Investment Strategies and Market Structure: An Empirical Analysis of Bank Branching Decisions

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ABSTRACT: We analyze the effects of market structure on the branching decisions of three types of depository institution: multimarket banks, single-market banks, and thrift institutions. Specifically, we consider branches as a sunk investment that potentially increases utility for consumers and examine how competition and product differentiation affect firms' decisions regarding whether to make such investments. We account for endogenous market structure using an equilibrium structural model, which corrects for bias caused by correlation in the unobservables that may drive market structure and branching activity. We estimate the model using data from over 1,750 concentrated rural markets. Our results demonstrate the importance of product differentiation, as (1) branches are strategic complements for firms of the same type, and (2) competition from multimarket banks is associated with denser branch networks for all types of firm while the opposite correlation holds when competitors are single-market banks or thrifts.

JEL classification: L11, L13, G21, G28
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I. Introduction

This paper examines the relationship between market structure and the investment decisions of firms. We are interested in a specific type of investment, one which requires sunk costs and potentially increases consumers' utility for a firm's products or services. A monopolist would choose the level of such an investment that balances its costs against its effect on demand. With competition, however, it is unclear whether investments would be strategic complements or strategic substitutes. To the extent that firms could use investments to deter entry or facilitate the exit of competitors, there may be an effect of investments on market structure, as well as the reverse.

In our application, we study the branch networks of financial institutions in concentrated retail banking markets. Over the past decade, a substantial consolidation of firms in this industry — facilitated by the relaxation of regulations — has been accompanied by an expansion of bank branches. Industry analysts report that investing in branch networks has increasingly been utilized as a strategy to steal market share from competitors, as consumers value more convenient access to branches. Because investments in branches may be substantial and largely sunk, they have the potential to facilitate and/or maintain consolidation. We also explore whether the incentives to invest in branches depend on other characteristics of banks, and their competitors.

Since markets for retail banking are inherently local, our data contains a large cross-section of market observations. The dataset includes 1,763 non-MSA markets, and we analyze the branching activity of 4,429 financial institutions that operate in these markets. We also incorporate horizontal differentiation, by distinguishing among firms that operate in many markets ("multimarket banks"), just one market ("single-market banks") and thrift institutions ("thrifts").[1] Making these distinctions also allows us to assess the competitive consequences of recent deregulation that has allowed banks to spread across multiple markets.

The empirical results demonstrate interesting and subtle connections among branching, competition and product differentiation. Most substantially, where institutions (of any type) compete in markets where operating multimarket banks is particularly attractive, their branch networks are *larger*. In addition, it appears from our results that investments in additional branches are complements when competitors are similar types of institutions. Finally, our procedure that corrects for the endogeneity of market structure — in particular, the strong negative correlation between unobservables associated with branching and multimarket bank presence — removes a significant bias in the empirical results.

The remainder of the paper is organized as follows. Section II provides background: first a brief review of the literature on investments and market structure and then a discussion of the rural bank branching application. We describe the estimation strategy in Section III and the data we use for the study in Section IV. Section V presents the empirical results and Section VI concludes.

II. Background

This paper uses data on branching activity in retail banking to empirically investigate the interaction between market structure and the investment strategies of

[1] The banks that we classify as "single-market" in our dataset would also qualify as "community banks" under almost all of the definitions that have been used in the community banking literature. Thrift institutions refer to savings banks and savings and loans. These institutions operate under different charters, statutory requirements and regulatory agencies than commercial banks.

competing firms. Assuming endogenous investments in branches, an individual firm would compare the costs associated with opening additional branches with the additional revenue that could be generated from the investment. This tradeoff could potentially be complicated depending on the amount of market competition faced by firms. Furthermore, investments in branch networks could increase market concentration if entry is more difficult or exit more likely where firms have made such investments. While a substantial theory literature analyzes their competitive implications, many results depend on whether investments are strategic substitutes or strategic complements — a question on which there is little empirical evidence.

In this paper, we explore the relationship between branch networks and competition in a cross-section of rural banking markets, distinguishing among single-market (or community) banks, thrift institutions, and multi-market banks. Certain features of this application make for an especially nice setting to analyze potential interactions between investment and market structure.[2] First, there is evidence to suggest that a bank's investments in branches are largely sunk. Specific construction requirements often make commercial space designed for bank branches inappropriate for alternative retail uses.[3] Analysts have suggested that larger branch networks may also serve an advertising function, as branches are thought to represent the "face" of the bank to customers. Many studies (Judd, 1985; Sutton, 1991, et al.) have demonstrated that the

[2] Few other empirical studies explore this issue directly – examples include Lieberman (1987), Vogt (1999), Ellison & Ellison (2000), Dafny (2005) and Hamilton & McManus (2005).

[3] Steve Reider (cited in Muto, 2005), president of the market-research firm Bancography, states, "There's not a lot of demand for retailers for a space where a good chunk of it is taken up by a cast-iron and concrete vault." Reider goes on to say that "some banks are reluctant to retrofit a former bank location to fit their own design criteria, which can be as expensive as building another bank from scratch."

commitment associated with sunk investments makes them more credible in influencing competition.

