MARKET STRUCTURE AND COMPETITION AMONG RETAIL DEPOSITORY INSTITUTIONS

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Abstract—We assess competition among retail depository institutions in 1,884 rural markets. We estimate an equilibrium market structure model that endogenizes the operating decisions of three types of depository institutions: multimarket banks, single-market banks, and thrift institutions. Observed market structures and a game-theoretic specification of entry behavior identify the parameters of an underlying profit function. We find strong evidence that product differentiation generates additional profits for retail depository institutions. These profits help to maintain smaller banks and thrifts, even as larger banks expand their operations. Consumers have more options, as more institutions can profitably operate as a result of product differentiation.

I. Introduction

THE U.S. banking industry has experienced significant regulatory change over the past three decades. The competitive landscape has shifted considerably in retail banking due to the liberalization of bank branching restrictions and the expansion of bank holding companies. In most areas, traditional community banks and thrift institutions now face competition from branches of large banks that operate in numerous locations across wide geographic areas. Regulators assessing market structure in this environment may need to distinguish among these various types of depository institutions to accurately measure competition. In addition, there is considerable policy interest in how the expansion of large banks affects the survival of smaller depository institutions.

This paper analyzes the competitiveness of local retail banking markets—focusing attention on potential distinctions among multimarket banks, single-market banks (which, in our sample, will generally correspond to "community banks"), and thrifts (savings banks and savings and loans). Our empirical strategy is based on econometric models developed recently in the industrial organization literature that make inferences about the intensity of competition based on observations of the operating firms in a cross section of markets. We observe the number of multimarket banks, single-market banks, and thrifts operating in 1,884 rural markets. To address the dynamic robustness of our inferences about competition and product differentiation, we perform the empirical analysis over the same set of markets observed in 2000 and in 2003. In addition, we explore geographic differences in the cross section by separately analyzing samples including more and less rural areas.

Our results provide evidence of significant differentiation among these three types of depository institutions. The differentiation manifests itself through smaller measured competitive effects of one type of institution on the profits of the other types, as compared to institutions of the same type. For example, competition is tougher between two multimarket banks than if the multimarket bank were competing with one single-market bank. Thrift institutions are the most differentiated overall, though somewhat less so in the markets near urban areas. In addition, we find our differentiation results to be largely stable over the 2000 to 2003 period. This suggests that while regulatory changes may have fostered multimarket bank expansion, the underlying economic profitability of pursuing differentiation strategies provides a buffer that should help maintain community banks and thrifts. Furthermore, the profitability associated with product differentiation allows more options for consumers—our parameter estimates imply that there are an average of 24% more retail depository institutions for the markets in our sample with three product types, compared to a hypothetical situation in which only multimarket banks operate.

The remainder of the paper is organized as follows: section II provides background on the retail banking industry, including reference to important policy questions regarding market competitiveness and the geographic expansion of banks. Section III presents the econometric model and its application to retail depository institutions. Section IV contains our empirical work, starting with a description of the data and the baseline estimates from 2000. We proceed by examining extensions to these baseline results, first by exploring geographic market differences, then by comparing the 2000 estimates with an analysis of data from 2003, and finally with a counterfactual exercise that quantifies the effects of product differentiation. Section V discusses our conclusions.

II. Background and Significance

Our research is motivated by the substantial changes in retail banking precipitated by large-scale deregulation in the last quarter of the 20th century. In the 1970s, many individual states mandated that retail banks have only a single branch, and interstate banking was prohibited. Most of these regulatory restrictions have been lifted in the years since.

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The industry has consolidated considerably as a result, with the emergence of several large firms that operate banks across wide geographic areas. While these multimarket banks have expanded—through growth and merger—thousands of much smaller single-market[1] banks operate in individual local markets throughout the United States. In addition, rules regulating thrifts have changed to allow these institutions to potentially compete more directly for retail banking customers.

These developments complicate the assessment of competitive conditions in banking markets. Therefore, one important question that we address in this paper is the following: to what extent does differentiation among types of retail depository institutions affect competition? In addition, there may be a policy interest in the continued survival of community banks and thrifts as multimarket banks continue to expand. During congressional debate on the Gramm-Leach-Bliley Act of 1999, Rep. Rick Lazio of New York attempted to mollify concerns about consolidation by noting, that "We have over 9,000 banks right now. That number will certainly drift down. . . But at the same time, the main street bank, the smaller thrift, will continue to thrive in their niche. . . ." Our empirical analysis will also address the strength of that niche and, in turn, the future prospects for smaller banks and thrifts.

Inference about competitive conditions in the banking industry also must confront difficult issues with respect to market definition. While banking organizations have grown in size and geographic scope, there is strong evidence that retail banking markets are local in nature. Studies using data from the Federal Reserve's Survey of Consumer Finances and Survey of Small Business Finances, as well as data newly available under the Community Reinvestment Act (Elliehausen & Wolken, 1990, 1992; Kwast, Starr-McCluer, & Wolken, 1997; Amel & Starr-McCluer, 2002), have found that consumers and small businesses tend to obtain their bank services from nearby providers.[2] Importantly, numerous studies have found a relationship between local market concentration and deposit or loan interest rates.[3] Based on this evidence, our empirical analysis will examine competitive conditions in a cross section of local markets, which we will define precisely in section IVA.

In terms of product market definition, banks have a wide variety of offerings (e.g., consumer loans, small business loans, checking accounts, and savings accounts) for which comprehensive price and quantity data are rarely available at disaggregate (product/geographic market specific) levels.[4] The Supreme Court has interpreted antitrust laws based on the idea that the banks provide a "cluster" of services that are assumed to be traded in local markets.[5] More recently, Cyrnak and Hannan's (1999) analysis of business lending supported the continued use of the cluster concept as an appropriate proxy in assessing competition. Since inferences are made based on firm presence rather than data from individual product lines, our empirical framework analyzes competition among types of depository institutions in a manner consistent with the assumption that the cluster of services represents the relevant product market.

The role of thrift institutions may also affect bank merger analysis to the extent that thrifts represent a potentially important source of competition for banks. Thrifts differ from commercial banks in their charters, regulatory and insurance agencies, and statutory requirements. Thrifts were originally established to provide real estate loans (primarily residential mortgages) financed by time deposits, but were precluded from offering demand deposits and required to hold most of their assets in real estate. In 1974, the Supreme Court ruled that thrifts competed in a different product market than commercial banks because they did not offer the same cluster of services.[6] Since then, statutory restrictions that had prevented thrifts from offering demand deposit accounts and engaging in commercial and industrial (C&I) lending have been relaxed. In addition, banks have been permitted to affiliate with nondepository financial institutions, which thrifts had been permitted to do for some time.[7] The

[1] As mentioned earlier, the institutions in our sample that we classify as single-market banks would qualify as "community banks" according to almost all definitions used in the banking literature. Because we refer to other papers in which the term "single-market bank" is used rather than community bank, we maintain the terminology for the sake of consistency. We will define single-market banks more precisely below.

[2] Note that local geographic markets are not uncontroversial and are subject to change over time. For example, Petersen and Rajan (2002) present evidence that the geographic distance between small businesses and their lenders has increased over the last 20 years. Still, the distances are very small—the mean distance is four miles for their most recent data. In addition, the distribution of distances is quite skewed, with the vast majority of their observations well within the market boundaries that we define. In fact, these authors use counties to define markets in subsequent work using a similar data set (Berger et al., 2005). In addition, recent work using Community Reinvestment Act (CRA) data suggests that distances between small businesses and their lenders have been flat or decreasing over time (Brevoort & Hannan, forthcoming). Section IVC provides some additional analysis of geographic differences among the markets in our data set.

[3] See, for example, Calem and Carlino (1991), Hannan and Prager (1998, 2004), Heitfield and Prager (2004). Radecki (1998) interprets the finding that multimarket banks offer the same interest rate in different metropolitan statistical areas (MSAs) as evidence against local banking markets; however, Heitfield (1999) demonstates that single-market bank interest rates differ substantially across MSAs, suggesting that local market conditions dictate the pricing behavior of single-market banks.

[4] There are several papers studying competition in banking markets that use price data. Some papers have used survey data, which are often for a particular product in a limited geographic area. Others have used constructed prices which tend to be aggregated over different products and geographic areas.

