markup of the fixed-rate firm is f minus the expectation of costs when costs are high enough that it retains its existing customers. When f rises, the lower bound on the realization of costs that allows the fixed-rate firm to retain its customers also rises. (I am grateful to an anonymous referee for suggesting this interpretation of the result.)

[15] This suggests a dynamic model in which firms compete taking the effect of current price on future market share into account. Analytical results for such a model show that such competition strengthens the single-period comparative static results: firms offer lower rates in the first period than in the second in order to compete for market share, with variable rates being even lower relative to fixed rates.

[16] The simplest case to analyze is one with no switching costs. In this case, price competition is Bertrand, and firms will continually undercut each other until prices equal marginal cost. This arises from the fact that, when costs are certain, each firm can undercut the other with certainty by setting a rate just below the rate of its competitor. When costs are volatile and the firms have different rate types, this is no longer possible; there is always some probability that even a very low rate will not steal the competitor's customers due to the realization of costs. More formally, introducing this uncertainty resolves the discontinuity in each firm's residual demand curve.

[17] Of course, if the firms move sequentially this might not be the unique Nash equilibrium. In particular, small firms might preempt by switching to variable rates first. This would weaken the empirical results.

alternatives might partly explain this pattern of coefficients. A standard switching cost model, for example, would predict a positive correlation between margin and market share. It would not predict any differences between firms with fixed and variable rates. If consumers or firms are risk averse, the volatility of costs might also affect the relative attractiveness of the two types of cards, but in equilibrium it is difficult to sign the effects of volatility on the margin of a given rate type.

IV. Empirical Tests

To test the empirical predictions outlined above, I proceed in three steps. The first step is an informal test of the prediction that market share is more valuable to firms with variable rates. The second step estimates the determinants of fixed/variable margins in the context of a firm-level supply relation. The third examines the rate type choice using a discrete-choice model.

A. *Some Preliminary Evidence on Nonprice Competition*

Recall that a general implication of the model is that variable-rate firms should value market share more than fixed-rate firms do. Because the most common way of attracting new customers is through mailout solicitations, this proposition implies that systematic differences might exist between the solicitations of fixed- and variable-rate firms. Table 2 summarizes a sample of such solicitations collected in the spring of 1995. As the table shows, variable-rate firms are more likely to send these solicitations; while variable-rate firms comprise roughly 60% of the market, the percentage of solicitations coming from these firms is 90%.[18] Variable-rate firms are also more aggressive in their use of "teaser" rates, which have become quite common during the last two years. Variable-rate firms are both more likely to employ these teaser rates, and also more likely to offer a very low teaser rate. As the second and third rows of the table show, 100% of variable-rate solicitations offered teaser rates, while 66% of fixed-rate firms offered them. Furthermore, the average teaser discount was nearly 55% for variable-rate firms, compared to 35% for fixed-rate firms. Variable-rate firms compete more aggressively on nonprice characteristics as well. They are more likely to offer frequent flyer miles, other nonprice amenities such as cash rebates or discounts on certain types of purchases, and affinity affiliations with universities or professional organizations.

B. *Determinants of Margins for Fixed- and Variable-Rate Issuers*

I use data covering the years 1989 to 1994 to estimate the regressions. The data are compiled from the ***Card Industry Directory,*** an annual publication published since 1990 that provides detailed rate, market share, and cost information for the largest 250 credit card issuers (ranked by outstanding balances). Some firms enter or leave the data set during the sample period, rendering the usable data set a pseudo-panel. Although the implications of the model are primarily cross-sectional, the fact that the data set spans six years allows the model to estimate some year-specific effects.

The most natural way to view such a regression is as a supply relation.[19] The right-hand variables of interest are market share, market share interacted with a dummy for variable-rate firms, cost volatility, cost volatility interacted with a variable-rate dummy, and the percentage of total accounts in the market held by variable-rate firms. All of these variables vary by firm except volatility and the percentage of the market held by variable-rate firms, which vary by year. I use the share of total accounts held by the firm as a measure of market share.[20] Because the prime rate is the most common index used by firms, I measure cost volatility using the coefficient of variation of the prime rate. An observation for 1994, for which the firm-specific data were collected at the end of the year, uses a volatility measure based on the period 1/94 to 12/94.

