Local Entry Decisions in the US Banking Industry

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Abstract

In this paper I estimate a dynamic model of entry/exit in local markets for the US banking industry with heterogeneous firms: single-market and multimarket banks. The econometric model allows for differences between single-market and multimarket banks in competitive effects, sell-off values, and sunk costs of entry. I use the model to run counterfactual exercises addressing the future of the single-market business model in the industry. The contribution of the paper is twofold. First, discusses the coexistence of firms with such a different geographic scope in an industry. Second, provides evidence of the viability of single-market banks in the US banking industry. Results suggest that single-market banks have profit advantages over multimarket banks, but single-market banks pay a sunk cost of entry which is 25% higher. These higher barriers to entry can be linked to start-up costs, advertisement, and hiring costs for management positions.

JEL classification: G21, L11, L13. **Keywords:** banking, entry costs, dynamic games.

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1 Introduction.

The US banking industry presents direct competition between heterogenous firms in a local market: single-market and multimarket banks. Though single-market banks have an important role in the industry, their market share has been steadily decreasing in the last three decades. These two observations rise relevant economic questions. First, how can firms with different geographic scopes coexist in an industry? Second, are single-market banks still economic viable in the US banking industry?

In this paper I estimate a dynamic model of entry/exit in local markets for the US banking industry with heterogenous firms: single-market and multimarket banks. The econometric model allows for differences between single-market and multimarket banks in competitive effects, sell-off values, and sunk costs of entry. In addition, I run counterfactual exercises to address the future of the single-market business model in the industry.

I formulate a simple entry/exit model which is a simplified version of Ericson and Pakes (1995)'s model, and I use new econometric techniques presented in Pakes, Ostrovsky, and Berry (2007)(POB) aimed at estimating dynamic games. I choose POB approach over competing methodologies (like Aguirregabiria and Mira (2007) or Bajari, Benkard, and Levin (2007)) because POB estimates transition probabilities in a flexible way without explicitly specifying a mapping between entry/exit probabilities and transition probabilities. This feature turns out to be important in my model because transitions are determined both by entry/exit and merger decisions.

The main contribution of the paper is twofold. First, it discusses the coexistence of firms with such a different geographic scope in an industry. Second, it provides evidence of the viability of single-market banks in the US banking industry. The paper also contributes to a new empirical research agenda which applies fully dynamic structural models to uncover parameters linked to dynamic decisions.

The results in this paper suggest that single-market banks can compete at the local market level with multimarket banks. Moreover, single-market banks can even have profits advantages over multimarket banks. On the other hand, single-market banks face higher barriers to entry which can be linked to start-up costs, advertisement, and hiring costs for management positions. The results show different incentives underlying similar entry behavior: single-market banks and multimarket banks enter with a similar probability in a local market but for different reasons. Single-market banks have profit advantages in retail banking but pay a high entry cost; multimarket banks have a profit disadvantage in retail banking but pay a low entry cost.

2 Industry Background.

The US banking industry is getting a lot of media attention these days. In particular banks like Bank of America, Citibank, or JP Morgan have been mentioned quite often. But most of the banks in US are more like Cambridge Trust Company: a small bank with 9 branches located in the Boston Area which makes most of its loans to farmers and small businesses. In fact more than 60% of US banking institutions have presence in only 1 urban or rural area, and these banks makes 40% of all banking loans to small businesses.

This feature of the US banking industry is not random but the consequence of restrictions on the geographic expansion of banks which have a long history in the United States. Because the U.S. Constitution prevents states from issuing fiat money and from taxing interstate trade, the states used their power to grant bank charters to generate a substantial part of state revenues. A state received no charter fees from banks incorporated in other states, so states prohibited out-of-state banks from operating in their territories. These are called **interstate branching restrictions**. In addition, states restricted the ability of banks to expand geographically within their borders. These are called **intrastate branching restrictions**.

In the period 1970-1994, states started to deregulate these geographic restrictions. There were different stages of deregulation. First, states relaxed intrastate branching restrictions. Second, state signed bilateral agreements allowing banks chartered in those states to open branches in both states. Though the deregulation phenomenon was quite extended, different states showed different timing and intensity in the deregulation. See Kroszner and Strahan (1999) for a political economy explanation of different speed of deregulation across markets.

In 1994, the Congress passed the Riegle-Neal Interstate Banking and Branching Efficiency Act which effectively permitted banks and holding companies to enter any state. States have the option to opt-in or opt-out until 1997 some of the provisions in the act, but most of the states opt-in in 1994.

At least since 1994 the industry has become more concentrated. Figure 2 shows that the number of banks halved since 1979 and has decreased 25% since 1994. Interestingly, concentration indexes at the market level have remained steady even when the aggregate concentration has increased. Table 1 shows that the Herfindahl-Hirschman Index (HHI) have increased four times at the industry level while it has remained constant or slightly decrease at the metropolitan and non-metropolitan level.

The increase concentration in the industry has a different effect on single-market and multimarket banks. Figure 2 shows that the number of multimarket banks has increased a 27% and the number of single-market banks has decrease more than 40%. Looking at the numbers in terms of branches is even more striking as shown in figure 3. As a consequence a metropolitan market has a mean of 14 SM banks and 15 MM banks in 2007 while it had 19 SM banks and 9 MM banks in 2007, and a non-metropolitan market has a mean of 2 SM banks and 4 SM branches in 2007 while it had 3 SM banks and 2 MM banks in 2007.

Table 3 shows the entry/exit decisions taken by single-market and multimarket banks. Exit by closing branches is a rare event in the data for both SM and MM banks. Figure 3 illustrates that the consolidation at the bank level is joined by expansion at the branch level. Then it seems natural that closing a branch is not very common during this period. M&A are important determinants of the market structure. Most of the M&A during this period were out-of-market M&A. That means a bank without presence in the local market acquires an incumbent. It is likely that antitrust restrictions play a role here. But an out-market M&A does not necessary affect the market structure in a local market, only a M&A between a single-market and a multimarket bank. In particular, mergers between multimarket banks are a change of ownership but do not affect the number of incumbents in a local market.

3 Data

3.1 Data Source.

The data set consists of yearly data for nearly all commercial banks and thrifts in US during the period 1994-2007. The data were obtained from several sources: the Summary of Deposits (SOD) from the Federal Deposit Insurance Corporation (FDIC), the Reports on Condition and Income (Call Reports) from the Federal Reserve Bank of Chicago (FED), and the Thrift Financial Reports from the Office of Thrift Supervision (OTS).

The Summary of Deposits is a yearly survey conducted by the FDIC which is a government corporation which insures deposits, examines and supervises financial institutions, and manages receiverships. The FDIC requests all FDIC-insured banks to submitt a survey with the amount of deposits in each branch at June, 30th each year. The Summary of Deposits includes deposits, branch's location, and branch's ownership information. The Summary of Deposits information is used to construct the number of SM incumbents, the number of MM incumbents, and entry and exit variables.

To identify M&A I complemented the data in the SOD with the FDIC's Institution Directory. The Institution Directory lists structural changes in bank institutions: the date a bank began operations, the date a bank finished operations, and the reasons for finishing operations. In case a bank merges with another bank, the Institution Directory includes the bank code of the acquirer.