[5] *United States v. Philadelphia National Bank* (1963). In support of this idea, several of the studies using the survey data described in the previous paragraph find that consumers tend to obtain multiple financial services from the same bank.

[6] *United States v. Connecticut National Bank* (1974).

[7] While it is true that thrifts are able to offer a wider variety of products, it is not clear that they actually have availed themselves of these options. Pilloff and Prager (1998), for example, find that thrift C&I lending was limited despite the removal of some of the restrictions on it.

issue of whether the reduction of these practical differences should lead to including thrifts as market competitors has not been resolved by the relevant antitrust authorities—in fact, the four regulatory bodies that oversee bank mergers have three different rules of thumb for treating thrift institutions in merger analysis.[8]

Our study complements recent papers that have begun to explore how these different types of depository institutions might compete with each other. For example, Hannan and Prager (2004) find that local market concentration is negatively related to deposit rates offered by single-market banks, but that the effect attenuates as the share of deposits at multimarket banks increases. Biehl (2002), using data on deposit interest rates from five metropolitan areas in New York State, finds evidence that suggests that multimarket banks may engage in softer price competition than single-market banks. Dick (2002) focuses on a single product (deposit accounts) and structurally estimates demand and measures product differentiation among single- and multistate banks, while Adams, Brevoort, and Kiser's (forthcoming) demand specification allows for differentiation between single- and multimarket institutions as well as between banks and thrifts. Finally, Amel and Hannan (2000) estimate residual deposit supply equations for two bank products, MMDAs and NOW accounts. They find very small elasticities of the residual bank supply curve and interpret this as suggesting that only banks should be included in the product market used in bank merger analysis.[9]

Our approach to analyzing competition among multimarket banks, single-market banks, and thrift institutions is novel in several respects. We estimate a model of equilibrium market structure that specifies distinct behavioral functions for each of the three types with which we can identify variables that increase the probability of entry for each type of firm. In addition, the model allows us to explicitly measure how much the existence of competitors may decrease profitability—and to compare the competitive effects across types. For example, we are able to distinguish between the extent to which a single-market bank degrades the profits of a multimarket bank as opposed to the effect that a single-market bank has on the profits of other single-market banks. We use this comparison to arrive at measures of differentiation among the types of institutions.

An advantage of our approach is that we can perform a powerful statistical analysis of competitive conditions across a large number of markets without severe data requirements. In fact, the only data our model requires are the observed set of institutions (of each type) operating in a cross section of local markets. We believe that this sort of model is well-suited for the retail banking application based on the cited evidence regarding market definition. Focusing on market presence rather than detailed product-level data corresponds well to the cluster concept, and our geographic market definition reflects the importance of proximity to customers for depository institutions. However, it is important to acknowledge that these are maintained assumptions of our model—we analyze competition among product types given these assumptions about product and geographic markets, but do not have the ability to test them per se. Finally, ours is a positive exercise and we do not attempt to contribute to the normative discussion about the welfare effects of bank competition.[10]

III. A Model of Endogenous Market Structure in Local Banking Markets

To examine the competitive consequences of concentrated industry structure in local banking markets, we make use of the "multiple-agent qualitative-response" models employed in the industrial organization literature to evaluate entry strategies and market competition.[11] In these models, firms' strategies can be represented by discrete decisions (for example, enter/don't enter a particular market) that are arrived at by evaluating the profitability of the potential alternatives. The goal of the econometrician is to estimate parameters of the profit functions using information provided by the firms' observed decisions. For example, we infer that a firm is profitable based on its presence in the market and that an additional market participant would not be profitable. Estimation in this context is complicated by the fact that

[8] The Office of the Comptroller of the Currency and the FDIC include 100% of thrift deposits in computing bank HHIs, while the Federal Reserve Board typically includes 50% of thrift deposits, and the Department of Justice includes either 100% of thrift deposits or none at all (depending on the extent to which the thrift is involved in C&I lending). These agencies construct Herfindahl-Hirschman Index (HHI) screens using deposit market share as a proxy for the degree of competition over the entire cluster of services offered by banks, with mergers receiving closer scrutiny if the post-merger HHI increases by more than 200 to a level above 1,800 in any market involved in the merger.

[9] Credit unions are another potentially important competitor that other researchers have studied in a similar way. For example, Tokle and Tokle (2000) find that local market shares for credit union deposits are associated with higher interest rates on bank CDs in Idaho and Montana, and Feinberg (2001) finds that larger credit union deposit shares are associated with lower bank lending rates on unsecured and new vehicle loans. As discussed below, it may be possible to extend the type of analysis we do here to include credit unions, given the availability of appropriate data.

[10] For example, studies like Petersen and Rajan (1995) and others have suggested that market power may actually be desirable in banking markets to the extent that firms operating in those markets are less credit constrained as a result.

[11] In addition to the papers cited here, see Berry (1992), Toivanen and Waterson (2005), and Seim (forthcoming). Reiss (1996) provides an overview of the empirical framework.

the decisions of competing firms affect the profitability of the potential alternatives—that is, operating should be less profitable as the number of competitors in the market increases. A game-theoretic behavioral model is therefore used to infer individual firm profitability from an oberved market structure outcome, determined by the choices made by interacting agents. Because our goal is to assess the competitiveness of different types of depository institutions, we analyze a model where each distinct type of institution has a separate behavioral function.

Our analytical framework derives from Bresnahan and Reiss (1991), who propose a simple yet flexible profit function that governs behavior in a symmetric equilibrium in market *m.* The profit of each operating firm is given by

$$\Pi_m = (\textit{Variable Profits})_m{*}(\textit{Market Size})_m - (\textit{Entry Costs})_m. \tag{1}$$

Variable profits represent the per-customer revenues of the firm, less variable costs. The effects of competition are incorporated by allowing variable profits to be a function of the number of firms; that is, per-customer revenue may be higher where the number of market participants is lower to the extent that market concentration reduces price competition. Specifically, let the profits of each of *n* symmetric firms operating in market *m* equal

$$\Pi_{n,m} = X_m\beta - \mu_n + \varepsilon_m, \tag{2}$$

where X_m are exogenous market factors (including market size), μ_n measures the effect of having *n* competitors on the firms' profits, and ε_m is a market-level error term assumed to follow a normal distribution. We assume that firms will participate in the market if they earn nonnegative profits. Therefore, the probability of observing *n* firms in equilibrium equals

$$P(\Pi_n \geq 0 \text{ and } \Pi_{n+1} < 0) = \phi(\bar{\Pi}_n) - \phi(\bar{\Pi}_{n+1}), \tag{3}$$

where ϕ is the cumulative normal density function and $\bar{\Pi}_n = X_m\beta - \mu_n$. Bresnahan and Reiss used an ordered probit model to estimate the β and μ_n parameters.[12,13]

To accommodate differentiation among competitors, we follow Mazzeo (2002) and employ a model that endogenizes product type choice as well as entry. We identify competitors as being one of three types of depository institution (either "multimarket bank," "single-market bank," or "thrift") and posit a separate profit function for competitors of each type. This allows us to determine whether same-type competitors affect profits more than different-type competitors. We include both the number and the product types of competitors as arguments in the reduced-form profit function. We treat all firms within a given product type as symmetric.[14]

More generally, we can specify the profits of a firm of type τ in market *m,* where market *m* contains N_1 firms of type 1, N_2 firms of type 2, and N_3 firms of type 3:[15]

$$\pi_{\tau,m,N_1,N_2,N_3} = X_m\beta_\tau + g(\theta_\tau;N_1,N_2,N_3) + \varepsilon_{\tau m} \tag{4}$$

The first term represents market demand characteristics that affect firm profits (note that the effect of X_m is allowed to vary by type). The $g(\theta_\tau; N_1, N_2, N_3)$ portion of the profit function captures the effects of competitors, with N_1, N_2, and N_3 representing the number of competing firms of each type. Parameters in the $g(\theta_\tau; N_1, N_2, N_3)$ function can distinguish between the effects on profits of same-type firms and the competitive effects of firms of each of the different types. The set of θ parameters can also be specified to capture the incremental effects of additional firms of each type. Note that the parameter vector θ varies across types; this allows the competitive effects to potentially differ by type. The estimates reported in the following section reflect the following specification of the competitive-effect dummy variables:[16]

[12] If entry costs are sunk, there may be a meaningful distinction between inferences drawn from new entry, continued operation of incumbents, and exiting firms. Bresnahan and Reiss (1994) expanded on their original model in a paper that distinguished between entry and exit thresholds in order to provide information about the extent of sunk costs. It would be difficult to adapt their approach in markets with heterogeneous competitors.