Table 3 shows descriptive statistics for the data set used in the regressions below. The table illustrates the dramatic changes brought about by the new price structure of the market. In 1989, the average variable-rate firm was roughly half as large as the average fixed-rate firm; by 1994, the average variable-rate firm was over four times larger than the average fixed-rate firm. This change occurred primarily because most of the firms that switched to variable rates were very large.[21]

TABLE 2.—MAILOUT SOLICITATIONS OF FIXED- AND VARIABLE-RATE CREDIT CARD ISSUERS

	Variable Rate	Fixed Rate
Percentage of solicitations received[1]	90.0%	10.0%
Percentage of solicitations offering "teaser" discount	100.0%	66.6%
Average "teaser" discount[2]	53.5%	35.6%
Percentage of offering:		
Frequent flyer plan	4.3%	0.0%
Amenities[3]	30.8%	26.7%
Affinity identification[4]	25.4%	0.0%
n	135	15

[1] Solicitations were received between 6/95 and 8/95.
[2] "Teaser" discount = (standard rate − intro rate)/standard rate.
[3] "Amenities" include cash bonuses for purchases, free gifts included with a new card, and any other inducements of real value except those (such as purchase protection plans) offered by VISA or Mastercard rather than the credit card firm itself.
[4] Affinity identification is the association of the card with an organization such as a sports team, university, or professional organization.

[18] Ausubel (1995) cites an independent source claiming that, in a sample of 46 solicitations (less than one-third the size of this sample), 75% offered variable rates.

[19] The term follows the discussion of Bresnahan (1989).

[20] Using receivables rather than accounts to measure market share left the results unchanged.

[21] This raises the possibility that observations on a few large firms could be driving the regression results. To test for this, I dropped first the ten largest and then the twenty largest firms from the sample. The results grew slightly weaker, but the sign and significance of the results still supported the model.

TABLE 3.—DESCRIPTIVE STATISTICS FOR CREDIT CARD FIRMS, 1989–1994. MEANS OF FIRM-SPECIFIC VARIABLES

	1989		1990		1991		1992		1993		1994	
Year Variable	Fixed	Var	Fixed	Var	Fixed	Var	Fixed	Var	Fixed	Var	Fixed	Var
Firm-Specific Variables:												
Interest rate (%)	18.1	17.5*	18.0	16.5**	18.2	14.4**	18.1	14.0**	17.3	14.2**	16.6	16.5
Margin (%)	7.6	7.0*	8.0	6.5**	11.0	7.2**	12.1	8.0**	11.3	8.2**	8.1	8.0
Credit unions as % of firms	4.8	4.7	11.1	4.2	14.5	8.7	19.8	15.2	32.5	6.8**	40.7	3.6**
Chargeoffs per account ($1982)	24	23	20	23	21	25	28	28	29	33	22	24
Chargeoffs as % of receivables	2.4	2.3	2.3	2.1	2.5	2.3	3.2	2.7	3.1	3.1	2.4	2.4
Accounts (thousands)	586	350	695	324*	815	460	963	1262	544	2798**	480	2339**
Receivables per account (thousands $1982)	768	740	662	692	611	684	610	666	615	656	621	630

Source: ***Card Industry Directory,*** 1990–1995. Averages exclude credit unions.
* Means for fixed- and variable-rate firms differ at 10% or less.
** Means for fixed- and variable-rate firms differ at 5% or less.

C. Controls

I include the following other variables: a dummy equal to 1 if the firm is a credit union, a dummy equal to 1 if the firm charges a variable rate, chargeoffs (default) as a percentage of receivables, the mean of the prime rate, and the mean of the prime rate interacted with a dummy equal to 1 if the firm has a variable rate. The credit union control is important for two reasons. Credit unions are systematically different from the commercial banks in the sample; they are smaller on average, have lower default rates, and offer lower interest rates than non-credit union banks. They also seem to eschew offering variable rates; only 5% of credit unions in the sample offer variable rates. Chargeoffs enter the supply relation as a potentially endogenous cost variable. I discuss a method of correcting for the endogeneity below.

Using the margin between a firm's interest rate and the prime rate as the dependent variable without including the prime rate on the right side imposes the restriction that rates move one-for-one with the prime. As table 1 indicated, this is clearly not the case with fixed rates in the credit card market. I therefore also include the prime rate on the right side. If fixed rates are perfectly sticky (meaning that fixed rates do not change when the prime changes), the coefficient on the prime rate should be -1, while, if fixed rates move one for one with the prime, the coefficient should be 0.[22] Including an additional term that interacts costs with a dummy equal to 1 if the firms has a variable rate allows movements in variable rates to differ from movements in fixed rates.