In addition, practitioners and analysts in the banking industry consider retail branches to be a crucial determinant of a firm's demand. Federal Reserve Governor Mark Olson recently noted that, "Branch offices and networks continue to be critical factors to customers as they choose their financial services providers…Surveys conducted by the Federal Reserve Board indicate that the single most-important factor influencing a customer's choice of banks is the location of the institution's branches."[4] Of course, there are other product characteristics that are likely to be important to consumers. Some consumers may value more personalized service, accessibility of an institution's executives, or longer hours of operation. In fact, we will be able to investigate whether there are different branching strategies for different types of financial institutions and if these strategies depend on the type of competitors a firm faces.

The potential connection between branching and competition was not empirically relevant until relatively recently, as regulation severely limited the potential entry and branching strategies of financial institutions. As late as 1970, only a handful of U.S. states allowed banks to have more than one branch, and several states restricted branching activity through the early 1990s. In addition, banks were typically not permitted to cross state lines until the late 1980s.[5] In this context, there has been

[4] Speech delivered to the Fortieth Annual Conference on Bank Structure and Competition in Chicago, IL on May 6, 2004. The surveys to which Governor Olson refers are the 2001 Survey of Consumer Finances and the 1998 Survey of Small Business Finances. Studies like Berger, Leusner and Mingo (1997) support the role of branches in consumer demand. They find about twice as many branches as would minimize costs, but suggest that having extra branches may nonetheless be profit maximizing, "since additional offices provide convenience for the bank's customers that may be recaptured by the bank on the revenue side."

[5] A series of papers has examined the consequences of regulatory changes on dynamic efficiency (Jayaratne and Strahan, 1998), entry (Amel and Liang, 1992), merger and acquisition activity (Berger et al., 2004) and

vigorous debate in industry and policy circles over whether smaller "single-market" banks and thrift institutions would represent an important potential source of competition as multimarket banks are permitted to expand their operations.[6] While pointing out that branching is generally related to better financial performance, the FDIC notes that "these relationships are especially evident among community banks, which are less profitable on average than larger institutions."[7] Our empirical framework allows us to address the role of competition within and across these different types of depository institutions.

III. Empirically Analyzing Branching and Market Structure

One goal of our paper is to understand the relationship between bank branching decisions and market structure. Other researchers (at least as far back as White, 1976) have investigated this issue by running a straightforward regression of the form:

$$B_{j,m} = Z_{j,m}\gamma + h(\phi; \vec{N}_m) + \mu_{j,m} \tag{1}$$

where $B_{j,m}$ is the number of branches that institution j has in market m, $Z_{j,m}$ is a vector of control variables that may vary by firm and/or market, ϕ is a vector of parameters to be estimated, the vector $\vec{N}_m$ is some measure of concentration in market m, and $\mu_{j,m}$

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even overall economic growth (Jayaratne and Strahan, 1996). A similar literature has studied bank branching in Portugal (Barros, 1995; Cabral and Majure, 1994), Norway (Kim and Vale, 2001) and in a cross-section of European markets (Cerasi, Chizzolini and Ivaldi, 2002). Our study is closest in spirit to Dick's (forthcoming) analysis of large banking markets. She relates various measures of quality — including the density of a bank's branch network — to market size, and finds that quality tends to be greater in larger MSAs.

[6] For example, Hannan and Prager (2004) find that the share of deposits held by multimarket banks is negatively related to deposit rates offered by single-market banks. Cohen (2004) rejects the hypothesis that banks and thrifts operate in independent product markets.

[7] The FDIC report goes on to say that "these results suggest that maintaining a branch network may be one way in which smaller institutions can close the profitability gap with their larger rivals."

represents the unobservable component of the firm's branching decision which may have both a market and firm specific component. We will ultimately end up estimating a similar specification; however, this section discusses three features that we think are important to add to this empirical framework. First, we back up and explicitly consider the branching decision of competitive firms from which an equation like (1) derives. In so doing, we will uncover a second feature — the need to incorporate the branch networks of competitors as well as their presence into the analysis. Third, we will confront market structure endogeneity in the basic specification and suggest a potential fix.

Behaviorally, we begin with individual institutions as decision makers, maximizing profits with their choice of how many branches to operate in a market. To consider market presence and branching simultaneously, we can allow zero branches to be in each institution's choice set. We only examine firms' decisions regarding operation and branching, and assume that firms compete in prices, other service offerings, etc. once the set of market participants and their branch networks have been established.[8] While we will not attempt to estimate it directly in this paper, we have this sort of conceptual profit function in mind:

$$\max_{B_j} \pi_{j,m} = f(X_m^R \beta^R; \vec{N}_m, B_{j,m}, B_{-j,m}) - c(X_m^C \beta^C; B_{j,m}) + \omega_{j,m} \qquad (2)$$

where the first term represents the revenue a bank earns and the second term its costs.

While equation (2) is purposefully general, we can say a bit about its component parts. The revenue term is meant to reflect a market's total opportunity and that quantity

[8] An alternative would be to break up the operation and branching decisions such that firms optimally choose branching networks in an environment with a fixed set of competitors. This is the basic approach of Ishii's (2005) study of ATM networks.

depends upon, and is split between, the operating firms. If branch networks enter consumer utility positively, a bank's share of the market would depend on the size of its branch network relative to the total number of branches in the market. Holding this share equal, market competition may be less tough if there are fewer firms operating.[9] In addition, product differentiation could be incorporated here, affecting competition and potentially increasing demand overall. The cost term reflects an incremental cost for additional branches and can be specified so that the first branch has higher costs (encompassing entry as well as branch costs). The entry and branching costs could also depend on market conditions and product type.