[13] Cetorelli (2002) estimates a similar model for depository institutions. That paper, which does not distinguish between types of depository institution, finds decreasing incremental effects of additional competitors which is consistent with our findings within each type.

[14] As such, we cannot specifically address the potential heterogeneous impact of particular competitors within type—for example, whether some multimarket banks have more of a competitive effect than others. See Berry (1992), Ciliberto and Tamer (2005), and Andrews, Berry, and Jia (2004) for examples of endogenous product choice models that allow for heterogeneity among all potential entrants.

[15] This specification of the profit function was chosen primarily to make the estimation tractable. Following Berry (1992) and Bresnahan and Reiss (1991), it can be interpreted as the log of a demand (market size) term multiplied by a variable profits term that depends on the number (and product types, in this case) of market competitors. There are no firm-specific factors in the profit function. The error term represents unobserved payoffs from operating as a particular type in a given market. It is assumed to be additively separable, independent of the observables (including the number of market competitors), and identical for each firm of the same type in a given market.

[16] The goal is to make the specification of the competitive effects as flexible as possible, while maintaining estimation feasibility. For example, in the cases where the data represent the "number" of competitors, we implicitly assume that the incremental effect of each additional competitor is the same. The specification also reflects the maximum number of institutions of each type, as discussed in section IVA.

$$\begin{aligned} g_M = {} & \theta_{MM1} \times \textit{presence of first multimarket bank competitor} \\ & + \theta_{MM2} \times \textit{presence of second multimarket bank competitor} \\ & + \theta_{MM3} \times \textit{number of additional multimarket bank competitors} \\ & + \theta_{MS1} \times \textit{presence of first single-market bank competitor} \\ & + \theta_{MS2} \times \textit{number of additional single-market bank competitors} \\ & + \theta_{MT1} \times \textit{presence of first thrift competitor} \\ & + \theta_{MT2} \times \textit{number of additional thrift competitors} \end{aligned} \tag{5}$$

$$\begin{aligned} g_S = {} & \theta_{SS1} \times \textit{presence of first single-market bank competitor} \\ & + \theta_{SS2} \times \textit{presence of second single-market bank competitor} \\ & + \theta_{SS3} \times \textit{presence of third single-market bank competitor} \\ & + \theta_{SM1} \times \textit{presence of first multimarket bank competitor} \\ & + \theta_{SM2} \times \textit{number of additional multimarket bank competitors} \\ & + \theta_{ST1} \times \textit{presence of first thrift competitor} \\ & + \theta_{ST2} \times \textit{number of additional thrift competitors} \end{aligned} \tag{6}$$

$$\begin{aligned} g_T = {} & \theta_{TT1} \times \textit{presence of first thrift competitor} \\ & + \theta_{TT2} \times \textit{presence of second thrift competitor} \\ & + \theta_{TM1} \times \textit{presence of first multimarket bank competitor} \\ & + \theta_{TM2} \times \textit{number of additional multimarket bank competitors} \\ & + \theta_{TS1} \times \textit{presence of first single-market competitor} \\ & + \theta_{TS2} \times \textit{number of additional single-market competitors} \end{aligned} \tag{7}$$

We specify the unobserved part of profits, $\varepsilon_{\tau m}$, to follow an independent standard trivariate normal distribution. As such, there is no implied correlation of among the individual elements of (ε_M, ε_S, ε_T) within a given market, and the variance of the unobservables is the same for all types. These assumptions could potentially affect the parameter estimates and their interpretations (for example, market-level correlation of unobservables could be picked up in certain θ parameters); so, we have taken care to verify that these error term assumptions are not driving our main results.[17] To proceed, we need to make an assumption about the nature of the entry process. We will start by assuming that there are three possible types of depository institution; that could operate in a given market—multimarket bank (M), single-market bank (S), or thrift (T). Abstracting from differences among firms of the same type, firms that do enter market m earn $\pi_{\tau m}(M, S, T)$, where τ is the product type of the firm and the ordered triple (M, S, T) represents the number and product types of all the competitors that also operate in market m.[18] Firms that do not enter earn zero.

We estimate the model assuming that the observed outcome is arrived at as if identical potential entrants were playing a Stackelberg game. In such a specification, players sequentially make irrevocable decisions about entry and product choice before the next firm plays. As they make these decisions, firms anticipate that potential competitors will subsequently make entry and product choice decisions

[17] In the case of the covariance assumption, the error term covariances would be separately identified from the "cross-type" θ parameters based on observations with few market participants (that is, where the θ parameters would not appear in the likelihood-defining inequalities). Since we do have some useful observations, we estimated a version with a free covariance parameter and found it to be very close to zero. Our data, unfortunately, do not allow us to separately identify the relative variances. However, we can make similar inferences based on different assumptions regarding the relative variances across types (though this does cause a rescaling of the parameter estimates).

[18] We assume that firms optimize on a market-by-market basis, which may be somewhat less realistic for multimarket banks (it is conceivable that such a bank might operate in an individual market to broaden its coverage, even if that market is not individually profitable to operate in). By not analyzing the larger markets that would be more attractive for this purpose, difficulties caused by this difference should be mitigated.

once the earlier movers have committed to their choice.[19] While this is clearly an abstraction, this Stackelberg game has the attractive feature that the highest-profit types will have the largest presence in equlibrium. As a result, this game's outcome is observationally equivalent to what would obtain if firms' types were fixed and they played a long-run, repeated simultaneous move entry/exit game, where the later entry of a higher-profit type would likely precipitate the subsequent exit of a competitor that is no longer profitable as a result of the entry.[20] Of course, this assumes that our observations represent something resembling a long-run equilibrium across our cross section of markets. We will explore the stability of our estimates by comparing the results in two separate periods, in an effort to discern the impact of this modeling choice.

For this game, a Nash Equilibrium can be represented by an ordered triple (*M, S, T*) for which the following inequalities are satisfied:

$$\begin{array}{ll} \pi_M(M-1,S,T) > 0 & \pi_M(M,S,T) < 0 \\ \pi_S(M,S-1,T) > 0 & \pi_S(M,S,T) < 0 \\ \pi_T(M,S,T-1) > 0 & \pi_T(M,S,T) < 0 \end{array} \quad (8)$$

and

$$\begin{array}{l} \pi_M(M-1,S,T) > \pi_S(M-1,S,T) \\ \pi_M(M-1,S,T) > \pi_T(M-1,S,T) \\ \pi_S(M,S-1,T) > \pi_M(M,S-1,T) \\ \pi_S(M,S-1,T) > \pi_T(M,S-1,T) \\ \pi_T(M,S,T-1) > \pi_M(M,S,T-1) \\ \pi_T(M,S,T-1) > \pi_S(M,S,T-1) \end{array} \quad (9)$$

As long as we assume that an additional market participant always decreases profits and that the decrease is larger if the market participant is of the same product type, a unique equilibrium exists.[21]

[19] A natural alternative is a simultaneous move game; however, it has been well established that such a game has multiple equilibria, which precludes straightforward econometric estimation (see Tamer, 2003). New methodologies that are currently being developed to estimate in the presence of multiple equilibria (e.g., Andrews, Berry, & Jia, 2004 and Ciliberto & Tamer, 2004) remain beyond the scope of this paper. We proceed with the Stackelberg assumption, in part relying on the finding in Mazzeo (2002) that parameter estimates are very similar across various game formulations that generate unique equilibria.

[20] Long-run, dynamic equilibrium models of entry and exit have been proposed, but have not yet been successfully estimated. See Pakes (2003) for a discussion of recent progress in this area.

[21] Mazzeo (2002) contains proofs of existence and uniqueness. The inequalities in equation (8) are not sufficient to guarantee uniqueness since more than one outcome may satisfy them simultaneously. The inequalities in equation (9) represent a mechanism that selects from those outcomes that satisfy the inequalities in equation (8). Then, since the equilibrium is unique, the sum of the probabilities for all market configurations always equals one. Note that the ordered triple represents the product types of competing firms (not including itself). For example, for a multimarket bank in market (*M, S, T*), the relevant ordered triple is (*M−1, S, T*); for a thrift, it is (*M, S, T−1*).