D. Endogeneity of Market Share and Chargeoffs

Market share is undoubtedly endogenous in any regression with price-cost margins as the dependent variable. Unfortunately, it is very difficult to find an instrument for market share that is uncorrelated with the error term in the regression. Greene (1993) suggests the following solution. If firms can be categorized by market share into groups ("large," "medium," and "small") across which there is very little movement over time, these groups can be used to instrument for market share, and the endogeneity will be mitigated. For example, if a firm is in the "large" group both before and after choosing a variable rate, the fact that it seeks to build market share after switching to a variable rate will not affect the value of the instrumental variable. This approach seems very well suited to the credit card market, and to this data set in particular; most firms retain their relative size throughout the sample. For example, of the twenty largest issuers in 1989, sixteen were still in the largest twenty in 1994. In order to assess the robustness of the results to group definition, I chose two sets of instruments. The first defines ***large*** and ***small*** as including roughly the ten largest and ten smallest firms, respectively, in each year. The second set is more inclusive: it includes roughly the fifty largest and fifty smallest firms in each year.[23] The results were robust to the definition of groups. Results are reported for the less inclusive definition.

Chargeoffs per account are also endogenous. Higher margins increase the probability of default, because they increase the expected level of future interest payments. The exogenous right-hand variables and the overidentifying instruments for market share were used to instrument for chargeoffs.[24]

[22] Theory suggests that in a linear model a unit change in costs should result in a unit change in rates. In a log-linear specification, a coefficient of 0 indicates that a 1% change in costs changes price by 1%. However, in this case, the mean of the dependent variable is 8.08, while the mean of the prime rate in the sample is 8.99; because the values of the variables are close to each other, it will be approximately true that a unit change in costs will cause a unit change in rates.

[23] These groups were chosen because they are close to natural breaks in the data.

[24] The market share instruments overidentify the model because there are two excluded endogenous variables (market share and market share interacted with the variable-rate dummy), and four instruments ("large," "small," and these two dummies interacted with the variable-rate dummy). In a regression with chargeoffs as the dependent variable and the exogenous right-hand variables and the instruments on the right side, the instruments were jointly significant at 99%.

TABLE 4.—DETERMINANTS OF MARGINS FOR FIXED- AND VARIABLE-RATE FIRMS

	Dependent Variable: Log of Margin Between Interest Rate and Prime Rate			
	OLS	IV		
Variable	No Effects	No Effects	Firm Effects	Firm & Year Effects
Log of market share (accounts)	0.017**	0.017**	0.020**	0.021**
	(0.005)	(0.005)	(0.007)	(0.007)
Log of market share (accounts) × variable-rate dummy	0.036**	0.036**	0.025**	0.022**
	(0.010)	(0.010)	(0.007)	(0.007)
Log (coefficient of variation)	0.005	0.005	0.007*	0.024**
	(0.008)	(0.008)	(0.004)	(0.009)
Log (coefficient of variation) × variable-rate dummy	0.037*	0.037*	0.034**	0.033**
	(0.019)	(0.019)	(0.010)	(0.009)
Log (percentage of accounts held by var.-rate firms)	− 0.068**	− 0.068**	− 0.071**	− 0.045**
	(0.011)	(0.011)	(0.004)	(0.009)
Log (mean of prime rate)	− 1.058**	− 1.058**	− 1.035**	− 0.917**
	(0.036)	(0.036)	(0.019)	(0.044)
Log (mean of prime rate) × variable-rate dummy	0.684**	0.684**	0.682**	0.678**
	(0.087)	(0.087)	(0.046)	(0.040)
Variable-rate dummy	− 1.295**	− 1.295**	− 1.287**	− 1.296**
	(0.215)	(0.215)	(0.116)	(0.101)
Credit union dummy	− 0.345**	− 0.345**	− 0.265**	− 0.235**
	(0.019)	(0.019)	(0.026)	(0.027)
Log (chargeoffs as % of receivables)	0.068**	0.068**	0.061**	0.058**
	(0.011)	(0.011)	(0.015)	(0.016)
Constant	4.378**	4.378**	4.319**	4.181**
	(0.085)	(0.085)	(0.070)	(0.110)
n	1312	1312	1312	1312
adj. R^2	0.59	0.59	0.57	0.55

* Significant at 10% or greater.
** Significant at 5% or greater.
Firm-level data compiled from ***Card Industry Directory,*** 1990–1995. The data set covers 1989 to 1994.