Call Reports are available for all commercial banks regulated by the FED, FDIC, and the Comptroller of the Currency. The Call Reports contain balance sheet information collected on a quarterly basis. I use the Call Reports data to construct deposit interest rates, loans interest rates, default rates, wage expenditures, and other costs. I use the second quarter information to make it comparable with the SOD information. Thrift Financial Reports provide similar information for thrifts.

Demographic data at the local market level come from the US Census Bureau, the Bureau of Economic Analysis (BEA), and the Bureau of Labor Statistics (BLS). Population, income per capita, number of employees, and average wage come from the BEA's Local Area Personal Income, number of establishments comes from the US Bureau of Census' County Business Patterns, consumer price indexes comes from the BLS's CPI.

3.2 Variable Definitions.

3.2.1 Local Market Definition.

A local market definition should balance two contradictory objectives. On the one hand, it should be large enough so that households and firms do not use banking services from banks outside the local market. On the other hand, it should be small enough so there are no distinct or overlapping submarkets within the local market.

To satisfy those requirements I selected,

1. Micropolitan Statistical Areas and rural counties,
2. with less than 100,000 inhabitants, and
3. less than 8 multimarket and 8 single-market incumbent banks in the period 1994-2007.

Micropolitan Statistical Areas are defined by the Office of Management and Budget, and consist of set of counties with at least one urban cluster of at least 10,000 but less than 50,000 population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. They are small urban markets.

Rural counties are counties not classified as Micropolitan or Metropolitan Statistical Areas.[1] They are rural markets.

Metropolitan Statistical Areas (MSA) and markets with more than 100,000 inhabitants are dropped to avoid the presence of distinct and overlapping submarkets. The upper bound in the number of SM and MM incumbents helps to reduce the size of the state space. [2]

The sample consist of 1,691 local markets. The sample represents around 12% of the total population in the US but it is more representative of some regions than others. Figure 4 shows a map of the US with MSAs in grey, Micropolitan Statistical Areas in black, and the rest of counties in white. The maps shows that the sample is more representative of the Midwest and South regions rather than the West and Northeast regions. For example, the sample represents around 30% of the population in the East South Central Division (Alabama, Kentucky, Mississippi, Tennessee) and West North Central Division (Iowa, Nebraska, Kansas, North Dakota, Minnesota, South Dakota, Missouri), but around 5% of the Middle Atlantic Division (New Jersey, New York, Pennsylvania) and Pacific Division (Alaska, California, Hawaii, Oregon, Washington).

The sample is representative of small urban and rural markets. This reflects how difficult is to identify markets in large urban areas for retail activities. In general, empirical

[1] A Metropolitan Statistical Area is similar to the Micropolitan Statistical Area but it has at least one urbanized area of 50,000 or more population.

[2] To control for possible selection issues due to the upper bound in the number of incumbents I check that the results are robust to an increase in such upper bound.

researchers drop those markets and deal with a selected sample. For example, Bresnahan and Reiss (1991)'s seminal paper selected 202 isolated markets at least 20 miles from the nearest town of 1,000 people or more, Mazzeo (2002) selected 492 markets excluding MSA and counties with more than 15 firms, and Seim (2006) selected 151 markets which consisted in cities with population between 40,000 and 150,000.

Table 4 shows descriptive statistics for the sample of local markets. The median market has a population of 15,000 inhabitants, an income per capita of $ 21,000, and 343 business establishments. This shows that local markets in the sample are relatively small. There is important variability in the sample in population, employees, establishments, and population density which can be exploited in the estimation. As expected, the distribution of population, employees, and establishments is asymmetric with a right tail.

3.2.2 Single-market and Multimarket bank.

The empirical definition of a Single-market is a bank which hold more than 80% of its total deposits in a single local market. Otherwise the bank is classified as a Multimarket bank.

Table 5 shows differences in observable characteristics between Single-market and Multimarket banks. I compute variables at the bank-market level and at the bank level. For the variables at the bank-market level I calculate a simple mean, for the variables at the bank level I calculate a mean weighted by the number of branches.

Multimarket banks and Single-market banks differ in geographic scope, size, ownership structure, and lending practices. The average SM bank was active in 2 local markets and 1 state in 2007 while the average MM bank was active in 73 local markets and 5 states. Also the average SM bank owned 6 branches in 2007 while the average MM bank owned 570 branches in 2007. These differences in geographic scope and size have increased since 1994 as a result of deregulation and consolidation in the banking industry. Regarding ownership structure, 25% of SM banks were owned by a Multibank Holding Company in 2007 while 58% of MM banks were owned by a Multibank Holding Company in 2007.

More relevant are differences in lending practices. In 2007, the average SM bank lent 86 % of its business loans to small businesses while the average MM bank lent 59 % of its business loans to small businesses. Also, the average SM bank lent 83 % of its farm loans to small farms while the average MM bank lent 65 % of its farm loans to small farms.[3] Such ratios show some evidence of SM banks having comparative advantages in the provision of loans to small businesses and small farms. The source of this comparative advantage can be explained by advantages of SM banks in relationship lending that depends on soft (non-quantifiable) information. Relationship lending seems to be more important for more informal borrowers like small businesses and farms. Conversely, MM banks have advantages in other lending technologies that depend on hard (quantifiable) information.

There are also differences between SM and MM in average interest rates paid on deposits and average interest rates charged on loans. The average SM paid higher interest rate on deposits and charged higher interest rate on loans than the average MM bank. The higher interest rate on deposits may be evidence that a SM bank has to offer a higher return to attract depositors. The higher interest rate on loans may be evidence of SM banks exploiting their informational advantage when lending to more opaque lenders or may be evidence of SM lending to riskier lenders. It can also be the case that MM banks charge smaller loan interest rate because they can exploit their economies of scale.

There are also differences in the ratio of equity to assets and non-performing loans to loans. The average SM had a higher equity-assets ratio and a higher non-performing loans-loans ratio. These might highlight that MM can decrease the risk in their portfolio through diversification in different geographic markets.

To sum up, the average SM has less geographic scope, is smaller, and has a simpler ownership structure. Hence a SM cannot enjoy economies of scale, economies of scope, or geographic risk diversification. But it can exploit informational advantages in relationship lending.

Finally, there does not exist observable differences in the number of branches per market of an incumbent bank of the SM or MM type. Both type of incumbents owned approximately 2 branches. This statistic is useful to rule out a posssible interpretation for the differences in sunk cost of entry between the 2 types: they are not driven by differences in the number of branches.

[3]Loans to businesses includes loans secured by nonfarm nonresidential property and commercial and industrial loans, and loans to farms includes loans secured by farmland and loans to finance agricultural production and other loans to farmers. Loans to small businesses are loans to businesses with amounts smaller than $ 1,000,000, and loans to small farms are loans to farms with amounts smaller than $ 500,000.

There is a caveat to the statistics in table 5. Given that most of the statistics are computed are the bank level, the selected sample might explain some of the observed differences between SM and MM. In short, a mean at the bank level for MM includes the lending practices in other markets where those banks are incumbents while a mean at the bank level for SM includes the lending practices in the markets in the sample. If lending practices are differ for those markets in the sample and not in the sample, those differences will be capture in difference in mean. The descriptive statistics should be interpreted with such limitation in mind.

Table 6 shows the distribution of market structures in the sample. Each cell gives the percentage of times that such market structure is observed in the data. The most observed market structure is a local market with 2 MM banks and 1 SM bank. The markets in the sample are concentrated markets: 75% of the observed markets have less than 4 incumbents of each type. It does not exist a clear pattern between banks types and market concentration which can drive the results such as SM being incumbents in more concentrated markets or viceversa. For example, a SM monopolist is observed 2.7% of the time and a MM monopolist is observed 3.8% of the time.