Under the specification described above, the inequalities corresponding to exactly one of the possible ordered-triple market structure outcomes are satisfied for every possible realization of (ε_M, ε_S, ε_T) based on the data for the market in question and values for the profit function parameters. A predicted probability for each of the possible outcomes is calculated by integrating $f(\varepsilon_M, \varepsilon_S, \varepsilon_T)$ over the region of the (ε_M, ε_S, ε_T) space corresponding to that outcome. Maximum likelihood selects the profit function parameters that maximize the probability of the observed market configurations across the data set. The likelihood function is

$$L = \prod_{m=1}^{M} \text{Prob}[(M,S,T)_m^o], \quad (10)$$

where $(M, S, T)_m^o$ is the observed configuration of firms in market *m*—its probability is a function of the Stackelberg solution concept, the parameters and the data for market *m.* For example, if $(M, S, T)^o = (1,1,1)$ for market *m,* the contribution to the likelihood function for market *m* is Prob [(1,1,1)].[22]

IV. Results

A. *Sample and Data*

Estimating the endogenous market structure model outlined in the previous section requires information on the operating depository institutions and demographic characteristics in a cross section of markets. As described in section II, we characterize geographic markets in this industry as "local." Specifically, we define markets with the following goals in mind: (1) consumers in the defined geographic markets should not typically use depository institutions outside of their area and (2) distinct or overlapping submarkets should not exist within the defined geographic markets. To the extent these conditions are met, we can be more confident that the demographic characteristics of these areas reflect the actual market for the institutions in our sample and that the competitive effects are accurately measured.

While the literature cited in section II has typically used counties to delineate geographic markets (outside of MSAs), such a definition would be inappropriate if political boundaries do not represent meaningful economic distinctions. Instead, we use labor market areas (LMAs), defined by the the Bureau of Labor Statistics to represent integrated economic areas, that are based on commuting patterns between counties. Contiguous counties are combined into a single LMA if at least 15% of the workers from one county

[22] Analytically computing the probability of each outcome is exceedingly complex in the case of three product types. As a result, simulation techniques are used in estimation. The details of the simulation method are available in a technical appendix from the authors upon request.

TABLE 1.—MARKET CONFIGURATIONS

		Multimarket								
		0	1	2	3	4	5	6+	*Total*	
Single-market	0	13	83	95	95	62	31	34	*413*	Thrifts = 0
	1	28	72	80	56	37	27	19	*319*	
	2	28	39	41	32	25	13	18	*196*	
	3	8	7	14	20	12	3	7	*71*	
	4+	2	11	7	5	6	6	13	*50*	
	Total	*79*	*212*	*237*	*208*	*142*	*80*	*91*	*1,049*	
Single-market	0	4	9	22	40	34	30	29	*168*	Thrifts = 1
	1	5	28	24	32	24	18	34	*165*	
	2	10	10	16	25	12	14	19	*106*	
	3	1	8	9	9	15	8	16	*66*	
	4+	3	5	12	8	16	13	18	*75*	
	Total	*23*	*60*	*83*	*114*	*101*	*83*	*116*	*580*	
Single-market	0	0	5	9	10	6	9	15	*54*	Thrifts = 2
	1	1	2	4	10	10	11	14	*52*	
	2	1	2	6	8	3	5	12	*37*	
	3	0	1	1	5	2	3	9	*21*	
	4+	1	0	1	5	5	2	7	*21*	
	Total	*3*	*10*	*21*	*38*	*26*	*30*	*57*	*185*	
Single-market	0	0	0	1	2	8	3	6	*20*	Thrifts = 3+
	1	0	0	1	5	3	1	6	*16*	
	2	0	0	0	1	1	2	6	*10*	
	3	0	0	0	0	1	0	6	*7*	
	4+	0	0	0	4	2	1	10	*17*	
	Total	*0*	*0*	*2*	*12*	*15*	*7*	*34*	*70*	

commute for work to the other. Using LMAs gives us more confidence that two neighboring markets are distinct and satisfy the first criterion above. To accomplish (2), we eliminated all urbanized areas (MSAs) and larger rural areas (LMAs with more than 100,000 residents in 2000); these are more likely to contain distinct submarkets. Our focus on rural markets also reflects the fact that many of the mergers that raise competitive concerns with regulators do so because of their effect on these smaller markets.[23]

To construct the dependent variable—the number of institutions of each of the three types within the LMA—we use data from two sources. The number of multimarket and single-market banks operating in each LMA was obtained from the FDIC summary of deposits. A bank was classified as a single-market bank (in a given market) if more than 80% of its deposits are received from branches in that market. Otherwise, the bank was classified as a multimarket bank.[24] The number of thrifts operating in each LMA was obtained from the Office of Thrift Supervision's Branch Office Survey. Table 1 shows the distribution of firm configurations among the LMA markets in our data set. Each panel of the table represents a particular number of thrifts in the market, with the rows and columns of each panel referring to single-market banks and multimarket banks, respectively. The numbers in the table represent the number of markets in which the operating firms follow the given configuration—for example, there are 72 markets that include one multimarket bank, one single-market bank, and zero thrifts.[25]

The following variables were included in X, the vector of exogenous market factors that may also affect the profitability of financial institutions across the LMAs in the data set: (1) the number of farms; (2) the number of nonfarm establishments; (3) population; (4) per capita income; and (5) the housing unit occupancy rate. These variables are intended to capture market size—the demand for the services of banks and thrifts—in each market. The sources for these variables are the Agricultural Census, the Bureau of Economic Analysis, and the Census Bureau. Each X-variable was rescaled by dividing each observation by the mean of that variable. The transformed variables all have a mean of one, which aids in the estimation. Table 2 presents summary statistics for the unscaled variables for both 2000

[23] Smaller markets raise the majority of antitrust issues in bank merger analysis because they are more concentrated than larger urban markets. For example, the average HHI for all rural counties was 3,765 and 3,725 for 2000 and 2003, respectively, while the average HHI for all MSAs was 1,628 and 1,608 for 2000 and 2003. (All numbers reflect a 50% weighting of thrift deposits. Sources are the FDIC's Summary of Deposits and the Office of Thrift Supervision's Survey of Savings.)

[24] This definition is consistent with previous papers that distinguish "single-market" banks. Note that a bank with 90% of its deposits in market A and 10% in market B would, according to this definition, be classified as a single-market bank in market A and a multimarket bank in market B. This reflects the view that the decision to operate in market B would be significantly more affected by the role of the branch in market B in the bank's overall network, as opposed to in market A where the presence of any branches in market B would be less important.

[25] We have collapsed the distribution of markets from above for each of the three categories—that is, all markets with three or more thrifts are treated as if they have exactly three, etc. This reduces the complexity of the estimation without influencing the results; other studies have found that incremental competitive effects die out after three or four additional competitors (e.g., Bresnahan & Reiss, 1991; Cetorelli, 2002).

TABLE 2.—MARKET SIZE VARIABLES

Variable	2000 Sample				2003 Sample			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Farms	617	452	0	4,302	674	494	1	4,363
Establishments	542	508	1	4,855	544	518	0	4,981
Population	23,299	19,944	65	99,428	23,555	20,509	64	141,409
Per capita income	20,943	3,980	5,475	69,960	22,552	4,058	5,540	71,457
Occupancy rate	0.83	0.10	0.23	0.97	0.83	0.10	0.23	0.97

N = 1,884

Because of changes in the agricultural census, the number-of-farms variable is measured slightly differently for 2000 and 2003. For use in the subsequent estimations, these variables are scaled by their respective means (within year—making the two sets of estimates comparable). The variables used for 2003 are the most recent year available (occupancy rate was last reported in 2000).

and 2003. Finally, we examined potential differences among our markets by noting which of the LMAs were adjacent to MSAs. Below, we compare competition among institutions in the more and less rural markets in the sample.