E. Results

Table 4 reports the results for four different specifications, all of which employ a double-log functional form.[25] The first column reports ordinary least squares (OLS) results. The second reports instrumental-variables (IV) estimates. The third and fourth columns report the results of an IV model with random effects, first for firms only and second for firms and years.[26] The third column therefore estimates coefficients based on within-issuer variation, while the fourth estimate coefficients based on within- and between-issuer variation. The fourth column is the most complete specification and is preferred. The OLS and first IV regressions use the White heteroskedasticity-consistent covariance matrix to estimate standard errors, while the random-effects models use generalized least squares (GLS) to estimate coefficients and standard errors.

The estimated effect of market share on margins is positive and significant in every specification shown. The interaction term is also positive and significant in every specification. This is consistent with switching cost models in which large firms exploit their captive customers, and it is also consistent with the fixed/variable pricing model that suggests a more positive coefficient on market share for variable-rate firms. The coefficients are relatively small, but the total effects of market share can be large given the range of values in the data: the largest firm is nearly 100,000 times larger than the smallest. As a point of comparison, the model estimates that (reading from the results with firm and year effects) a fixed-rate firm that is ten times bigger than a competitor can charge a margin 21% higher than that of its

[25] The theory provides no guide as to whether a log-linear or a linear specification should be used. In such cases, Davidson and Mackinnon (1981) suggest the following test. First, run the model separately in linear and log-linear form, and save the fitted values of the dependent variable $\hat{\boldsymbol{Y}}_{\boldsymbol{lin}}$ and $\hat{\boldsymbol{Y}}_{\text{log-}\boldsymbol{lin}}$. Then reestimate the linear model with the new variable $Z_{\text{lin}} = \boldsymbol{Y}_{\boldsymbol{lin}}\text{-exp}(\hat{\boldsymbol{Y}}_{\text{log-}\boldsymbol{lin}})$ included on the right side; a significant t-statistic on this variable indicates that the log-linear specification adds explanatory power to the model, arguing in favor of the log-linear specification. Similarly, one can reestimate the log-linear model with $Z_{\text{log-lin}} = \boldsymbol{Y}_{\text{log-}\boldsymbol{lin}}\text{-ln}\,\boldsymbol{Y}_{\boldsymbol{lin}}$ as a right-hand variable, with analogous implications for the t-statistic. In this model, the t-statistics on Z_{lin} is 8.10, and the t-statistic on $Z_{\text{log-lin}}$ is 1.20. Both of these argue in favor of using a log-linear functional form.

[26] The choice of fixed versus random effects raises several issues. First, note that because some variables (such as the prime rate) vary only annually, fixed-year effects cannot be estimated because they are perfectly collinear with any year-specific variable. Thus, any year effects must be random. The results of specifications using fixed issuer effects are similar to those using random issuer effects alone, with the exception that the coefficient on market share is not significant. The market share/variable-rate interaction is positive and significant, as are the cost volatility and volatility/variable-rate interaction coefficients. One caveat regarding the use of random effects is that they are vulnerable to endogeneity bias. It is possible, for example, that rate type might be a function of omitted issuer characteristics. These characteristics will be imputed into the random effect, which will then be correlated with rate type (an RHS variable). The relative similarity of the fixed-effects and random-effects specifications suggests that this is not a serious problem, but it is a valid concern.

competitor, whereas a variable-rate firm that is ten times bigger than a competitor can charge a margin 43% higher than that of its competitor.[27]

The estimated effect of volatility on margins also fits general intuition of the model. The coefficient on volatility is positive and statistically significant. This is evidence that volatility increases the margins of all firms. The interaction term is positive as well, and significant in every specification. The magnitude of the effects is economically significant, although not tremendously so; the estimates suggest that, if volatility doubled, margins at fixed-rate firms would rise by 2% and at variable-rate firms by 5%.