3.2.3 Potential Entrants.

Determining the number of potential entrants is always a difficult task in entry/exit models. At a minimum it requires using different alternatives and running a sensitivity analysis of the estimates to the different alternatives.

I use 2 different pools of entrants. For the first pool I assume one potential entrant of each type, and I drop a few markets which experience multiple entries. For the second pool I compute the maximum number SM incumbents in each market across time, and I define the number of SM potential entrants in period t as the difference between that maximum and the number of SM incumbents in period t. I apply the same procedure the number of MM potential entrants. The rationale behind this definition is that in each geographic market we observe all potential entrants being active at some point in time. Dunne, Klimek, Roberts, and Xu (2009) use a similar definition but for a model with homogenous firms.

3.2.4 Exit and Entry Definition.

The SOD has a bank code and a branch code variable. Unfortunately, the branch code variable is not completely reliable: it has 10% of missing values and it does not change in a consistent manner. Then I put an important effort in the construction of the longitudinal data set at the branch level. To match branches over time I use 7 variables: branch's FDIC code, bank's FDIC code, Bank Holding Company's FED code, address, city reported, ZIP code, state, and county. I use exact merge and fuzzy merge with different subsets of these variables. [4] The exact merge matched 95 % of the branch-year observations and the fuzzy merge matched 1.5 %-2 % of the branch-year observations.

The longitudinal data set at the branch level allows me to identify opening and closing of branches: a new branch in the data set is an opening, and a branch that drops from the data set is an closing. I use the branch code and branch's address to differentiate true opening and closing of branches from changes of ownership, i.e. a bank acquired by another bank or a bank selling some branches to another bank.

Finally, I identified entry of bank when a bank is not an incumbent in $t-1$ but is an incumbent in t and all its branches are opened in t. I identified exit of bank when a bank is an incumbent in $t-1$ but is not an incumbent in t and all its branches are closed in $t-1$. I do not consider an entry or an exit those situations where there is a change in ownership: when a bank acquired another bank or when a bank enters in a local market by buying branches from another bank.

I clean some cases from the data to avoid measurement error issues. Specifically, I do not consider as an entry or exit: a bank that enters and exit more than once in the same local market, and an entry/exit using the bank code but not the branch code. I also drop banks without deposits, and branches in Hawaii, Alaska, Puerto Rico or American Islands.

In table 7 I computed some entry and exist statistics for the different number of incumbents in the local market. There are some observation which are consistent with the empirical evidence in Dunne, Klimek, Roberts, and Xu (2009). First, though not shown in the table the number of entries and exits increase with the number of incumbents. This is not showing that there is more turnover in larger or more profitable markets. Second,

[4] For the fuzzy merge I use the command reclink in Stata which employs a bigram string comparator to assess imperfect string matches.

the entry proportion decreases with the number of incumbents. Third, the exit ratio does change with number of incumbents. So the number of entrants increases less that proportional with the number of incumbent but the number of exits increases proportionally with the number of incumbents. Without a structural model it is difficult to interpret whether this observation is driven by differences in the number of potential entrants, entry costs, or profitability. Four, the entry proportion is larger than the exit rate. This is evidence of the geographic expansion of banks after the deregulation and a quite profitable period for the banking industry. Also, the saving and loans crisis of the 80's and early 90's caused more inefficient banks to exit the industry, and this contributed to the lower exit rate afterwards.

More relevant for this paper are differences between SM and MM banks. I observe that the entry proportion is larger for SM than for MM banks, and the exit rate is slightly smaller for SM than MM banks. Such an evidence shows that the decrease in the number of SM branches was due either to SM banks downsizing, SM expanding to new local markets and becoming MM banks, or a MM banks acquiring a SM banks. But it is also true that SM banks were active players in the industry during this period. It is not clear whether SM banks continue to open branch because the face low entry cost than compensate demand or production cost disadvantages with respect to MM banks, or SM banks face higher entry costs that were compensated by informational advantages with respect to MM banks.

The structural model introduced in the next section tries to identified such differences in entry costs, demand, and production costs between SM and MM banks.

4 Model

The model is an oligopolistic model of entry/exit with imperfect information similar to Pakes, Ostrovsky, and Berry (2007)(POB). There are incumbent and potential entrant banks competing in geographic markets. Each period a bank observes a private information shock. An incumbent bank decides whether to continue or exit, and a potential entrant bank decides whether to enter or not. Banks choose optimal actions based on their beliefs about their competitors' behavior. In equilibrium, those beliefs are correct. The model departs from POB framework by allowing heterogeneity between banks based on their geographic scope: single-market and multimarket banks.

Both single-market and multimarket banks take entry/exit decisions separately in each market based on the market profitability. Such an assumption is reasonable for identification of heterogeneity between single-market and multimarket banks in several dimensions: preferences, technology, sell-off value, and sunk costs of entry.

There are $m \in \{1, 2, \ldots, M\}$ geographic markets and infinite periods $t \in \{1, 2, \ldots, \infty\}$. Banks are indexed by $i \in \mathcal{N}$, where the set of banks $\mathcal{N}$ can be partitioned in the set of multimarket banks and the set of single-market banks.

Bank's profitability depends on common knowledge and private information state variables. Common knowledge state variables are number of incumbents of type $\tau \in \{1, 2\}$, n^{τ}_{mt}, and market state variables, z_{mt}. The private information state variable for the incumbent is its sell-off value ϕ^{τ}_{imt}, and for the potential entrant is its sunk cost of entry κ^{τ}_{imt}.

The timing of the game is as follows. First, a bank observes the number of incumbents, the market state, and its private information realization. Second, banks simultaneously choose actions. Third, entrants pay the entry cost and incumbents earn the operating profits. Finally, at the end of the period, exiters earn the sell-off value, entrants become incumbents, and the market evolves to a new state. The timing is summarized in figure 1.

The incumbent has a period profit function

$$\Pi^{\tau}_{imt} = \begin{cases} \pi^{\tau}(n^1_{mt}, n^2_{mt}, z_{mt}; \theta^{\tau}_P) & \text{if } a^{\tau}_{imt} = 1, \\ \pi^{\tau}(n^1_{mt}, n^2_{mt}, z_{mt}; \theta^{\tau}_P) + \beta\, \phi^{\tau}_{imt} & \text{if } a^{\tau}_{imt} = 0, \end{cases}$$

where $\pi^{\tau}(.; \theta^{\tau}_P)$ is the bank operating profit function parameterized by θ^{τ}_P, β is the discount factor, and a^{τ}_{imt} is the action continue/exit for the type τ incumbent or enter/not enter for the type τ potential entrant. The period profit function is consistent with the timing of the game: incumbents earns the operating profits, and, at the end of the period, exiters receive the sell-off value.

The potential entrant has a period profit function

$$\Pi^{\tau}_{imt} = \begin{cases} -\kappa^{\tau}_{imt} & \text{if } a^{\tau}_{imt} = 1, \\ 0 & \text{if } a^{\tau}_{imt} = 0. \end{cases}$$

I assume that potential entrants are short-lived to avoid timing of entry issues. Entrants pay the entry cost this period but become incumbents next period, not entrants receive a zero payoff.