In light of the discrete nature of the firms' choice variable, we assume that firms would decide by comparing the profits under various alternatives. Assuming that π_j is concave in B_j then firms would choose B_j* such that:

$$\pi_j(B_j^* | X_m; \vec{N}, B_{-j,m}) \geq \pi_j(B_j^* \pm 1 | X_m; \vec{N}, B_{-j,m}) \quad (3)$$

Following this approach boils down to a market structure model in a very high dimensional space. Specifying a unique equilibrium such that (3) holds simultaneously for all *j* in each market is too burdensome computationally. Alternative approaches that focus on necessary conditions for equilibrium may not fully capture the range of potentially relevant strategic behavior, such as the possibility that firms can deter entry by adding branches.[10] Instead, we argue that any equilibrium based on the framework above

[9] For example, there may be softer competition for a bank with two branches where there is just one additional firm (with two branches) as opposed to two competitors with one branch each.

[10] See, for example, Pakes, Porter, Ho and Ishii (2005), Andrews, Berry and Jia (2004) and Ciliberto and Tamer (2004). To illustrate, consider an observed Nash-type game structure in which all market participants are better off with their choice given competitors' (fixed) choices. A two-branch monopolist, as an example, could be difficult to explain, though it may be more profitable than a one-branch monopolist if such a firm would invite a competitor's entry.

implies a series of reaction functions (one for each operating firm) that determines the optimal number of branches given market conditions and the decisions of competitors. Assuming a linear functional form for this reaction function, we specify B_j* as follows:

$$B^*_{j,m} = Z_{j,m}\gamma + h(\phi; \vec{N}^*_m, B^*_{-j,m}) + \mu_{j,m} \qquad (4)$$

While estimating this reaction function rather than directly tackling the equilibrium is a simplification motivated by estimation tractability that prevents us from uncovering potentially interesting parameters within the *f(.)* and *c(.)* functions of equation (2), it does allow us to make inferences about the relationship between observed branch choice and competition.

To proceed with estimation of equation (4), we must address the potential endogeneity induced by having the competitors' operating decisions as well as their optimal branching choice on the right hand side. As was the case with equation (1), bias will arise to the extent that the unobservables associated with operating in the market are correlated with the unobservables associated with the profitability of operating additional branches. In addition, there may be correlated unobservables within markets: a competitor with a large $\mu_{k,m.}$ will show up with a larger B_k*. To the extent that such that $\mu_{k,m.}$ is correlated with $\mu_{j,m.}$, the effect of *k's* branches on *j's* branching decision will be confounded.

Our approach to these endogeneity issues is to decompose $\mu_{j,m}$ into a portion that is common across firms within each market, $\mu_{m.}$, and a firm-specific portion, $\zeta_{j,m}$. Acknowledging potential connections across types we can futher break down the common component into three parts — for each type *T* we have: (1) a term that is common across firms of that same type *T*; (2) a term that is common to firms of type *T* and one of the other types; and (3) a term that is common to firms of type *T* and the remaining type. This leaves the error term, for a type τ , firm in equation (4) to be:

$$\mu_{j,m}^{\tau} = \sum_{T} \mu_{T,m}^{\tau} + \zeta_{j,m} \tag{5}$$

where $E\left[\zeta_{j,m} \middle| Z_{j,m}, \vec{N}_{j,m}, B^{-j}\right] = 0$.

To proceed, we will make a specific assumption that will allow us to condition on the first term in (5), leaving only the second term (which we have assumed to be i.i.d.). *We assume that the common portion of the unobservables affecting the attractiveness of adding an additional branch are captured by the unobservables affecting the attractiveness of simply operating in the market.* Because the dimensionality of the problem is substantially reduced, we are able to estimate an equilibrium model that focuses only on firms' operating decisions. We use the estimates from this model to back out the type-specific unobservables associated with the operating decision in each market. Then, we insert these into equation (4) which, given our assumption, leaves us with an error term that is independent across the firms. In short, we rely on the assumption that any common component (within market) of the unobservable that affects firms' profits from opening their additional branches in the market also affects the decision to operate in the market (i.e., open its first branch).[11]

We will assume that a firm of type *T* will earn:

$$\pi_{T,m} = X_{T,m}\beta_T + g(\theta_T; \vec{N}_{T,m}) + \varepsilon_{T,m} \tag{6}$$

[11] We have been unable to isolate any possible unobserved variable that might have a common effect on the returns to (additional) branching, but not on the operating decision. To the extent that our assumption is violated, the estimates of the effect of competitors' branches will be biased upward.

in market *m* if it chooses to operate and zero otherwise. Firms will choose to operate if returns according to equation (6) are positive, with β_T representing the effects of market characteristics and θ_T capturing the degree to which additional competition reduces returns. These estimated parameters can vary by type; however, we explicitly assume that firms are symmetric within type, abstracting from other potential differences along with the number of branches.