B. *Baseline Estimates*

Table 3 presents the baseline maximum likelihood estimates from our three-type endogenous market structure model using data from 2000. The estimated parameters allow us to compute the relative payoffs for each type of institution based on particular market conditions and in different competitive situations. For example, consider monopolists (all θ parameters multiplied by zero) operating in markets with sample mean values for all of the X-variables (all β parameters multiplied by one). In this scenario, a multimarket bank would expect to earn 2.97, while a single-market bank would expect to earn 1.15, and a thrift would expect to earn 0.02.[26] These figures represent predicted payoffs, and are normalized based on the standard normal assumption of the market-specific unobservables. We can use the estimates, therefore, to compare the relative profitability of the various types and to check whether the operating threshold is met—that is, if predicted payoffs are positive.

The estimated coefficients on the X-variables are (with one exception) positive, reflecting that more institutions of each type are likely to operate when these market, size proxies are positive.[27] Differences in the estimated β parameters across types reflect how these various measures might stimulate one type of institution more than another. Single-market banks, for example, do relatively better than multimarket banks and thrifts in markets with more farms (0.71 vs. 0.56 and 0.29, respectively), suggesting that single-market banks have a comparative advantage serving consumers in more agricultural areas. In contrast, multimarket banks do better in markets with more business establishments (1.09 vs. 0.48 and 0.39, for single-market banks and thrifts, respectively).

[26] For example, for the multimarket monopolist, predicted payoffs = (−1.10 + 0.56 + 1.09 + 0.13 + 0.70 + 1.59) = 2.97.

[27] The one exception is the effect of population on single-market bank profits, which is estimated to be negative. This may suggest that single-market banks have a harder time servicing large populations or, alternatively, are associated with more personalized service in smaller markets.

The top panel of table 3 presents the parameters (θ_τ) that capture the amount by which the presence of particular competitors reduces payoffs for each type of institution. For example, the estimated θ_{MM1} equals −1.10; therefore, the estimated payoff to a multimarket bank in a "sample mean" market where the only competition is from another multimarket bank is (2.97 − 1.10) = 1.87. Within-type competition appears to be tightest for thrifts (θ_{TT1} equals −1.19) and lowest for single-market banks (θ_{SS1} equals −0.93). In all cases, the incremental effect of additional same-type competitors decreases as the number of same-type competitors increases. We are particularly interested in the cross-type effects measuring how firms of one type affect the profits of other-type firms. Crucially, in all cases the effects of same-type competitors are greater than different-type institutions. We can measure differentiation by comparing the estimated θ-parameters; for example, the first single-market bank has about half of (−0.55) the effect of the first multimarket bank competitor (−1.10) on multimarket bank profits. This comparison illustrates how product differentiation translates into increased profitability: if the multimarket bank's competitor in the previous example were a single market bank, payoffs would be higher: 2.97 − 0.55 = 2.42 (vs. 2.97 − 1.10 = 1.87). This substantial product differentiation advantage is present in the estimates across all three types of financial institutions in our data set.

Looking across the types, multimarket banks and single-market banks appear to affect each other more than thrifts affect either. Interestingly, while the first thrift competitor has almost no competitive effect on multimarket (or single-market) bank profits, additional thrifts reduce multimarket bank profits by about a third (−0.27 vs. − 0.75) as much as additional multimarket bank competitors. It is possible that intense competition between thrifts (when there is more than one) results in outcomes that attract consumers away from banks. There may also be differences across markets—markets that are relatively more attractive to thrifts (that is, markets with larger and wealthier populations) may also be those markets where thrifts are viewed by consumers as good substitutes for banks. Either way, thrifts appear to be competitively distinct from both multimarket and single-market banks in most cases.

While the model's estimates imply that each type of institution prefers to face a competitor of a different type,

TABLE 3.—PARAMETER ESTIMATES FROM ENDOGENOUS MARKET STRUCTURE MODEL FOR 2000

	Estimate	Std Error
COMPETITIVE EFFECTS		
Effect of first multimarket competitor on multimarket profits	−1.0970	0.0646
Effect of second multimarket competitor on multimarket profits	−0.8193	0.0387
Effect of each additional multimarket competitor on multimarket profits	−0.7452	0.0195
Effect of first single-market on multimarket profits	−0.5453	0.1037
Effect of each additional single-market on multimarket profits	−0.1103	0.0513
Effect of first thrift on multimarket profits	−0.0329	0.1345
Effect of each additional thrift on multimarket profits	−0.2745	0.0920
Effect of first single-market competitor on single-market profits	−0.9291	0.0357
Effect of second single-market competitor on single-market profits	−0.7228	0.0346
Effect of third single-market competitor on single-market profits	−0.5552	0.0375
Effect of first multimarket on single-market profits	−0.3696	0.1706
Effect of each additional multimarket on multi-market profits	−0.1098	0.0513
Effect of first thrift on single-market profits	−7.E-06	0.1665
Effect of each additional thrift on single-market profits	−0.1388	0.1596
Effect of first thrift competitor on thrift profits	−1.1889	0.0464
Effect of second thrift competitor on thrift profits	−0.8918	0.0627
Effect of first multimarket on thrift profits	−0.0309	0.1768
Effect of each additional multimarket on thrift profits	−0.0149	0.0691
Effect of first single-market on thrift profits	−0.1214	0.1633
Effect of each additional single-market on thrift profits	−0.0004	0.1031
MULTIMARKET PROFIT SHIFTERS		
Intercept	−1.1031	0.2721
Farms	0.5621	0.0568
Establishments	1.0887	0.0748
Population	0.1258	0.0801
Per Capita Income	0.7045	0.1443
Occupancy Rate	1.5923	0.2609
SINGLE-MARKET PROFIT SHIFTERS		
Intercept	−2.2107	0.3328
Farms	0.7099	0.0570
Establishments	0.4843	0.1032
Population	−0.3261	0.0922
Per Capita Income	0.5118	0.2205
Occupancy Rate	1.9770	0.3057
THRIFT PROFIT SHIFTERS		
Intercept	−2.0512	0.3262
Farms	0.2901	0.0957
Establishments	0.3871	0.0950
Population	0.1618	0.0936
Per Capita Income	0.8546	0.1842
Occupancy Rate	0.3763	0.3482

N = 1,884
Log likelihood = −7,192.63
The profit shifters reflect data that have been scaled to facilitate estimation. See section IVA for details.

we nonetheless observe configurations involving multiple firms of the same type. Such cases can be explained by the interaction of the demand shifters (the β*s*) and the competitive effects (the θ*s*) as illustrated for Baker County, Florida in table 4. The grid at the bottom of the table indicates the expected payoffs for each product type for the market's observed configuration (3,0,0) and for relevant alternatives. In this case, an undifferentiated market structure occurs because the tougher competition is offset by the advantage of multimarket banks, given the demographic characteristics of Baker County (in particular, note that a multimarket bank in a (3,0,0) configuration is more profitable than a single-market bank in a (2,1,0) configuration. While differentiation is a profitable strategy, all else equal, consumer demand for particular product types is also critical in determining market structure.

TABLE 4.—BAKER COUNTY, FLORIDA, EXAMPLE

2000 Demographic Variables	*Baker County*	*Sample Mean*
Population	22,388	23,299
Per capita income	19,056	20,943
Farms	157	617
Establishments	278	542
Occupancy rate	0.93	0.83

Expected Profits at Relevant Configurations

Configuration	$E(\Pi_M)$	$E(\Pi_S)$	$E(\Pi_T)$
(3,0,0)*	0.21	0	0
(3,1,0)	−0.34	−0.02	0
(3,0,1)	0.18	0	−0.49
(2,1,0)	0.41	0.09	0
(2,0,1)	0.92	0	−0.47

*Indicates the observed configuration. The data listed above were multiplied by the parameter estimates in table 3 to compute the expected profitability figures for each possible configuration.