The coefficient on the "percentage of accounts held by variable-rate firms" is negative and highly significant in every specification. This suggests that, as variable-rate firms became a larger presence in the market, the margins of all firms fell. The estimates imply that, if the presence of variable-rate firms in the market doubled, margins would fall by roughly 5%.

The coefficient on the mean of the prime rate is very close to -1, which means that changes in the margins on fixed-rate cards are due almost entirely to changes in the prime rate; in other words, fixed rates are almost perfectly sticky. This fits with the assumption of the model. The coefficient on the variable-rate interaction term—which should be 1 if rates move one for one with costs (given that the coefficient on the mean of the prime rate is 1)—is positive and significant but significantly different from 1. However, this is an artifact of the way that margins are calculated for firms that index to rates other than the prime rate; for firms that index to the prime rate, the hypothesis that variable rates move one for one with the prime can not be rejected.[28]

The coefficient on the variable-rate dummy indicates that, ceteris paribus, variable-rate firms have lower margins than fixed-rate firms; this coefficient is significant. Credit unions tend to have lower margins than non credit unions. As was mentioned before, this may derive from the fact that credit unions have lower costs due to preferential tax treatment. The coefficients on chargeoffs are positive and significant in all equations, suggesting that they are indeed a relevant cost variable.

In sum, the regressions suggest that margins for both types of firm are positively correlated with market share and the volatility of the index rate, controlling for costs and other supply-side effects. These results illuminate reasons for some of the seemingly contradictory evidence on competition in the market. Competition for new customers intensified as variable-rate firms became more prominent in the market, due to the aggressive nature of these firms in building market share by attracting new customers. This exerted downward pressure on markups (as indicated by the negative coefficient on the variable-rate firm market share variable). However, the volatility of the index during the same period increased markups for all firms. The net effect was a market that looked more competitive on nonprice dimensions but in fact allowed firms to maintain markups that were very high by historical standards. In terms of the general discussion in the introduction, the model provides a description of a market with "price differentiation."

F. The Rate Type Choice

Recall that the model predicts that, as costs become more volatile, we should observe movement from a "fixed/fixed" equilibrium to a "fixed/variable" equilibrium. Also, in such an equilibrium, large firms should be more likely to have variable rates. This suggests a rate type choice model in which the dependent variable is the type of rate offered, and the right-hand variables include cost volatility and market share. The major problem with such a regression is that market share is endogenous; as was noted earlier in the paper, variable-rate firms are much more aggressive in building market share than are fixed-rate firms. These regressions therefore also employ the "large" and "small" instruments for market share discussed earlier. Because the model is nonlinear due to the binary dependent variable, estimation with instrumental variables requires either nonlinear two-stage least squares (NL2SLS) or generalized method of moments (GMM) estimation. I use GMM to estimate the model; Davidson and Mackinnon (1993) describe the procedure.

Table 5 reports the results of a binomial logit estimation of rate type choice, first with no instrumental variables (the first two columns), and with instrumental variables using GMM (the second two columns). These regressions include market share, two measures of cost volatility (the coefficient of variation of the index rate and the standard deviation of the index over the same one-year period), and a dummy variable equal to 1 if the firm is a credit union. The signs and significance of the variables are identical in the binomial logit and GMM specifications. Market share increases the likelihood that a firm will choose a variable rate, and the coefficients are significant at the 5% level. Cost volatility also increases the likelihood that a firm will choose a variable rate, a result that is significant at 5%. Also, credit unions are much less likely to offer variable rates than fixed rates; this coefficient is significant at 5% as well.

Because the model is nonlinear, the coefficients in table 5 cannot be interpreted as marginal effects. As a rough gauge

[27] These percentages reflect relative differences, not absolute differences. For example, as it is stated here, being able to charge a margin 19% higher than a competitor means that, if the small firm is charging an interest rate of 10%, the large firm can charge an interest rate of 11.9%, not an interest rate of 29%.

[28] For firms that index to a rate other than the prime (such as a *T*-bill rate), the measured margin is the actual rate on the card minus the prime rate; this makes the margin comparable to other margins in the data. However, rates other than the prime are typically more flexible and volatile than the prime, which causes the correlation between the measured margin and the prime rate to be less than one for one for these issuers. If they are dropped from the sample (leaving only those issuers who index to the prime), the coefficient on the interaction term is 0.87 with estimated standard deviation 0.04; this is not significantly different from the coefficient on the prime, which is 0.91.