Therefore, the first step in our estimation process is to specify an equilibrium model of market participation. Such a model will be governed by inequalities like the one in equation (3), but now firms will have the choice of whether or not to operate (i.e., having zero branches versus having one or more branches). The equilibrium market structure model predicts the observed product-type configuration at each market — the number of multimarket banks, single-market banks, and thrifts that are operating. When we assume that firms play a Stackelberg game, a unique set of inequalities follow that generate a unique equilibrium: that is, a particular product-type configuration (M,S,T) follows from the data for the market in question and the profit function parameters in equation (6), for every possible realization of $\varepsilon_{T,m}$ (which we assume to be independent trivariate normal).[12] Maximum likelihood selects the profit function parameters that maximize the probability of the observed outcomes across the dataset. The likelihood function is:

[12] For the Stackelberg game, we assume that there are an infinite number of symmetric potential entrants of each type and that the highest profit firms (types) in equilibrium play first. The inequalities consistent with this solution concept insure that (1) all extant firms are profitable, (2) no potential firm could profitably enter, and, (3) the highest profit types are represented in equilibrium. Mazzeo (2002) contains a uniqueness proof for the equilibrium of this game. Cohen and Mazzeo (2004) uses this type of model to characterize the extent to which product differentiation has increased consumers' banking options over time in response to legislation that has removed many restrictions regarding interstate banking.

$$L = \prod_{m=1}^{M} \text{Prob}\left[(M,S,T)_m^O\right] \tag{7}$$

where $(M,S,T)_m^O$ is the observed configuration of firms in market m — its probability is a function of the parameters and the data for market m.

Having estimated the profit function parameters, we can turn to the calculation of the terms we will use to correct equation (4). Consider, for example, a market where $\vec{N}$ = (1,1,1). In this case, we can calculate for a given type τ:

$$E\left[\mu_{j,m} \middle| \varepsilon_m : \vec{N} = (1,1,1)\right] = \sum_T \rho_T^\tau E\left[\varepsilon_T \middle| \vec{N} = (1,1,1)\right] \tag{8}$$

Using the estimated parameters from (7), we can back out estimates of the expectation in equation (8). These $E\left[\varepsilon_T \middle| \vec{N}\right]$ are then inserted as data (for each market) into the branching regression:

$$B_{j,m}^* = Z_{j,m}\gamma + h(\phi; \vec{N}_{j,m}, B_{-j,m}^*) + \sum_T \rho_T^\tau E\left[\varepsilon_T \middle| \vec{N}_m\right] + \zeta_{j,m} \tag{9}$$

and the ρ_T^τ become additional parameters to be estimated. Along with our assumptions in (5), this procedure ensures that $\zeta_{j,m}$ in equation (9) now has mean zero. As a result, the regression isolates the relationship between branching and competition from unobserved factors that may influence both the underlying profitability of the operating firms and common unobservables in the returns to branching. In addition, we will recover estimates of the ρ_T^τ, which will have an economic interpretation as discussed in section 5.

IV. Data

We use data on banks and their branch networks from 1,763 non-MSA labor market areas (LMAs) as of June 30, 2000. To represent individual observations, geographic markets must be defined in such a way that (1) all the firms in the geographic area compete with each other and (2) consumers do not typically use firms outside their own geographic area. To accomplish (1), we focus on less populated geographic markets, which are unlikely to contain distinct submarkets. We therefore eliminated all urbanized areas (MSAs) and rural areas with relatively high population (LMAs with over 100,000 residents). The Bureau of Labor Statistics defines LMAs as integrated economic areas, combining contiguous counties into a single LMA if at least 15 percent of the workers from one county commute for work to the other. Using LMAs (as opposed to counties) gives us more confidence that two neighboring markets are indeed competitively distinct.[13]

To construct the dependent variables for each stage of the model — the number of institutions of each of the three types within each LMA, and the number of branches belonging to each of those institutions — we use data from several sources. The FDIC Summary of Deposits contains location information on all banks and their branches. We classified each bank and branch within its LMA market: to be classified as a single-market bank, an institution must have a bank charter and receive at least 80 percent of its deposits from branches in that market; otherwise, the bank was classified as a multimarket bank.[14] Analogous information about operating thrifts was obtained from

[13] In addition, these markets have far fewer competitors, making the endogenous market structure model more tractable. More importantly, many of the mergers that raise competitive concerns with regulators do so because of their effect on the market structure of these smaller markets.

[14] This definition is consistent with previous papers that distinguish "single-market" banks. Note that a bank with 90 percent of its deposits in market A and 10 percent 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 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.

the Office of Thrift Supervision's Branch Office Survey. Table 1 shows the distribution of firm configurations among the LMA markets in our dataset. 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 67 markets that include one multimarket bank, one single-market bank and zero thrifts.[15] Table 2 summarizes the branching data for the firm/market combinations in the dataset. Note that in approximately 59 percent of the cases a firm operates only one branch (this includes all the active firms in approximately 20 percent of our markets). Very few of the firms have more than three branches in a market. Differences in branching across different market configurations will be exploited in the empirical analysis.

The control variables are summarized in Table 3. These variables represent market characteristics that may contribute to the profitability of financial institutions as well as exogenous factors that may influence the decision of banks to open additional branches in a particular LMA. These variables include: (1) the number of farms; (2) the number of non-farm establishments; (3) population; (4) per capita income; (5) a dummy variable indicating whether the LMA borders an MSA; and (6) a dummy variable for LMAs in the seven states that still had restrictions on intra-state bank branching as of

[15] In our estimation of the endogenous market structure model 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, all markets with four or more single-market banks are treated as if they have exactly four, and all markets with six or more multimarket banks are treated as if they have exactly six. We expect this to reduce the complexity of the estimation without appreciably influencing the results.

2000. The sources for these variables are the Agricultural Census, the Bureau of Economic Analysis, and the Census Bureau.