Table 5.—Parameter Estimates from Endogenous Market Structure Model by Geographic Orientation

	Rural Markets		Border Markets	
	Estimate	Std Error	Estimate	Std Error
COMPETITIVE EFFECTS				
Effect of first multimarket competitor on multimarket profits	−1.1770	0.0762	−1.0191	0.0976
Effect of second multimarket competitor on multimarket profits	−0.8625	0.0548	−0.7956	0.0569
Effect of each additional multimarket competitor on multimarket profits	−0.7689	0.0309	−0.7375	0.0286
Effect of first single-market on multimarket profits	−0.5666	0.1210	−0.5376	0.1666
Effect of each additional single-market on multimarket profits	−0.1317	0.0623	−0.0511	0.0861
Effect of first thrift on multimarket profits	−0.0019	0.1469	−0.0818	0.2019
Effect of each additional thrift on multimarket profits	−0.3204	0.1268	−0.2250	0.1402
Effect of first single-market competitor on single-market profits	−0.9429	0.0436	−0.9258	0.0490
Effect of second single-market competitor on single-market profits	−0.7294	0.0447	−0.7252	0.0479
Effect of third single-market competitor on single-market profits	−0.6030	0.0634	−0.5286	0.0483
Effect of first multimarket on single-market profits	−0.3366	0.1948	−0.4299	0.2922
Effect of each additional multimarket on single-market profits	−0.1177	0.0424	−0.1429	0.0890
Effect of first thrift on single-market profits	−0.0003	0.1582	−0.0609	0.3897
Effect of each additional thrift on single-market profits	−0.0748	0.1329	−0.1600	0.2912
Effect of first thrift competitor on thrift profits	−1.2665	0.0744	−1.1540	0.0653
Effect of second thrift competitor on thrift profits	−0.7848	0.1050	−0.9623	0.0850
Effect of first multimarket on thrift profits	−0.0020	0.2459	−0.3094	0.2564
Effect of each additional multimarket on thrift profits	−0.0096	0.0785	−0.0315	0.1026
Effect of first single-market on thrift profits	−0.0087	0.1649	−0.2591	0.3198
Effect of each additional single-market on thrift profits	−1.E-14	0.1018	−0.0232	0.2094
MULTIMARKET PROFIT SHIFTERS				
Intercept	−1.2407	0.3954	−1.1503	0.4168
Farms	0.7568	0.0845	0.4311	0.0859
Establishments	0.9699	0.1392	1.0870	0.1103
Population	0.3147	0.1620	0.0745	0.1103
Per capita income	0.6799	0.2195	0.9947	0.2577
Occupancy rate	1.6243	0.3617	1.4790	0.4119
SINGLE-MARKET PROFIT SHIFTERS				
Intercept	−2.6047	0.4205	−2.3485	0.5201
Farms	0.7133	0.0527	0.7226	0.0970
Establishments	0.3703	0.1420	0.5788	0.1550
Population	−0.1363	0.1740	−0.3785	0.1414
Per capita income	0.8166	0.2533	0.4000	0.3730
Occupancy rate	2.0300	0.3975	2.3106	0.4450
THRIFT PROFIT SHIFTERS				
Intercept	−2.1350	0.4488	−1.9369	0.5641
Farms	0.3104	0.1092	0.3187	0.1700
Establishments	0.4964	0.1064	0.2674	0.1839
Population	0.0320	0.1521	0.3154	0.1599
Per capita income	0.7411	0.2962	1.0220	0.2494
Occupancy rate	0.4918	0.4190	0.4031	0.6510
Number of observations	829		1,055	
Log likelihood	−3,084.1		−4,086.2	

The profit shifters reflect data that have been scaled to facilitate estimation. See section IVA for details.

C. *Border Markets vs. Rural Markets*

An important assumption of our empirical model is that geographic markets are sufficiently local, such that the LMA is an appropriate market definition. In addition, we assume that the markets in our sample are comparable in the sense that the map from the *X*-variables to equilibrium firm configurations is consistent across markets. We explored potential differences relating to market geography by splitting our sample in two, defining markets as either "rural" or "border." LMAs were considered rural if they did not share a border with an MSA; if they did share a border with an MSA, they were placed in the border market category. Our sample consists of 829 rural markets and 1,055 border markets. We reestimated the model on each subsample. Table 5 presents the results for the rural and border markets, respectively.

A likelihood ratio statistic can be used to test the hypothesis that the two sets of markets are equivalent. Given our estimation results, we fail to reject this null hypothesis.[28] This failure to reject gives us additional confidence that our two subsamples are sufficiently similar to one another. It also suggests that the LMA market definition is appropriate. We might otherwise expect that LMAs near urban areas would be quite different to the extent that the institutions within these LMAs might be forced to interact with banks and thrifts from a more

[28] The likelihood ratio statistic testing the null hypothesis that the two sets of markets are equivalent is constructed by subtracting the log likelihood for the original model from the sum of the log likelihoods for the two subsamples, and then multiplying by two. The statistic is 44.73. With 38 degrees of freedom, we are unable to reject the null hypothesis that the two subsamples are equivalent at the 20% level of significance.

TABLE 6.—MARKET TRANSITIONS BETWEEN 2000 AND 2003

		2003 Market Structures			
		Same Total Institutions		Different Total Institutions	
Total Institutions in 2000	Number of Markets	Same Product-Type Configuration	Product-Type Switches	Net Entry	Net Exit
0	13	13	0	0	0
1	115	94	8	12	1
2	209	156	24	26	3
3	288	198	42	36	12
4	255	148	44	38	25
5	235	120	43	47	25
6	233	124	52	31	26
7	170	69	35	33	33
8	140	61	18	21	40
9	90	36	7	19	28
10	75	36	11	10	18
11	37	16	1	4	16
12	14	7	0	1	6
13	10	7	0	0	3
Total	*1,884*	*1,085*	*285*	*278*	*236*

intense competitive environment. Instead, our findings suggest that local geographic markets appear to remain distinct no matter their relative proximity to urban areas.

As the results of the likelihood ratio test would suggest, the estimated parameters in the rural and border subsamples are quite similar. The only substantial difference that appears relates to the competitive effects of thrifts across the two estimations. The parameter values in table 5 suggest that thrifts are less competitively distinct in border markets than in rural markets. The more intense competition goes both directions—thrifts have a greater effect on multimarket and single-market bank profits, and each type of bank has a greater effect on the profits of thrifts. While these results are suggestive of a subtle difference in the competitive effects of thrifts and may be worth further study, the standard errors associated with these parameter estimates are large enough to question their statistical significance.

D. *Evolution of Competition Parameters*

The baseline estimates presented in table 3 were computed using data from market observations in 2000. Since the econometric model is predicated on the observed product-type configurations representing a cross section of market equilibria, 2000 was a convenient date—it was several years after many of the regulatory prohibitions against bank expansion had been removed and in a relatively quiet period of bank merger activity.[29] Still it is informative to revisit the sample in a later period, both to investigate the equilibrium assumption on which the model is based and to document any changes in the estimated θ_T parameters over time. To perform the comparison, we reconstituted the data set using observations from the same geographic markets in 2003.

Table 6 compares the market structure observations in 2003 with our 2000 data set. We have classified institutions using the same definitions as were used for the 2000 sample. This generated comparable product-type configurations for each market. The raw data demonstrate considerable stability in terms of market structures over this period—approximately 60% of the observations have the same product-type configurations in both 2000 and 2003.[30] The first column in table 6 lists the counts of markets in 2000 that contain the corresponding total (all three types) institutions. The next two columns indicate those markets with the same number of total institutions in 2003, starting with those that have the same product-type configuration, followed by those in which product types shifted in the interim. The next two columns show the number of markets in which there was net entry and net exit, respectively. The estimation of the empirical model will indicate whether these relatively few market structure changes have been consistent with the importance of product differentiation to firm profitability.

Table 7 presents the estimates using the 2003 data. Just as in table 3, the most striking feature in the table is the relative difference between the θ-parameters representing the effects of same-type and different-type competitors. Comparing the parameter estimates between the two tables, in fact, indicates vast similarity across the board. The estimates from 2003 appear to confirm the role that product differentiation plays in determining market structure among the retail

[29] There were about half as many bank and thrift mergers in the United States between 1999 and 2003 as there were between 1994 and 1998. See Pilloff (2004).

[30] Given our definitions, this does not guarantee that there has been no change during the period at the firm level. For example, if a (1,1,1) market in 2000 saw one single-market bank exit and a different one enter by 2003, it would appear to be stable over the period in terms of market structure. Since we do not focus on institution-level profitability, we abstract from such changes in this analysis.