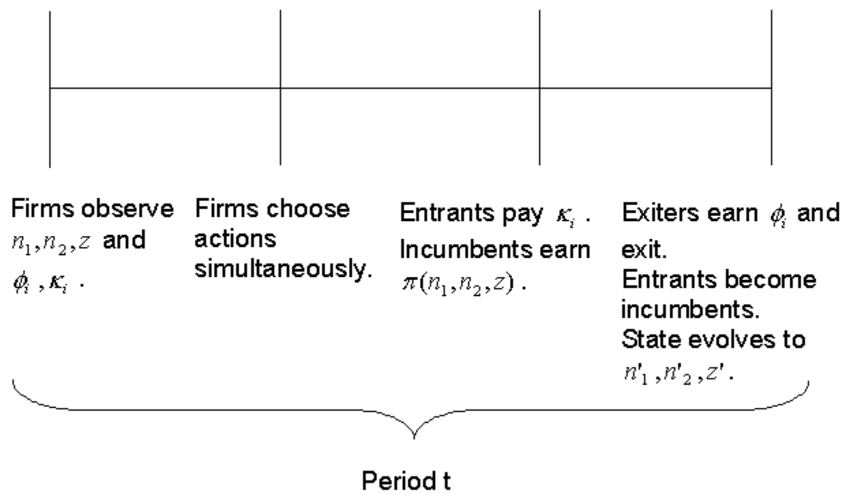

Figure 1: Timing of the game in period t.

Private information shocks are IID over banks, markets, and time with CDFs,

$$\phi^{\tau}_{imt} \sim F(.;\theta^{\tau}_X),$$
$$\kappa^{\tau}_{imt} \sim G(.;\theta^{\tau}_E).$$

θ^{τ}_X and θ^{τ}_E are the parameters of the sell-off value CDF and entry cost CDF. Although the entry costs and sell-off values are private information, their CDF is common knowledge.

To simplify notation the set of parameters is denoted by $\theta = (\theta^{\tau}_P, \theta^{\tau}_X, \theta^{\tau}_E)^2_{\tau=1}$, the set of common knowledge variables is denoted by $s = (n^1, n^2, z)$, and the private information shock is denoted generically by ν_i.

Each bank maximizes the discounted expected value of future profits,

$$\mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t \pi_i(a_{imt}, s_{mt}, \nu_{imt}) | s_{m0}, \nu_{im0}\right],$$

where the expectation is taken over beliefs about its competitors' actions and the evolution of the market state.

I focus on Markov Perfect Equilibria (MPE) of the game. A MPE is a Subgame Perfect equilibrium in payoff relevant strategies or Markov strategies. Formally, a Markov strategy is a mapping $\sigma_i(s, \nu_i) \mapsto \{0, 1\}$ which assigns an action to each possible realization of the state variables. A Markov strategy profile $\sigma = (\sigma_1, \ldots, \sigma_N)$ assigns an action to each player. Then a Markov strategy is a MPE if and only if for all s, ν_i, i, and alternative strategies σ'_i,

$$V_i(s, \nu_i|\sigma_i, \sigma_{-i}) \geq V_i(s, \nu_i|\sigma'_i, \sigma_{-i}),$$

where $V_i()$ is the value function of bank i associated to the corresponding strategy profile. I focus on symmetric MPE thus a Markov strategy for an incumbent and a potential entrant of each type completely characterize the equilibrium.

The integrated value function is the value function with the private information shock integrated out. Under an IID assumption for the private information shock there is no loss of generality in working with the integrated value function.

The integrated value function for the incumbent can be written as the solution of a functional equation:

$$V^{\tau}_{in}(s; \theta) = \pi^{\tau}(s; \theta^{\tau}_P) + \beta \int [\max\{\phi^{\tau}_i, VC^{\tau}(s; \theta)\}]\, dF(\phi^{\tau}_i; \theta^{\tau}_X), \quad (1)$$

$$VC^{\tau}(s; \theta) = \sum_{s'} V^{\tau}_{in}(s'; \theta) P^{\tau}_{in}(s'|s, a^{\tau}_i = 1). \quad (2)$$

$VC^{\tau}()$ is the continuation value, i.e. the expected value function next period conditional on the state today and the bank continuing. $P^{\tau}_{in}()$ is the transition probability for the state variables conditional on continuing and it embodies the beliefs about its competitors' strategies. Equations (1) and (2) can be solved for the integrated value function or the continuation value, but it is more convenient to write optimal policies in terms of the continuation value.

The optimal choice for a type τ incumbent is to exit if $\phi^{\tau}_i > VC^{\tau}()$, otherwise to continue. The exit probability of a type τ bank i is the expected behavior of the bank before the realization of the private information shock,

$$\begin{aligned} Pr(\tau\, exits|s; \theta) &= Pr(\phi^{\tau}_i > VC^{\tau}(s; \theta)), \\ &= 1 - F(VC^{\tau}(s; \theta); \theta^{\tau}_X). \end{aligned} \quad (3)$$

Given arbitrary beliefs on rivals strategies equation (3) is the expected best response of type τ bank, but it is the expected behavior of bank i if other firms are playing equilibrium strategies.

The integrated value function for the potential entrant can be obtained as the solution of the following equation

$$V_{en}^{\tau}(s;\theta) = \max\{0, -\kappa_i^{\tau} + \beta VE^{\tau}(s;\theta)\}, \tag{4}$$

$$VE^{\tau}(s;\theta) = \sum_{s'} V_{in}^{\tau}(s';\theta)P_{en}^{\tau}(s'|s, a_i^{\tau} = 1). \tag{5}$$

$VE^{\tau}()$ is the entry value or expected value of a potential bank next period conditional on entry, and $P_{en}^{\tau}()$ is the transition probability of the state variables conditional on entry. The entry value is a function of the continuation value through the incumbent value function.

The optimal choice for a type τ potential entrant is to enter if $\kappa_i^{\tau} < \beta VE^{\tau}()$, otherwise not entering is optimal. The entry probability of a type τ bank is

$$\begin{aligned} Pr(\tau\, enters|s;\theta) &= Pr(\kappa_i^{\tau} \leq \beta VE^{\tau}(s;\theta)), \\ &= G(\beta VE^{\tau}(s;\theta);\theta_E^{\tau}). \end{aligned} \tag{6}$$

The econometric implementation rests on the structural exit probability in equation (3) and the structural entry probability in equation (6). The estimation strategy is based on finding parameter values that minimize the distance between theoretical and observed exit and entry probabilities. Under similar observed entry probabilities for MM and SM banks can lay heterogeneity in different economic primitives: profitability, sell-off values, or entry costs. I take a agnostic position by imposing the economic structure, and using the data to identify the parameters that affects the entry/exit behavior of MM and SM banks.

5 Empirical Implementation

I estimate the parameters of the model using a two-stage procedure. In the first stage I obtain an estimation of VC and VE based on operating profit function, exit probability, and transition probability estimates. In the second stage I use the estimated continuation value $\widehat{VC}$ and entry value $\widehat{VE}$ to compute theoretical exit and entry probabilities that depend on θ. Then the parameter estimates are those values that minimize a distance between theoretical and observed probabilities.