V. Results

This section presents and discusses the estimated parameters that measure the relationship between competition and branching activity in our sample of rural banking markets. We begin with a brief discussion of the results from the market structure model. Then, we proceed to the branching regressions, whose parameter estimates demonstrate interesting competitive effects on branching. These results highlight the importance of addressing market structure endogeneity in the analysis of branching.

V.A Market Structure Model

We begin with a brief review of the results from the market structure model, which estimates the parameters in equation (6). Note that we specify separate effects for each type of depository institution in each market (multimarket banks, single market banks, and thrifts), since our likelihood is based on the observed ordered triples (M,S,T) of extant firms across the markets in our dataset. The $g(\theta_T;\vec{N}_m)$ portion term from equation (6) includes individual competitive effect dummy variables whose parameters represent the incremental effects of additional competitors. Table 4 lists the effects estimated — most importantly, separate parameters are estimated for the effect of each of the three types of competitors on multimarket banks, single-market banks and thrifts.

Table 4 displays the competitive effects in the top panel and the control variables below. These estimates indicate the relative effect on the returns to operating each type of financial institution under different market conditions and with various sets of competitors (abstracting from branches). The relative value of the three sets of intercept terms and control variables indicates that, all else equal, multimarket banks would earn the highest baseline profits (C_M = 2.84 vs. C_S = 1.18 or C_T = 0.01).[16] For the competitive effects, the key result is the large difference between the impact of same-type and different-type institutions. For example, the effect of the first multimarket competitor on multimarket banks (-1.0991) is more than twice the effect of the first single market competitor (-0.3933), while the effect of the first thrift is negligible (-0.0623).[17] The incremental effects of additional competing firms are smaller than for the first competitor; for example, the effect of the second multimarket competitor on multimarkets is roughly three-quarters the effect of the first (-1.0991 vs. -0.8365).

The control-variable parameters indicate the demographic conditions under which operating an institution of each type will be more or less attractive. For example, the number of establishments has a positive and significant effect on all three types, but the relative magnitude of the coefficients reveals that multimarket banks benefit from local commercial activity the most. Multimarket banks are also most affected, positively, by proximity to urbanized areas. Single-market banks benefit the most from agricultural activity while thrifts benefit the least. Branching restrictions have a significant adverse effect on multimarkets (larger than the effect of having a second single-market bank competitor) and a significant positive effect (of similar magnitude) on single-market banks. This suggests that the option to branch is a particularly important consideration for

[16] These effects are measured at the mean of the explanatory variables assuming that each type firm is a monopolist operating in a market that does not border an MSA and has no branching restrictions.

[17] The comparisons are similar for the profits of single-market banks and thrifts. Additional thrifts, however, have a larger effect on the profits of both multimarket and single-market banks than the first thrift. It is possible that aggressive competition between thrifts reduces profits for the other types.

multimarket banks, which should be kept in mind as we proceed to our discussion of the differences in the branching strategies of the different types of institution.

V.B Branching Regressions

Table 5 displays the results from the branching regressions, with the effects of competitors' branches listed first, followed by the effect of competitors' presence, demographic control variables and the endogeneity correction terms. In each specification, an observation (of which there are 9,250) is an institution/LMA combination and the dependent variable is the number of branches the institution operates in that LMA. There are two pairs of columns describing the results: in the first of each pair we present a base case from equation (4) in which no endogeneity corrections are made, and in columns 2 and 4 the estimated error terms from the market structure model are included as regressors, as in equation (9). The first pair of columns presents a Tobit specification, which acknowledges potential differences between institutions with a single branch and those with more than one, and the second pair of columns treats the dependent variable as linear. We have specified the competitive effects to be linear rather than incremental; therefore, we have nine estimated parameters representing the effect of additional branches and additional competitors of each type on the number of branches operated by multimarket banks, single market banks and thrifts, respectively.[18]

The first set of parameters estimates indicates how much competitors' branches affect the propensity of individual institutions to operate more branches. Here, the three horizontal product types appear quite important, as the most significant effects are on

[18] We report the linear specification of competitive effects for simplicity. An alternative specification with incremental effects produced similar results.

same-type institutions. For example, the estimated optimal response to competitors' branches by a multimarket bank is to have more branches only if that competitor is also a multimarket bank (the positive and significant estimates across the top row of the top panel). However, if competitors are single-market banks and thrifts, the effect is much smaller and less significant. Note that all of the estimated coefficients in the top panel that are significant are positive, indicating that branching strategies appear to be strategic complements (at least within type). This is also consistent with the empirical evidence and anecdotal advice regarding the proliferation of bank branching as an industry strategy. These estimated effects are present both with and without the endogeneity correction.

A second important result from Table 5 involves the effects of the presence of multimarket competitors on branching activity, as presented in the first, fourth and seventh rows of the second panel. First, the endogeneity correction has a clear impact on these effects — they are negative and significant in the unadjusted estimates, but positive and significant in the last two columns of each pair. Correspondingly, the estimated coefficients on the terms representing the correlations between the branching and the multimarket profit function errors are significantly different from zero (from the bottom panel). It appears that there is a strong enough negative correlation between the unobservables associated with multimarket bank presence and with branching to significantly bias the uncorrected results. Competition from single-market banks and thrifts, however, is associated with fewer branches per firm. Note that these result contrast with the market structure model estimates, in which the important distinction was between undifferentiated and differentiated competitors. Here, the particular product type of the competitor is the key distinguishing factor in the effect of competitors on branching.