TABLE 7.—PARAMETER ESTIMATES FROM ENDOGENOUS MARKET STRUCTURE MODEL FOR 2003

	Estimate	Std Error
COMPETITIVE EFFECTS		
Effect of first multimarket competitor on multimarket profits	−1.1565	0.0740
Effect of second multimarket competitor on multimarket profits	−0.8648	0.0417
Effect of each additional multimarket competitor on multimarket profits	−0.7695	0.0193
Effect of first single-market on multimarket profits	−0.4990	0.0903
Effect of each additional single-market on multimarket profits	−0.0847	0.0000
Effect of first thrift on multimarket profits	−0.0012	0.1013
Effect of each additional thrift on multimarket profits	−0.4206	0.0773
Effect of first single-market competitor on single-market profits	−0.9219	0.0336
Effect of second single-market competitor on single-market profits	−0.7431	0.0367
Effect of third single-market competitor on single-market profits	−0.4690	0.0365
Effect of first multimarket on single-market profits	−0.4257	0.1704
Effect of each additional multimarket on single-market profits	−0.1026	0.0327
Effect of first thrift on single-market profits	1.E-04	0.3410
Effect of each additional thrift on single-market profits	−0.1418	0.2351
Effect of first thrift competitor on thrift profits	−1.1666	0.0500
Effect of second thrift competitor on thrift profits	−0.9253	0.0726
Effect of first multimarket on thrift profits	−0.0330	0.2300
Effect of each additional multimarket on thrift profits	−0.0004	0.0548
Effect of first single-market on thrift profits	−0.0352	0.2957
Effect of each additional single-market on thrift profits	−4.E-09	0.1880
MULTIMARKET PROFIT SHIFTERS		
Intercept	−1.3698	0.2734
Farms	0.5134	0.0439
Establishments	1.5091	0.0830
Population	−0.1145	0.0858
Per capita income	0.6404	0.1314
Occupancy rate	2.1074	0.2487
SINGLE-MARKET PROFIT SHIFTERS		
Intercept	−2.4586	0.3475
Farms	0.6989	0.0573
Establishments	0.5244	0.1124
Population	−0.4427	0.0933
Per capita income	0.5302	0.2414
Occupancy rate	2.1966	0.2796
THRIFT PROFIT SHIFTERS		
Intercept	−2.4681	0.4049
Farms	0.2160	0.1523
Establishments	0.3176	0.1322
Population	0.1997	0.1142
Per capita income	0.9254	0.2145
Occupancy rate	0.6014	0.4800

N = 1,884
Log likelihood = −6,865.3
The profit shifters reflect data that have been scaled to facilitate estimation. See section IVA for details.

depository institutions studied. The inferences made do not depend on assumptions regarding timing of the sample with respect to continued market evolution. While this does suggest that the underlying profitability associated with product differentiation should help to maintain community banks and thrifts, the underlying preferences of consumers are also crucially important. In fact, we have been able to isolate particular demographic characteristics associated with product-type configurations dominated by multimarket banks. To the extent that policymakers have an interest in maintaining the viability of traditional institutions, policies targeted toward fostering consumer demand for their differentiated services may be the most effective.

E. *Market Structure Implications of Product Differentiation*

An additional implication of our finding that product differentiation generates significantly higher profits is that fewer institutions would operate in a counterfactual scenario that permits only a single product type. Table 8 contains the results of an experiment that quantifies the difference between the market structures that we observe in 2003 and what we might see if multimarket banks were the only type of depository institution. Using the estimated parameters from table 7, we first back out the corresponding region of the multimarket bank unobservable $[\underline{\varepsilon}_m, \bar{\varepsilon}_m]$ for each market (given its product-type configuration and demographic data). We then calculate the number of hypothetical multimarket banks that would operate in each market, if these were the only type—a lower bound is constructed assuming that $\varepsilon_m = \underline{\varepsilon}_m$ and an upper bound assuming that $\varepsilon_m = \bar{\varepsilon}_m$. We also calculate the mean number of multimarket banks as the following: $E(M^*) = \int_{\underline{\varepsilon}_m}^{\bar{\varepsilon}_m} M^* (\varepsilon_m)\, dF\, (\varepsilon_m)$.

The rows of table 8 group the markets based on the total number of institutions observed in 2003, and the second

TABLE 8.—COUNTERFACTUAL EQUILIBRIUM CONFIGURATIONS WITHOUT SINGLE-MARKET BANKS OR THRIFTS

Firms in 2003	Number of Markets	(Actual Number of Firms in 2003—Number of Counterfactual Multimarket Banks) per market			Additional Banking Options Due to Single-Market Banks and Thrifts, total			Percent Reduction in Banking Options Under Counterfactual
		Lower Bound	Mean	Upper Bound	Lower Bound	Mean	Upper Bound	Mean
1	23	0.00	0.44	1.00	0	10.2	23	44%
2	97	0.32	0.69	1.22	31	66.9	118	34%
3	173	0.52	0.85	1.42	90	147.8	245	28%
4	172	0.73	0.97	1.46	125	166.7	251	24%
5	190	1.04	1.30	1.88	197	247.5	357	26%
6	195	1.23	1.52	2.11	240	296.2	412	25%
7	178	1.08	1.43	2.07	193	253.9	369	20%
8	138	1.05	1.55	2.57	145	213.4	354	19%
9	84	1.04	1.83	2.96	87	153.7	249	20%
10	79	1.41	2.44	3.68	111	192.5	291	24%
11	30	0.90	2.54	4.03	27	76.2	121	23%
12	15	0.93	3.29	4.87	14	49.4	73	27%
13	9	0.00	3.10	4.67	0	27.9	42	24%
Total	*1,383*				*1,260*	*1,902.3*	*2,905*	

The anlaysis is not performed for the 501 markets that did not contain any single-market banks or thrifts in 2003. The averages in columns three through five are computed the average across markets with the same number of firms in 2003.

column presents the number of markets with the corresponding number of total institutions. Note that 501 markets did not contain any single-market banks or thrifts and were therefore not included in the calculations.[31] We compute the lower bound, mean, and upper bound for the number of counterfactual multimarket banks that would operate in each of the remaining 1,383 markets. The third through fifth columns of the table represent the average difference between the total number of institutions in 2003 and the number of institutions (all multimarket banks) that would operate in our hypothetical scenario. The next three columns calculate the total implied reduction in banking options (the average difference multiplied by the corresponding number of markets).

The results indicate that the product differentiation represented by single-market banks and thrifts is sufficient to support between 1,260 and 2,905 additional banking options, relative to the hypothetical in which all institutions were multimarket banks.[32] The expected reduction in banking options (the "mean" columns of table 8) appears to be most severe for the smallest markets. Markets with one, two, or three institutions would have 30.6% fewer institutions operating in 2003 under the counterfactual no-differentiation scenario, while markets with four or more institutions would have only 22.9% fewer. Again, the welfare effects associated with our counterfactual exercise may be somewhat ambiguous.[33] However, the counterfactual exercise does demonstrate that differentiation opportunities provided by single-market banks and thrifts generate additional options from which rural customers may obtain retail depository services, at least through 2003.

V. Conclusions

In this paper, we employ a model of endogenous market structure and a data set of 1,884 rural banking markets to quantify the effects of differentiation among multimarket banks, single-market banks, and thrifts on competition between retail depository institutions. Our results demonstrate that competition between institutions of the same type is much greater than competition among different types. Furthermore, thrifts appear to be competitively distinct from banks of either type, despite regulatory changes that have removed many practical differences between them. Our results are robust to geographic differences across the markets in our data set (those that border MSAs are similar to those that do not), and the estimates of product differentiation remain stable in models run using data from 2000 and 2003. Finally, we show that the returns to product differentiation allow markets to support many more depository

[31] In addition, we expand our original specification to permit up to thirteen multimarket banks to enter a market. This ensures that we are not underestimating the counterfactual number of multimarket banks. Since no market had more than thirteen total institutions, we can be sure that we are not overestimating the effect of competition from single-market banks and thrifts on market structure. We use the estimated reduction in profit associated with each additional multimarket bank competitor beyond the second in the counterfactual exercise.

[32] Given the setup of the econometric model, the multimarket error is unbounded in markets with the minimum (zero) and maximum (six) multimarket banks in the dependent variable. This affects the counterfactual lower bound in the 61 markets with no multimarket banks and the counterfactual upper bound in the 365 markets with six multimarket banks in the 2003 product-type configuration. These are integrated out in the mean calculation, which we use for comparison purposes.