I assume that sell-off values follow an exponential distribution, and entry costs follow a logistic distribution. The exponential assumptions allows me to obtain an explicit expression for $\widehat{VC}$, but it can be replaced by another parametric distribution at the cost of complicating the computation of $\widehat{VC}$. The exponential probability has also the nice property to impose the sell-off values to be positive. In theory the CDF for entry costs is non-parametrically identified, in practice data constraints require to assume a parametric distribution. I choose the logistic distribution because is similar to the normal distribution but more convenient analytically so it helps me to decrease computational time. Notice that the independent of irrelevant alternatives critique of the logistic does not apply here because there are only two choices: continue/exit or entry/no entry.

Assumption 1. *Distribution of entry costs and sell-off values.*

1. *The sell-off values follow an exponential distribution with mean and variance θ_X^τ,*

$$F(\phi;\theta_X^\tau) = 1 - \exp\left(\frac{\phi}{\theta_X^\tau}\right) \text{ with } \phi \in (0,\infty). \tag{7}$$

2. *The entry costs follow a logistic distribution with mean θ_E^τ and variance $\pi^2/3$,*

$$G(\kappa;\theta_E^\tau) = \frac{\exp(\kappa - \theta_E^\tau)}{1+\exp(\kappa - \theta_E^\tau)} \text{ with } \kappa \in \mathbb{R}. \tag{8}$$

θ_E^τ can depend on market size to allow the mean sunk cost of entry to increase with market size. Moreover, the effect of market size on sunk cost of entry can be different for SM and MM banks. In the estimation I explore these possibilities.

I assume that z follows an exogenous Markov process. This assumption helps to alleviate the curse of dimensionality when estimating transition matrices nonparametrically.

Assumption 2. *Exogenous Markov process for z. z follows an exogenous first order Markov process, $Pr(z'|n^1, n^2, z, a) = Pr(z'|z)$.*

For an exponential distributed random variable, $\mathbb{E}[\phi_i^\tau|\phi_i^\tau > VC^\tau] = \theta_X^\tau + VC^\tau$ holds. Then the VC can be written as,

$$VC^\tau(s;\theta) = \sum_{s'} \left\{\pi^\tau(s';\theta_P^\tau) + \beta\, P_{exit}^\tau(s')\,\theta_X^\tau + \beta\, VC^\tau(s';\theta)\right\} P_{in}^\tau(s'|s, a_i^\tau = 1),$$

where $P^{\tau}_{exit}(s)$ is the reduced form exit probability in state s. Such a functional equation can be solved for the continuation value in matrix form as

$$VC^{\tau}(\theta) = [I - \beta M^{\tau}_{in}]^{-1} M^{\tau}_{in}[\pi^{\tau}(\theta^{\tau}_{P}) + \beta P^{\tau}_{exit}\, \theta^{\tau}_{X}], \tag{9}$$

where VC^{τ},π^{τ},P^{τ}_{exit} are vectors that stack the continuation value, operating profit, and exit probability in each state, M^{τ}_{in} is a matrix with the transition probability between states conditional on the incumbent continuing, and I is the identity matrix. Analogously the entry value can be written in matrix form as

$$VE^{\tau}(\theta) = M^{\tau}_{en}[I + \beta(I - \beta M^{\tau}_{in})^{-1} M^{\tau}_{in}][\pi^{\tau}(\theta^{\tau}_{P}) + \beta P^{\tau}_{exit}\, \theta^{\tau}_{X}], \tag{10}$$

where M^{τ}_{en} is a matrix with the transition probability between states conditional on entering in the market.

The first stage of the estimation entails obtaining estimates of operating profit function, transition probability for market state, exit and entry probabilities, and transition probabilities, and use them to estimate continuation and entry values.

5.1 First Stage Estimation.

5.1.1 Profit Function.

The parameters of the operating profit function can be estimated with operating profits and covariates data without imposing the dynamic model.

Unfortunately I cannot observe bank's operating profits at the market level, but I observe the deposits held in a bank in a local market and I can compute average interest rates, wage expenditure, and other costs at the bank level. Using the available data I compute a measure of bank's operating profits using $\pi_{imt} = q_{imt}\,(r^{L}_{it} - r^{D}_{it}) - wages_{imt} - other_{imt}$ where q_{imt} are deposits held by bank i in market m, r^{D}_{it} is the bank's average deposit interest rate, r^{L}_{it} is the bank's average loan interest rate (adjusted by default rates), $wages_{imt}$ is the wage expenditure in the market, and $other_{imt}$ is other costs incurred by the bank in the market.

Such a measure of operating profits is reasonable because loans and deposits are the main retail activities carried out by banks. Measurement error in average interest rates measured at the bank level rather than the bank-market level is a minor concern since empirical evidence supports MM banks charging uniform prices at the state level.[5] The estimating equation for the operating profit function is,

$$\pi^{\tau}_{imt} = \sum_{\tau=1}^{2} \mathbf{1}(i \in \tau)\, g^{\tau}(n^1_{mt}, n^2_{mt}; \theta^{\tau}_{RN}) + \theta'_{RZ}\, z_{mt} + \eta_m + u_{imt}, \tag{11}$$

where

$$\begin{aligned} g^{\tau}(n^1_{mt}, n^2_{mt}; \theta^{\tau}_{RN}) = & \theta^{\tau}_{0,RN} + \theta^{\tau}_{1,RN} \times \text{presence of first type } \tau \text{ competitor} \\ & + \theta^{\tau}_{2,RN} \times \text{presence of second type } \tau \text{ competitor} \\ & + \theta^{\tau}_{3,RN} \times \text{additional type } \tau \text{ competitors} \\ & + \theta^{\tau}_{4,RN} \times \text{presence of first type } \tau' \text{ competitor} \\ & + \theta^{\tau}_{5,RN} \times \text{presence of second type } \tau' \text{ competitor} \\ & + \theta^{\tau}_{6,RN} \times \text{additional type } \tau' \text{ competitors,} \end{aligned}$$

where η_m is a market fixed effect, and z_{mt} includes population and income per capita in the local market. Controlling for unobserved market profitability is important for two reasons. First, an unobserved variable positively correlated with both own profitability and rival's presence creates a positive bias in the estimates. Second, the estimated market fixed effects are used as unobserved correlated state variables in the dynamic game.[6] I estimate equation (11) by OLS with variance-covariance matrix robust to heteroscedasticity, and time series and within market correlation.

5.1.2 Transition Probability for Market State Variables.

Market state variables include the observable and unobservable market state variables, (z_{mt}, η_m). I classify market in 3 groups using η_m, and estimate transition probability for each type using a nonparametric estimator.

To apply a non-parametric estimator I discretize the market state variables. First, I use the estimated market fixed effects to classify markets in 3 groups: low, medium, and high

[5] Some papers showing empirical evidence of uniform pricing are Biehl (2002) and Heitfield and Prager (2004).

[6] Dunne, Klimek, Roberts, and Xu (2009) follow a similar procedure in their paper about dentists and chiropractors.

profitable markets. I choose the same number of markets for each group and I assign the group mean to each bank in the group. Second, I work with $\hat{z}_{mt} = \hat{\theta}'_{RZ} z_{mt}$ to reduce the dimensionality of z. Then, I choose 10 group specific bins for $\hat{z}_{mt}$ such that they contain the same number of observations and I assign the mean value of $\hat{z}_{mt}$ to each bin. Finally, I estimate separate transition probabilities for each market type $\widehat{M}_z$ using a non-parametric estimator:

$$\widehat{M}_z(i,j) = \frac{\sum_{(m,t)\in T(z_i)} \mathbf{1}(z_{m,t+1} = z_j)}{\#T(z_i)}.$$

$M_z(i,j)$ is the estimated probability of being in state z_j tomorrow give the market is in state z_i, $T(z)$ is the set of observations with market state z, and $\#T(z)$ is the number of observations in $T(z)$.