We interpret the corrected regressions to strongly suggest that the *market conditions that are conducive to operating multimarket banks induce firms (of all types) to operate larger branch networks*, while this does not hold where single-market banks or thrifts are more likely to operate. This may well reflect the alternative strategies of retail banking firms — while single-market banks and thrifts focus on providing more personalized service, while the nature of multimarket banks is that they have broader branch networks. Just as competition with multimarket banks induces additional branching, firms may also be able to discourage additional multimarket banks from entering particular local markets by expanding their own branch networks (and effectively co-opting the favored strategy of multimarket banks). This behavior, which cannot be observed by the econometrician, is nonetheless consistent with our results. If firms that anticipate further entry by multimarket banks (those in markets with characteristics that would make multimarket banks relatively more profitable) add additional branches, multimarket banks may choose not to enter. In that case, we would observe the incumbent firms offering more branches than expected and markets containing fewer multimarket banks than expected, which is consistent with the estimated negative correlation between the branching unobservable and the multimarket bank presence unobservable.

In this case, a simple regression of branches on market structure could indicate that institutions operate more branches in more concentrated markets, to the extent that markets in which additional branching and a lack of multi-market banks are prevalent.

The uncorrected results would therefore obscure the fact that while multimarket banks' underlying behavior is to compete in branches, this behavior induces other types to do so as well. Once we account for endogenous market structure, this effect is revealed. In fact, the competitive effect of branching is so strong that it appears to successfully pre-empt the entry of multimarket banks.[19]

Our empirical results suggest that the strategic response to competition from multimarket banks is to provide more accessible branch networks. It is nonetheless worth noting that competition from single-market banks and thrifts may induce additional investments as well — just along different dimensions. Unfortunately, there is no data that would enable us to verify this claim since many alternative service features banks could otherwise provide (such as access to bank executives or familiarity with regular bank employees) are not readily quantifiable. Either way, differences in branching strategy appear to depend critically on the identity of competitors, with only multimarket banks (a relatively new phenomenon) associated with more branching activity by their competitors.

The remainder of Table 5 presents the estimated control variable parameters regarding the baseline propensity of financial institutions to establish additional branches in a market. The estimated effects of the control variables generally have the expected signs; in particular, in markets with greater population and business presence, operating firms have more branches. Interestingly, higher income residents do not correlate with more branching activity, even though income predicts entry of each type of firm. The

[19] Note that we do not provide independent evidence to support the preemption hypothesis among others that could potentially explain the estimated correlation. While such an exercise is beyond the scope of this paper, we intend to pursue this in future work.

branching restriction dummy is small and positive, and not statistically significant in most of the specifications, suggesting that these restrictions primarily affect firms' operating decisions as seen in the Table 4 results. We also included dummy variables for multimarket and single market banks; these have more branches than thrifts as a baseline, but their estimated fixed effects are roughly equal.

The results from Table 5 suggest a complex relationship between branching, competition and product differentiation. The comparison between the first and second pair of columns in Table 5 demonstrates the importance of accounting for market structure endogeneity. Advice from industry analysts and regulatory agencies based on the correlation between branches and profitability that fails to consider the potential effects of branching on market structure may result in ineffective investments by community banks and thrifts (i.e., in markets where multimarket banks already operate). In addition, the profound difference between multimarket bank competition and other financial institutions is highlighted by these results. Policy makers may be interested in this market-level consequence of multimarket bank competition. Along with the efficiency benefits other studies have documented, our results suggest that when multimarket banks are present, consumers are provided with more branch locations than would be expected in a similar economic environment or if the market consisted of only single market banks and thrifts. Given the impact of the market structure endogeneity correction, the mere threat of entry by multimarket firms may be sufficient to induce this response.

VI. Conclusions

In this paper, we look for evidence of a connection between investments made by firms and the competition they face by examining the decisions of financial institutions about the extent of their local branching networks. We acknowledge the importance of product heterogeneity in this industry by distinguishing between multimarket banks, single-market banks and thrift competitors in the analysis. By doing so, we uncover interesting insights regarding the differential effects of heterogeneous competitors. Branching investments are found to be strategic complements, but only with respect to institutions of the same type. In addition, while competition from traditional single market banks and thrifts is associated with smaller branching networks, institutions (of all types) tend to have more branches when they face multimarket banks as their competitors. These insights are lost if the analyst (1) ignores product differentiation among these types of firms and (2) fails to correct for the endogeneity of competitors and their branching decisions. Our results provide further evidence that submarkets within retail banking are very important for understanding competition in this industry. The empirical results also provide a powerful demonstration for why (2) is particularly important in an application like this where market structure could affect investments and vice versa. We find that failing to account for the endogeneity of market structure would have led to significantly different conclusions. In particular, the positive relationship between multimarket bank competition and the expansion of bank branching networks is obscured in the uncorrected results.

The empirical analysis undertaken in this paper makes inferences based on differences among a cross-section of banking markets, all of which are observed at a single moment in time. While this identification strategy is informative, it does not fully incorporate the dynamic process in which markets become more concentrated over time as firms enter and exit the market and make investments in additional branches. An important extension to this analysis would incorporate data on the timing of firm entry, as well as the opening of additional branches within markets where institutions are already operating. Such an extension could potentially verify that incumbents use branching to pre-empt the entry of multimarket banks, as suggested by our results. Finally, it is important to note that while we have demonstrated correlations between investments in branches and market competition, the effects on consumer welfare are ambiguous. Consumers may face lower or higher deposit and loan rates depending on competition, which will trade off against the effects of different types of institution having more (or fewer) branches.