[33] In addition to the argument made by Petersen and Rajan (1995), that market power is associated with less credit-constrained firms, some have argued that market power is associated with higher service quality; see Dick (forthcoming).

institutions than in a hypothetical scenario with homogenous competitors.

The estimates from our empirical model illustrate and measure the effects of product differentiation on competition; in addition, they can be used to compare the policy outcomes associated with changes in demographic characteristics or market structure. While counterfactual exercises such as "how would the demand shifters have to change to induce a change in entry and market structure?" are relatively straightforward, applications for merger analysis may be more subtle. However, it is clear from the estimates that the impact on profitability will depend on the initial market structure and the product types of the merging institutions. For example, if a multimarket bank were to enter a local market by purchasing one of two single-market banks currently operating, competition would likely be reduced—as compared to a scenario in which a different multimarket bank were purchased. Our results suggest that regulators should consider heterogeneity in institution type rather than simply applying straightforward market concentration measures when analyzing the effects of mergers on individual local markets.[34]

Finally, our results should provide some comfort to those advocating for the survival of smaller community banks and thrifts in the face of multimarket bank expansion. The estimates indicate that there is a niche for single-market banks and thrifts in most local markets, and that this differentiated position continues over time. Furthermore, our counterfactual exercise suggests that the additional profitability generated through product differentiation allows markets to support a greater overall number of institutions as compared with a scenario in which only multimarket banks remain in the industry. While the most recent data indicate there are more options for consumers as a result, product differentiation itself does not guarantee continued existence of small banks and thrifts. Consumer tastes may certainly change in the future, and the returns to operating in that niche will be determined by those tastes.[35]

REFERENCES

Adams, Robert, Kenneth Brevoort, and Elizabeth Kiser, "Who Competes with Whom? The Case of Depository Institutions," *Journal of Industrial Economics* (forthcoming).

Amel, Dean, and Timothy Hannan, "Defining Banking Markets According to the Principles Recommended in the Merger Guidelines," *The Antitrust Bulletin* 45:3 (2000), 615–639.

Amel, Dean, and Martha Starr-McCluer, "Market Definition in Banking: Recent Evidence," *The Antitrust Bulletin* 47:1 (2002), 63–88.

Andrews, Donald, Steven Berry, and Panle Jia, "Confidence Regions for Parameters in Discrete Games with Multiple Equilibria, with an Application to Discount Chain Store Location," Yale University working paper (2004).

Berger, Allen, Nathan Miller, Mitchell Petersen, Raghuram Rajan, and Jeremy Stein, "Does Function Follow Organizational Form? Evidence from the Lending Practices of Large and Small Banks," *Journal of Financial Economics* 76:2 (2005), 237–269.

Berry, Steven, "Estimation of a Model of Entry in the Airline Industry," *Econometrica* 60:4 (1992), 889–917.

Biehl, Andrew, "The Extent of the Market for Retail Banking Deposits," *The Antitrust Bulletin* 47:1 (2002), 91–106.

Bresnahan, Timothy, and Peter Reiss, "Entry in Concentrated Markets," *Journal of Political Economy* 99:5 (1991), 977–1009.

——— "Measuring the Importance of Sunk Costs," *Annales D'Economie et de Statistique* 31 (1994), 183–217.

Brevoort, Kenneth, and Timothy Hannan, "Commercial Lending and Distance: Evidence from Community Reinvestment Act Data," *Journal of Money, Credit and Banking* (forthcoming).

Calem, Paul, and Gerald Carlino, "The Concentration/Conduct Reduction in Bank Deposit Markets," this REVIEW 73:2 (1991), 268–276.

Cetorelli, Nicola, "Entry and Competition in Highly Concentrated Banking Markets," *Economic Perspectives* 26:4 (2002), 18–27.

Ciliberto, Federico, and Elie Tamer, "Market Structure and Multiple Equilibria in Airline Markets," University of Virginia working paper (2004).

Cyrnak, Anthony, and Timothy Hannan, "Is the Cluster Still Valid in Defining Banking Markets? Evidence from a New Data Source," *The Antitrust Bulletin* 44:2 (1999), 313–331.

Dick, A. "Market Size, Service Quality and Competition in Banking," *Journal of Money, Credit and Banking* (forthcoming).

——— Nationwide Branching and Its Impact on Market Structure, Quality and Bank Performance," *Journal of Business* 79:2 (2002), 576–592.

Elliehausen, Gregory, and John Wolken, "Banking Markets and the Use of Financial Services by Households," *Federal Reserve Bulletin* 78:3 (1992), 169–181.

——— "Banking Markets and the Use of Financial Services by Small and Medium Sized Businesses," *Federal Reserve Bulletin* 76:10 (1990), 801–817.

Feinberg, Robert, "The Competitive Role of Credit Unions in Small Local Financial Markets," this REVIEW 83:3 (2001), 560–563.

Hannan, Timothy, and Robin Prager, "Do Substantial Horizontal Mergers Generate Significant Price Effects? Evidence from the Banking Industry," *The Journal of Industrial Economics* 46:4 (1998), 433–452.

——— The Competitive Implications of Multimarket Bank Branching," *Journal of Banking and Finance* 28:8 (2004), 1889–1914.

Heitfield, Erik, "What Do Interest Rate Data Say About the Geography of Retail Banking Markets?" *The Antitrust Bulletin* 44:2 (1999), 333–347.

Heitfield, Erik, and Robin Prager, "The Geographic Scope of Retail Deposit Markets," *Journal of Financial Services Research* 25:1 (2004), 37–55.

Kwast, Myron, Martha Starr-McCluer, and John Wolken, "Market Definition and the Analysis of Antitrust in Banking," *Antitrust Bulletin* 42:4 (1997), 973–995.

Mazzeo, Michael J. "Product Choice and Oligopoly Market Structure," *RAND Journal of Economics* 33:2 (2002), 221–242.

Pakes, Ariel, "Common Sense and Simplicity in Industrial Organization," *Review of Industrial Organization* 23:3–4 (2003), 193–215.

Petersen, Mitchell, and Raghuram Rajan, "Does Distance Still Matter? The Revolution in Small Business Lending," *Journal of Finance* 57:6 (2002), 2533–2570.

Petersen, M., and Raghuram Rajan, "The Effect of Credit Market Competition on Lending Relationships," *Quarterly Journal of Economics* 110:2 (1995), 407–443.

Pilloff, Steven, "Bank Merger Activity in the United States, 1994–2003," Board of Governors of the Federal Reserve System Staff Study, 176 (2004).

Pilloff, Steven, and Robin Prager, "Thrift Involvement in Commercial and Industrial Lending," *Federal Reserve Bulletin* 84:12 (1998), 1025–1037.

Radecki, Lawrence, "The Expanding Geographic Reach of Retail Banking Markets," *Federal Reserve Bank of New York Economic Policy Review* 4:2 (1998), 15–33.

Reiss, Peter, "Empirical Models of Discrete Strategic Choices," *American Economic Review* 86:2 (1996), 421–426.

[34] Note that the Federal Reserve Board and the Department of Justice differentiate between commercial banks and thrifts, but not between multimarket and single-market banks.

[35] In a similar vein, we have abstracted from the effect of credit unions in this paper. Though smaller in scale than both banks and thrifts, credit unions have nonetheless been shown to be somewhat competitive with banks along certain product lines. We plan to consider these institutions as well in future work.

Seim, Katja, “An Emprical Model of Entry with Endogenous Product-Type Choices,” *RAND Journal of Economics* (forthcoming).

Tamer, Elie, “Incomplete Simultaneous Discrete Response Model with Multiple Equilibria,” *Review of Economic Studies* 70:1 (2003), 147–167.

Toivanen, O., and M. Waterson, “Market Structure and Entry: Where’s the Beef?” *The Rand Journal of Economics* 36:3 (2005), 680–699.

Tokle, Robert, and Joanne Tokle, “The Influence of Credit Union and Savings and Loan Competition on Bank Deposit Rates in Idaho and Montana,” *Review of Industrial Organization* 17:4 (2000), 427–439.

U.S. v. Connecticut National Bank, 418 U.S. 656, 94 S.Ct. 2788, 41 L.Ed.2d. 1016 (1974).

U.S. v. Philadelphia National Bank, 374 U.S. 321, 83 S.Ct. 1715. 10 L.Ed.2d. 915 (1963).