5.1.3 Exit and Entry Probability.

The exit probability of a type τ bank is estimated as the mean of observed exit probabilities. Let $T(n^1, n^2, z) = \{(m,t) : (n^1_{mt}, n^2_{mt}, z_{mt}) = (n^1, n^2, z)\}$ be the set of observations satisfying a given state configuration. Then the estimated exit probability is

$$\widehat{P}^{\tau}_{exit}(s) = \frac{1}{\#T(n^1, n^2, z)} \sum_{(m,t)\in T(n^1,n^2,z)} \frac{x^{\tau}_{mt}}{n^{\tau}}.$$

The entry probability of a type τ bank is estimated as the mean of observed entry probabilities:

$$\widehat{P}^{\tau}_{entry}(s) = \frac{1}{\#T(n^1, n^2, z)} \sum_{(m,t)\in T(n^1,n^2,z)} \frac{e^{\tau}_{mt}}{E^{\tau}_{mt}},$$

where e^{τ}_{mt} is the number of type τ entrants, and $E^{\tau}_{mt}$is the number of type τ potential entrants. In general is difficult to identify potential entrants so I follow different approaches. I estimate the maximum number of type τ banks in a market as $N^{\tau}_m = \max_t(n^{\tau}_{mt})$, so the number of potential entrants is $E^{\tau}_{mt} = N^{\tau}_m - n^{\tau}_{mt}$. Another approach is to assume one potential entrant of each type per market. Though both approaches are imperfect, the estimation results are robust to the chosen potential entrant definition.

5.1.4 Incumbent and Potential Entrant Transition Probability.

Transition probability estimates are weighted nonparametric estimators with weights given by the number of incumbents that continue or the number of entrants. The probability of n_j^1, n_j^2 conditional on being in n_i^1, n_i^2, z_i and the type τ incumbent continuing is estimated by

$$\widehat{M}_{in,n}^{\tau}(i,j) = \frac{\sum_{(m,t)\in T(n_i^1,n_i^2,z_i)}(n_i^{\tau} - x_{mt}^{\tau})\mathbf{1}((n_{m,t+1}^1, n_{m,t+1}^2) = (n_j^1, n_j^2))}{\sum_{(m,t)\in T(n_i^1,n_i^2,z_i)}(n_i^{\tau} - x_{mt}^{\tau})}.$$

The probability of n_j^1, n_j^2 conditional on being in n_i^1, n_i^2, z_i and the type τ bank entering is estimated by

$$\widehat{M}_{en,n}^{\tau}(i,j) = \frac{\sum_{(m,t)\in T(n_i^1,n_i^2,z_i)} e_{mt}^{\tau}\mathbf{1}((n_{m,t+1}^1, n_{m,t+1}^2) = (n_j^1, n_j^2))}{\sum_{(m,t)\in T(n_i^1,n_i^2,z_i)} e_{mt}^{\tau}}.$$

Estimation of the type τ incumbent transition probability matrix $\widehat{M}_{in}^{\tau}$ derives directly from $\widehat{M}_{in,n}^{\tau}$ and $\widehat{M}_z$, and similarly for the type τ entrant transition probability matrix $\widehat{M}_{en}^{\tau}$.

5.1.5 Estimation of Continuation and Entry Values.

Plugging $\widehat{R}^{\tau}$, $\widehat{P}_{exit}^{\tau}$, and $\widehat{M}_{in}^{\tau}$ in equation (9) we obtain an estimation of the continuation value

$$\widehat{VC}^{\tau}(\theta) = \widehat{W}_{in,0}^{\tau}\,\widehat{R}^{\tau} - \widehat{W}_{in,1}^{\tau}\,\theta_{FC}^{\tau} + \widehat{W}_{in,2}^{\tau}\,\theta_X^{\tau}, \tag{12}$$

where $\widehat{W}_{in,0}^{\tau} = [I - \beta\widehat{M}_{in}^{\tau}]^{-1}\widehat{M}_{in}^{\tau}$, $\widehat{W}_{in,1}^{\tau} = \widehat{W}_{in,0}^{\tau}\iota$, and $\widehat{W}_{in,2}^{\tau} = \widehat{W}_{in,0}^{\tau}\beta\widehat{P}_{exit}^{\tau}$. Similarly, plugging $\widehat{R}^{\tau}$, $\widehat{P}_{exit}^{\tau}$, $\widehat{M}_{in}^{\tau}$, and $\widehat{M}_{en}^{\tau}$ in equation (10) we obtain an estimation of the entry value

$$\widehat{VE}^{\tau}(\theta) = \widehat{W}_{en,0}^{\tau}\,\widehat{R}^{\tau} - \widehat{W}_{en,1}^{\tau}\,\theta_{FC}^{\tau} + \widehat{W}_{en,2}^{\tau}\,\theta_X^{\tau}, \tag{13}$$

where $\widehat{W}_{en,0}^{\tau} = \widehat{M}_{en}^{\tau}[I + \beta(I - \beta\widehat{M}_{in}^{\tau})^{-1}\widehat{M}_{in}^{\tau}]$, $\widehat{W}_{en,1}^{\tau} = \widehat{W}_{en,0}^{\tau}\iota$, and $\widehat{W}_{en,2}^{\tau} = \widehat{W}_{en,0}^{\tau}\beta\widehat{P}_{exit}^{\tau}$. Estimated continuation and entry value are linear functions of the parameters of interest.

5.2 Second Stage Estimation.

In the second stage, the estimated continuation and entry value are used to construct theoretical probabilities that depend on the parameters. The estimates are those parameter values than minimize a distance between theoretical and observed probabilities.

Plugging the estimated continuation value in equation (9) in the exit probability in equation (3) and using the distributional assumption, the theoretical exit probability is

$$Pr(\tau\, exit|s;\theta,\widehat{P}) = \exp\left\{-\frac{1}{\theta_X^\tau}[\widehat{W}_{in,0}^\tau(s)\,\widehat{R}^\tau(s) - \widehat{W}_{in,1}^\tau(s)\,\theta_{FC}^\tau + \widehat{W}_{in,2}^\tau(s)\,\theta_X^\tau]\right\}. \tag{14}$$

$\widehat{P}$ denotes the exit and transition probabilities used to estimate the continuation value. Plugging the estimated entry value in equation (10) in the entry probability in equation (6) and using the distributional assumption, the theoretical entry probability is

$$Pr(\tau\, entry|s;\theta,\widehat{P}) = \frac{\exp\left\{\beta[\widehat{W}_{en,0}^\tau(s)\,\widehat{R}^\tau(s) - \widehat{W}_{en,1}^\tau(s)\,\theta_{FC}^\tau + \widehat{W}_{en,2}^\tau(s)\,\theta_X^\tau] - \theta_E^\tau\right\}}{1+\exp\left\{\beta[\widehat{W}_{en,0}^\tau(s)\,\widehat{R}^\tau(s) - \widehat{W}_{en,1}^\tau(s)\,\theta_{FC}^\tau + \widehat{W}_{en,2}^\tau(s)\,\theta_X^\tau] - \theta_E^\tau\right\}}.$$

Finally, I apply a minimum distance estimator that minimize a metric in the difference between theoretical and empirical probabilities,

$$\widehat{\theta} = \arg\max_{\theta\in\Theta}(\widehat{\pi} - \widehat{h}(\theta))' A_T(\widehat{\pi} - \widehat{h}(\theta)),$$

where $\widehat{\pi} = (\widehat{P}_X^{1\prime}, \widehat{P}_X^{2\prime}, \widehat{P}_E^{1\prime}, \widehat{P}_E^{2\prime})'$ is the vector that stacks the reduce form probabilities for each state, $\widehat{h}(\theta) = (Pr^1(exit;\theta,\widehat{P})', Pr^2(exit;\theta,\widehat{P})', Pr^1(entry;\theta,\widehat{P})', Pr^2(entry;\theta,\widehat{P})')'$ is the vector that stacks the theoretical probabilities for each state, and A_T is matrix that weights the different equalities.