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Table 1: Market Configurations

Thrifts=0

Single-market	Multi-market: 0	1	2	3	4	5	6+	*Total*
0	13	83	93	92	59	31	34	*405*
1	26	67	74	53	35	25	19	*299*
2	26	37	38	30	22	12	15	*180*
3	6	7	12	19	10	2	6	*62*
4+	1	10	7	3	6	5	13	*45*
Total	*72*	*204*	*224*	*197*	*132*	*75*	*87*	*991*

Thrifts=1

Single-market	Multi-market: 0	1	2	3	4	5	6+	*Total*
0	4	9	22	40	33	29	29	*166*
1	5	27	23	32	24	16	30	*157*
2	8	10	14	24	10	14	16	*96*
3	1	6	9	7	14	7	13	*57*
4+	3	5	12	6	15	12	17	*70*
Total	*21*	*57*	*80*	*109*	*96*	*78*	*105*	*546*

Thrifts=2

Single-market	Multi-market: 0	1	2	3	4	5	6+	*Total*
0	0	5	9	7	4	9	15	*49*
1	1	2	4	10	8	10	9	*44*
2	1	2	5	7	3	5	12	*35*
3	0	1	0	5	2	2	7	*17*
4+	1	0	0	5	5	2	5	*18*
Total	*3*	*10*	*18*	*34*	*22*	*28*	*48*	*163*

Thrifts=3+

Single-market	Multi-market: 0	1	2	3	4	5	6+	*Total*
0	0	0	1	2	8	3	6	*20*
1	0	0	1	4	3	1	5	*14*
2	0	0	0	0	1	1	6	*8*
3	0	0	0	0	1	0	5	*6*
4+	0	0	0	4	1	0	10	*15*
Total	*0*	*0*	*2*	*10*	*14*	*5*	*32*	*63*

Table 2: Distribution of branches per market, by type

	Type			
# of Branches	**M**	**S**	**T**	**All**
1	56.9%	59.2%	70.5%	59.0%
2	23.0%	21.9%	19.0%	22.2%
3	10.2%	10.2%	5.8%	9.7%
4	5.0%	4.8%	2.3%	4.6%
5	2.4%	2.3%	1.5%	2.3%
6+	2.7%	1.7%	0.9%	2.2%
# of distinct institutions	1651	2310	456	4417
# of institution/market obs	5853	2310	1087	9250

Table 3: Summary Statistics for Explanatory Variables

	Mean	Med	Std Dev	Min	Max
Farms	611	499	453	0	4302
Establishments	528	369	488	1	4855
Population (in 1000s)	23	17	20	0.07	99
Per Capita Income (in 1000s)	21	21	4	5	70
Border Market	0.56	1	0.50	0	1
Branching Restrictions	0.19	0	0.40	0	1

N=1763 markets

Table 4: Parameter Estimates from Endogenous Market Structure Model

	Estimate	Asymptotic t-stat
COMPETITIVE EFFECTS		
Effect of first multi-market competitor on multi-market profits	-1.0991	(-20.45)
Effect of second multi-market competitor on multi-market profits	-0.8365	(-21.24)
Effect of each additional multi-market competitor on multi-market profits	-0.7542	(-36.75)
Effect of first single-market on multi-market profits	-0.3933	(-3.99)
Effect of each additional single-market on multi-market profits	-0.1100	(-2.10)
Effect of first thrift on multi-market profits	-0.0623	(-.63)
Effect of each additional thrift on multi-market profits	-0.2804	(-3.52)
Effect of first single-market competitor on single-market profits	-0.9375	(-27.19)
Effect of second single-market competitor on single-market profits	-0.7300	(-20.84)
Effect of third single-market competitor on single-market profits	-0.5354	(-14.15)
Effect of first multi-market on single-market profits	-0.3853	(-2.49)
Effect of each additional multi-market on single-market profits	-0.1390	(-2.79)
Effect of first thrift on single-market profits	-2.E-04	(-.00)
Effect of each additional thrift on single-market profits	-0.1935	(-.85)
Effect of first thrift competitor on thrift profits	-1.2368	(-23.32)
Effect of second thrift competitor on thrift profits	-0.8838	(-13.04)
Effect of first multi-market on thrift profits	-0.0615	(-.35)
Effect of each additional multi-market on thrift profits	-0.0093	(-.18)
Effect of first single-market on thrift profits	-0.0731	(-.28)
Effect of each additional single-market on thrift profits	-0.0013	(-.01)
MULTI-MARKET PROFIT SHIFTERS		
Intercept	0.1903	(1.23)
Farms	0.6289	(10.30)
Establishments	1.1487	(13.24)
Population	0.0895	(.96)
Per Capita Income	0.7845	(5.44)
Border Market	0.1715	(3.22)
Branching Restrictions	-0.1962	(-3.07)
SINGLE-MARKET PROFIT SHIFTERS		
Intercept	-0.5819	(-2.59)
Farms	0.7901	(12.22)
Establishments	0.3310	(3.16)
Population	-0.0575	(-.58)
Per Capita Income	0.6975	(3.07)
Border Market	-0.0182	(-.31)
Branching Restrictions	0.1816	(2.62)
THRIFT PROFIT SHIFTERS		
Intercept	-1.7083	(-7.85)
Farms	0.2886	(2.02)
Establishments	0.3545	(3.87)
Population	0.2225	(2.60)
Per Capita Income	0.8566	(4.12)
Border Market	-0.0410	(-.64)
Branching Restrictions	0.0624	(.72)