TABLE 5.—INFLUENCE OF MARKET SHARE AND COST VOLATILITY ON FIRM RATE TYPE

Variable	Dependent Variable: Firm Rate Type, Variable = 1, Fixed = 0			
	Binomial Logit		GMM	
Standard deviation of prime rate	1.182**		1.189**	
	(0.263)		(0.300)	
Coefficient of variation of prime rate		11.15**		11.20**
		(2.13)		(2.48)
Market share	11.64**	11.53**	24.01**	23.59**
	(3.93)	(3.94)	(7.71)	(7.58)
Credit union dummy	– 1.384**	– 1.447**	– 1.187**	– 1.253**
	(0.338)	(0.340)	(0.683)	(0.317)
Constant	– 2.185**	– 2.306**	– 2.294**	– 2.414**
	(0.145)	(0.153)	(0.168)	(0.179)
n	1313	1313	1313	1313

Standard errors in parentheses.
** Significant at 5% or greater.
Firm-level data compiled from ***Card Industry Directory,*** 1990–1995. The data set covers the years 1989 to 1994.

of the impact of market share and cost volatility on rate type choice, the model predicts that, when cost volatility is low (a coefficient of variation of 0.01), a firm with 0.01% market share has a 12% probability of choosing a variable rate, a firm with 1% market share has a 14% probability of choosing a variable rate, and a firm with 10% market share has a 44% probability of choosing a variable rate. When cost volatility is high (coefficient of variation = 0.15), a firm with 0.01% market share has a 22% probability of choosing a variable rate, a firm with 1% market share has a 25% probability of choosing a variable rate, and a firm with a 10% market share has a 62% probability of choosing a variable rate.[29] It appears that market share has a large effect on rate type choice, particularly for very large firms. Cost volatility has a smaller impact.

V. Discussion

The results for both sets of regressions are fairly robust, but other issues are worth discussing. First, the regressions do not explicitly control for nonprice card characteristics.[30] These could contaminate the results if they are omitted, and correlated with either rate type or market share. To examine whether this could be affecting the empirical results, I compiled data on nonprice characteristics from the Federal Reserve E.5 Statistical Release ''Terms of Credit Card Plans.'' There were 854 observations for firms that are listed in both the E.5 and the Card Industry directory. I then estimated a specification identical to that in table 3, including a set of dummy variables for the nonprice characteristics. Their inclusion left the results unaffected.

A second point regarding the interpretation of the empirical results is that the model is fairly static. In particular, the empirical prediction that margins should be positively correlated with market share is based on the relationship between beginning-of-period market share and expected margin. However, we may not necessarily be viewing firms at ''beginning-of-period'' in the data. One can show that the correlation between end-of-period market share and margin, while still positive, is less than that between beginning-of-period market share and margin. To test for the relevance of this consideration, a regression was estimated with a proxy for end-of-period status: a dummy variable equal to 1 if the firm had not adjusted its rate/margin in more than two years. This regression showed that, indeed, the correlation between market share and margin is lower for firms that have not recently adjusted rates. This result is evocative of switching cost models in which large firms set higher prices than small firms but have greater customer attrition.

A final factor that might be important is that the early 1990s were a period of heavy entry by large issuers, many of whom were nonbank holding companies. These issuers mounted aggressive campaigns to build market share in the early 1990s and also were more likely to offer variable rates.[31] Because these issuers are more likely to have variable rates and are aggressive competitors, it is possible that the regressions could be picking up a spurious correlation between having a variable rate and being aggressive. To test this proposition, I constructed a dummy variable indicating issuers who entered the data set after 1989 and had a variable rate (''variable entrants''). I then estimated specifications including a dummy variable indicating either variable entrant status, and an interaction of market share with the variable entrant dummy. The dummy variable coefficient was negative and significant, indicating that these issuers have significantly lower margins. Moreover, the dummy/market share interaction was negative and significant, and completely offset the positive coefficients on market share and the variable rate/market share interactions. However, the other coefficients remained unchanged, suggesting that the results are robust for the subset of issuers who were in the market during the sample period and changed their rate from fixed to variable. It appears that they do not apply for the subset of issuer who entered the market with variable rates during the early 1990s (although it should be noted that the pricing patterns of these issuers—setting low rates—is generally consistent with pricing with consumer switching costs).