The weighting matrix A_T is block diagonal with blocks

$$A_T(i,i) = \begin{pmatrix} \frac{\#T(s_1)^2}{T^2} & \frac{2\,\#T(s_1)\#T(s_2)}{T^2} & \cdots & \frac{2\,\#T(s_1)\#T(s_S)}{T^2} \\ \frac{2\,\#T(s_1)\#T(s_2)}{T^2} & \frac{\#T(s_2)^2}{T^2} & \cdots & \frac{2\,\#T(s_2)\#T(s_S)}{T^2} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{2\,\#T(s_1)\#T(s_S)}{T^2} & \frac{2\,\#T(s_2)\#T(s_S)}{T^2} & \cdots & \frac{\#T(s_S)^2}{T^2} \end{pmatrix},$$

where $\#T(s)$ is the number of observation in state s, and T is the total number of observations. A_T is not the asymptotic optimal matrix but reduces the finite bias, and it is equivalent to the method of moments estimator proposed by Pakes, Ostrovsky, and Berry (2007). Pesendorfer and Schmidt-Dengler (2007) call this class of estimators asymptotic least square estimators and prove consistence and asymptotic normality. Usual standard errors are not valid due to the estimation error in the first stage thus standard errors are computed using a non-parametric bootstrap.

6 Empirical Results

In this section I comment the results of the estimation. The main results are that a single-market bank has a profit advantage over a multimarket bank, but it pays a higher entry cost. Such higher entry cost estimate for SM banks is driven by the profit advantage estimated in the first stage and the lower entry of SM banks observed in the data.

6.1 Profit Function.

The estimates of the profit function shown in table 9 have the expected sign, and are statistically significant. A single-market bank has an advantage in profits over a multi-market bank, increasing competition decreases profits, and a bigger market size increases profits. A possible concern for the second stage is the fit of the model to the data: the model explains 2.6% of the within profit variation. Although this is expected given such simple econometric model, it may signal the need of a richer model of firm heterogeneity to capture the variability observed in the operating profit data.

The single-market dummy is positive and significant at 1%: in mean the profits of a single-market monopolist bank is 0.2 million $ higher than the profits of a multimarket monopolist bank. For the market configuration more common in the data with 1 SM and 2 MM banks the model predicts an average period profit for a SM bank of 1.1 million $ and for a MM bank of 0.96 million $. The result is robust to different specifications of the operating profit function and alternative operating profit definitions. A related result is obtained by Adams, Brevoort, and Kiser (2007) who estimate a deposit demand using a generalized extreme value model, and find that a SM bank faces a less elastic demand than a MM bank.

A plausible explanation for this SM advantage is the soft vs hard-information story.

The main idea is that there are different types of loans: transaction loans and relationship loans. Transaction loans are based on hard information like financial statements, collateral, covenants, credit scoring, etc. Relationship loans are based on soft information collected through repeated lender-borrower interactions. The crucial point is that soft information cannot flow easily within a formal organizational structure, and this creates an advantage for less hierarchical organizations like SM banks. And it is natural to think on smaller businesses relying more in relationship lending.

Complementary evidence supporting this idea is provided by Berger, Bonime, Goldberg, and White (2004). Berger, Bonime, Goldberg, and White (2004) find an increase in entry of small banks after a large bank acquires a small incumbent bank. The authors interpret their findings as small banks entering to supply credit to some relationship-dependent small businesses.

Another explanation is that a MM bank obtains a higher proportion of its operating profit from sources like brokerage fees, securitization, etc. which are not directly included in the operating profit approximation use in the empirical application. Such a operating profit approximation seems more suitable to analyze retail banking activity which is the focus of the paper.

The effect of increasing competition is negative and most of them are significant. The magnitude of the marginal effects is reasonable. When there exist 1 SM incumbent and 2 MM incumbents, the expected effect of an additional SM competitor is to decrease the profit of the SM incumbent in .086 million $ and to decrease the profit of a MM incumbent in .153 million $. While the expected effect of an additional MM competitor is to decrease the profit of the SM incumbent in .101 million $ and to decrease the profit of a MM incumbent in .087 million $.

The effect of increasing competition on operating profit is quantitatively similar for competitors of different types, and for the first, second, or additional competitors. Cohen and Mazzeo (2007) use data for banks and thrifts in 2001 and 2003, and exploit the cross-section variation in the number of competitors and market size to estimate a profit function for banks. They conclude that competition among banks of the same type is greater than competition among different types, and find decreasing effects of the number of competitors on profits. Adams, Brevoort, and Kiser (2007) also find greater cross price elasticities within types than between types.

The effect of average wage, number of business establishments, and number of employees in the geographic market have the expected positive sign while the effect of population and income per capita have an negative sign. These results are not surprising given that the market size regressors are highly collinear but I choose to keep all of them in the regression to capture more variability of the operating profits. I tried alternatives functional forms: quadratic, logarithmic, interacted with income per capita. The estimates were robust to the different specifications I choose a more simple model with a linear functional form.

6.2 Market State Variables.

The methodology I apply for the estimation requires a discrete state space. Number of incumbents of each type is a discrete variable, but the market variables must be discretized. Following Dunne, Klimek, Roberts, and Xu (2009) to reduce the dimensionality of the market state variables I use the estimated coefficients to construct a new artificial variable that capture the effects of population and income per capita. I work with the market state variable $\hat{z}_{mt} = \theta_{RZ} z_{mt}$ where z_{mt} is population and income per capita and θ_{RZ} are the estimated coefficients of those variables. Then, I choose 10 group specific bins for $\hat{z}_{mt}$ such that they contain the same number of observations and I assign the mean value of $\hat{z}_{mt}$ to each bin.

Table 8 shows descriptive statistics for each market state. Given that the coefficient on population is positive and the coefficient on income per capita is negative, the market state tends to be lower for markets with low population and high incomer, and it tends to be higher for markets with high population and low income. The average population is 2,208 inhabitants for the 1st group, and increases up to 60,000 for the 10th group. The increasing differences in average population between contiguous groups is due to the skewed population distribution.

As expected the number of banks, single-market banks, and multimarket banks are increasing in the market state. But the number of MM banks increases at a faster rate than the number of SM banks. It seems that MM banks presence is relatively greater in more profitable markets, while the SM presence is relatively greater in less profitable markets.