Table 5: Estimates from Branching Model
(Asymptotic t statistics in parentheses)

		Tobit Specification				Linear Specification			
		Unadjusted		Adjusted		Unadjusted		Adjusted	
Effect of:	On:	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Avg. branches of MM competitors	MM branches	0.629	(12.61)	0.507	(9.62)	0.355	(14.78)	0.280	(10.97)
Avg. branches of SM competitors	MM branches	0.074	(2.50)	0.056	(1.82)	0.039	(2.75)	0.027	(1.83)
Avg. branches of Thrift competitors	MM branches	0.012	(0.24)	-0.057	(-1.17)	0.005	(0.24)	-0.030	(-1.28)
Avg. branches of MM competitors	SM branches	0.217	(2.76)	0.245	(2.86)	0.099	(2.66)	0.136	(3.37)
Avg. branches of SM competitors	SM branches	0.628	(14.92)	0.651	(15.19)	0.335	(16.71)	0.358	(17.46)
Avg. branches of Thrift competitors	SM branches	-0.060	(-0.70)	-0.054	(-0.63)	-0.007	(-0.18)	0.000	(0.01)
Avg. branches of MM competitors	Thrift branches	0.132	(1.28)	0.038	(0.30)	-0.035	(-0.78)	0.000	(0.00)
Avg. branches of SM competitors	Thrift branches	-0.010	(-0.15)	-0.008	(-0.11)	-0.009	(-0.30)	0.004	(0.13)
Avg. branches of Thrift competitors	Thrift branches	0.730	(7.51)	0.686	(6.89)	0.427	(9.06)	0.436	(9.06)
# MM competitors	MM branches	-0.094	(-3.40)	0.298	(4.62)	-0.056	(-4.56)	0.094	(3.12)
# SM competitors	MM branches	-0.134	(-4.55)	-0.185	(-1.29)	-0.062	(-4.69)	-0.088	(-1.36)
# Thrift competitors	MM branches	-0.042	(-0.99)	-0.429	(-1.73)	-0.022	(-1.12)	-0.085	(-0.77)
# MM competitors	SM branches	-0.119	(-3.43)	0.230	(2.50)	-0.060	(-3.94)	0.121	(2.87)
# SM competitors	SM branches	-0.653	(-12.20)	-0.735	(-4.64)	-0.287	(-12.45)	-0.290	(-4.07)
# Thrift competitors	SM branches	-0.108	(-1.52)	-0.745	(-2.46)	-0.050	(-1.58)	-0.508	(-3.72)
# MM competitors	Thrift branches	-0.004	(-0.07)	0.552	(3.39)	-0.044	(-1.93)	0.204	(2.95)
# SM competitors	Thrift branches	-0.075	(-1.11)	-0.026	(-0.12)	-0.035	(-1.27)	0.071	(0.78)
# Thrift competitors	Thrift branches	-0.563	(-4.56)	-1.224	(-2.59)	-0.268	(-5.25)	-0.735	(-3.57)
Intercept		-2.169	(-7.01)	-4.133	(-3.72)	0.215	(1.72)	-0.929	(-1.95)
Farms		-0.048	(-0.99)	-0.091	(-0.57)	-0.051	(-2.26)	-0.086	(-1.20)
Establishments		0.131	(1.35)	0.087	(0.58)	0.111	(2.43)	0.085	(1.22)
Population		0.855	(7.91)	0.700	(5.46)	0.397	(7.83)	0.341	(5.70)
Per capita income		0.066	(0.33)	-0.149	(-0.55)	0.064	(0.73)	-0.039	(-0.33)
Border market		-0.003	(-0.04)	-0.117	(-1.91)	-0.007	(-0.27)	-0.057	(-2.11)
Branching restrictions		-0.011	(-0.15)	0.108	(1.37)	0.038	(1.22)	0.092	(2.64)
MM dummy		0.852	(3.29)	2.770	(2.65)	0.089	(0.88)	1.239	(2.78)
SM dummy		1.629	(5.90)	3.274	(3.06)	0.444	(4.02)	1.457	(3.19)
MM market presence unobservable	MM branches			-0.640	(-7.42)			-0.265	(-6.41)
SM market presence unobservable	MM branches			0.095	(0.56)			0.039	(0.50)
Thrift market presence unobservable	MM branches			0.355	(1.66)			0.050	(0.52)
MM market presence unobservable	SM branches			-0.415	(-3.23)			-0.198	(-3.33)
SM market presence unobservable	SM branches			0.224	(1.01)			0.060	(0.59)
Thrift market presence unobservable	SM branches			0.621	(2.37)			0.443	(3.77)
MM market presence unobservable	Thrift branches			-0.772	(-3.93)			-0.280	(-3.25)
SM market presence unobservable	Thrift branches			-0.008	(-0.03)			-0.084	(-0.75)
Thrift market presence unobservable	Thrift branches			0.802	(1.55)			0.565	(2.52)