Regarding the rate type choice model, two caveats are in order. First, the volatility of the index created a great deal of interest-rate risk for banks charging fixed rates. If risk-averse bank managers desired to offer variable-rate loans under such circumstances, this would be observationally equivalent to the prediction of the model regarding index

[29] The coefficient of variation takes on values between 0.001 and 0.12 in the data.

[30] Stango (1999b) examines the role of nonprice features in explaining rate variation in much greater detail.

[31] In the sample, 41% of variable-rate accounts are held by nonbanks, and 25% of fixed-rate accounts are held by nonbanks. These numbers reflect the fact that nonbank issuers, although small in number, are both large and more likely to offer variable rates. Only 4% of fixed-rate issuers are nonbanks, while 11% of variable-rate issuers are nonbanks, but nonbank issuers are, on average, roughly eight times as large as other issuers.

volatility.[32] Second, the fact that the prime rate fell so rapidly dramatically increased the margins that credit card issuers earned on their loans. For example, Citibank charged a rate of 19.8% throughout this entire period. Thus, its margin rose from 9.4% in January 1990 to 13.8% in December 1992 (a 47% increase). As consumers and legislators became aware of the massive increase in profitability that credit card issuers were enjoying, the outcry against high credit card rates became extremely fierce. In subsequent months, most large issuers cut their rates.[33] Most of these banks, however, ''cut'' their rates by switching to variable rates. Often they selected margins that were quite high by historical standards, but, because the prime rate was so low, they were able to announce rate cuts. This defrayed much of the criticism leveled at card issuers. Furthermore, cutting rates by switching to variable rates was an optimal strategy for these firms for two reasons. For firms that like keeping rates/margins fixed for extended periods of time, the strategy was optimal because it involved only one change in pricing. A firm that cut its rate by reducing its fixed rate would have had to raise its fixed rate after the prime rate had started to rise, thus changing its rate twice or more. Switching to a variable rate also mitigated the public-relations difficulties of raising fixed rates later; the variable rate would automatically rise as the prime rate rose, without changing the terms under which previous outstanding balances were borrowed. Switching to variable rates was therefore a good move because it reduced interest-rate risk at a time of great volatility, it involved one change in pricing terms rather than the several that changing fixed rates would require, and it avoided the public-relations difficulties of raising fixed rates after the (expected) increase in the cost of funds. We can conclude that the empirical results are consistent with the rate type choice model, but are also consistent with other explanations for the regime change in pricing.

VI. Conclusion

The empirical puzzle of the credit card market during the 1980s was that credit card issuers maintained extremely high interest rates in the face of large reductions in their cost of funds. The early 1990s left us with two more: dramatic changes in the competitive structure of the market, which offered contradictory evidence on the issue of whether competition was intensifying, and the sudden explosion in the number of cards offering variable rates. This paper deals with both puzzles in turn, although it treats the first much more fully.

It appears that the increase in competition for new customers during the 1990s is related to the stronger presence of variable-rate firms in the market; these firms are more aggressive in building market share than are fixed-rate firms. As variable-rate firms became more active in the market, however, costs were very volatile. This volatility increased industry profits, particularly for variable-rate firms. Thus, issuers continued to earn high returns. The simultaneous effects of these countervailing influences accounts for the mixed evidence on competition in the market. The growth in popularity of variable rates can be ascribed to both political pressures and the volatility of the prime rate from 1990 to 1992, although I cannot distinguish the influence of volatility insofar as it affected risk from its influence based on the model of rate type choice.

More generally, it may be that this type of pricing is important in other markets. For example, exporting firms must choose whether to invoice in the currency of the domestic or foreign country. If firms from the same market invoice in different currencies and maintain nominal prices over time, exchange-rate movements will create asynchronous movements in relative prices at the two firms. Another scenario in which these asynchronous movements might occur would be in situations in which firms write long-term delivery contracts. If some firms write contracts for fixed prices, while others write cost-plus contracts, the same type of movements will occur. The model discussed in this paper might provide insight into pricing and competition in such situations.

[32] Of course, risk-averse consumers might demand fixed-rate loans under these circumstances. It is not clear what would happen in equilibrium.

[33] See Stango (1999c) for an examination of issuer responses to the threat of regulation.

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