Population per bank and operating profit per bank are increasing in the market state. If we associate market state with population, the results are in line with Bresnahan and Reiss (1991)'s seminal paper. Increasing competition decreases markups, and a firm needs a larger demand to cover its fixed costs. Note that operating profit increases at the lower rate than population which seems to confirm the competition story.

6.3 Sell-off Values and Entry Costs.

I estimate the sell-off values and entry costs using a minimum distance estimator. I minimize the objective function using a Compass Search algorithm. The standard errors are computed using a non-parametric bootstrap.

The results of the sell-off value and sunk cost of entry estimation are in table 10. The sell-off estimates are basically zero which is not surprising given the low exit probability in the data. It is reasonable that banks do not close many branches in a period characterized by expansion in the number of branches. Likely many of the non-profitable branches were closed during the saving a loan crisis of the '80s. The reluctancy of banks to close branches can be explained by brand concerns when closing branches.

The main result in the entry cost estimation is that SM banks face a higher entry costs than MM banks, and the cost of a bank which decides to enter in a new local market is around 10 million $ for a SM bank and 7 million $ for a MM bank. Up to my knowledge, there has been no attempt at measuring entry costs in the banking industry, and the results and interpretations should be consider as a first approach to the issue.

The estimated differences in sunk cost of entry are driven by differences in operating profit: SM banks have a operating profit advantage, so they should face a higher entry cost if they enter in same proportion as MM banks. The result is robust to the pool of potential entrants used. The second pool of potential entrants shows a higher mean entry rate for SM banks and a I expect a decrease in the entry costs differential. But I obtain the opposite result: the entry cost differential increases with the second potential entrant definition.

A SM bank should pay a entry costs which is around 3 million $ higher than a MM bank. In relative terms it is a 30 % more expensive for a SM bank to enter in a new market than for a MM bank. There are some plausible explanations for the cost differential. In general, a SM bank which enters in a new market is a denovo bank and a denovo bank must pay start-up costs than a bank already operating avoid. Though, a MM bank that enter in a new state could face some red tape costs, it is reasonable to assume that are less important. Advertisement can be in part fixed at the bank, at in part fixed at the bank-market level. A MM bank has economies of scale advantages over the bank level or institutional advertisement. Another factor is hiring costs for management positions. A multimarket bank has many branches in different local markets, and could find it less costly to look for a manager for a new branch: directors can promote an employee to a manager position , or reallocate a manager from another branch. A single-market bank has to search for a manager in the job market which is more costly.

Finally, as expected entry costs are higher the higher the market size. But though this effect is higher for MM banks than SM banks does not close the gap between both types of banks in larger markets.

7 Conclusions

Historic restrictions to the geographic expansion of banks has greatly affected the market structure of the US banking industry. 60% of the banks have presence in only 1 local market: they are single-market banks. Recent deregulation, the most important in 1994, has created some tension within the SM bank community. Though the welfare and competitive effects of such market structure are not entirely clear, there is evidence that some economic sectors like farmers and small businesses benefit directly from the presence of SM banks.

This paper contributes to the understanding of the differences between these 2 types of business models that coexist in the same industry, and in particular to the future viability of the SM business model.

An important result of the paper is that SM incumbents banks are profitable and even more profitable than MM bank in retail banking activities. This operating profit advantages can be trace to relationship lending advantage which seems to be important in my sample. This result is supported by demand estimates (Adams, Brevoort, and Kiser (2007)) and observed entry patterns of SM banks(Berger, Bonime, Goldberg, and White (2004)).

The main contribution of the paper is the estimation of sunk costs of entry: SM has to pay a entry costs which is 30% higher than a MM bank. This higher entry costs can be linked to start up costs, or higher advertisement and recruitment costs faced by SM banks.

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A Figures and Tables

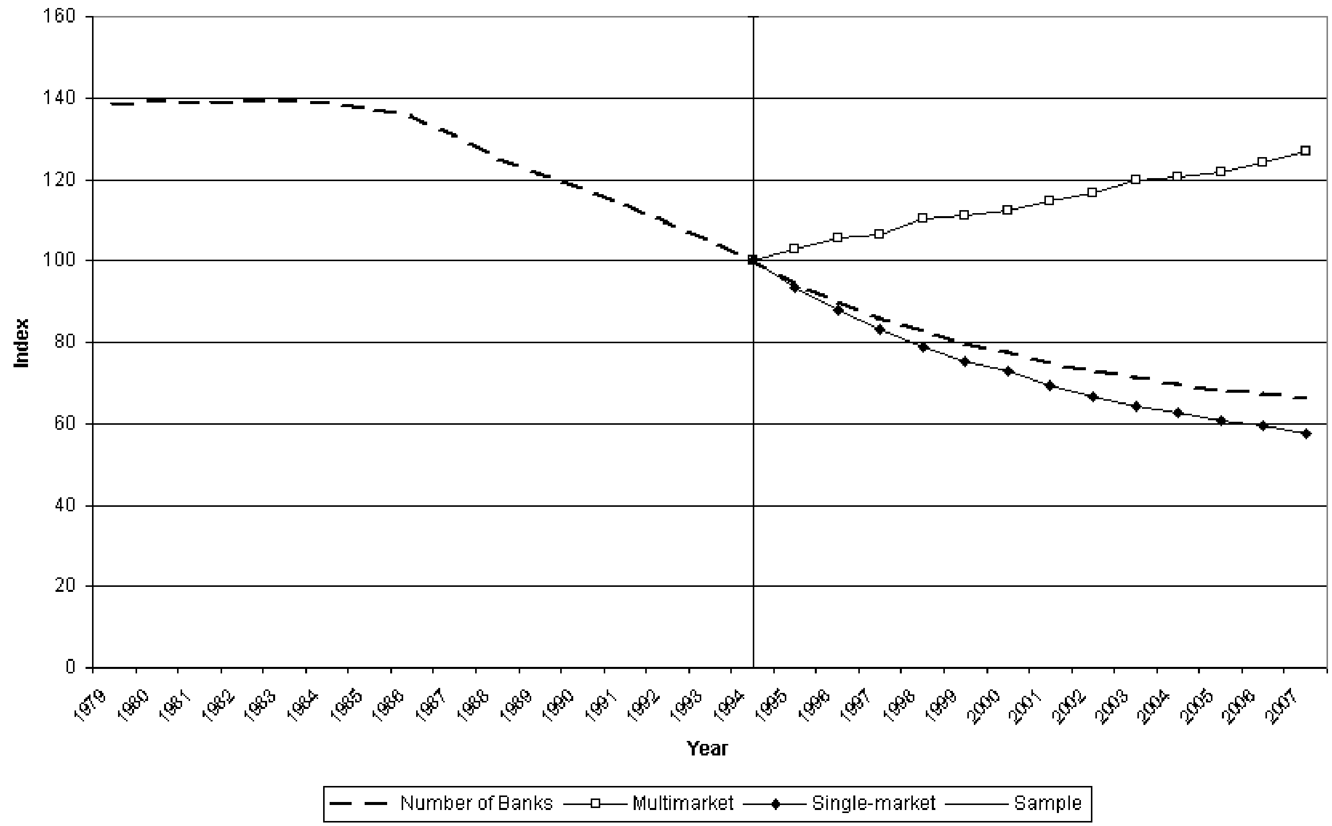

Figure 2: Number of Banks. US Commercial Banks. 1979-2007. Index 1994=100.

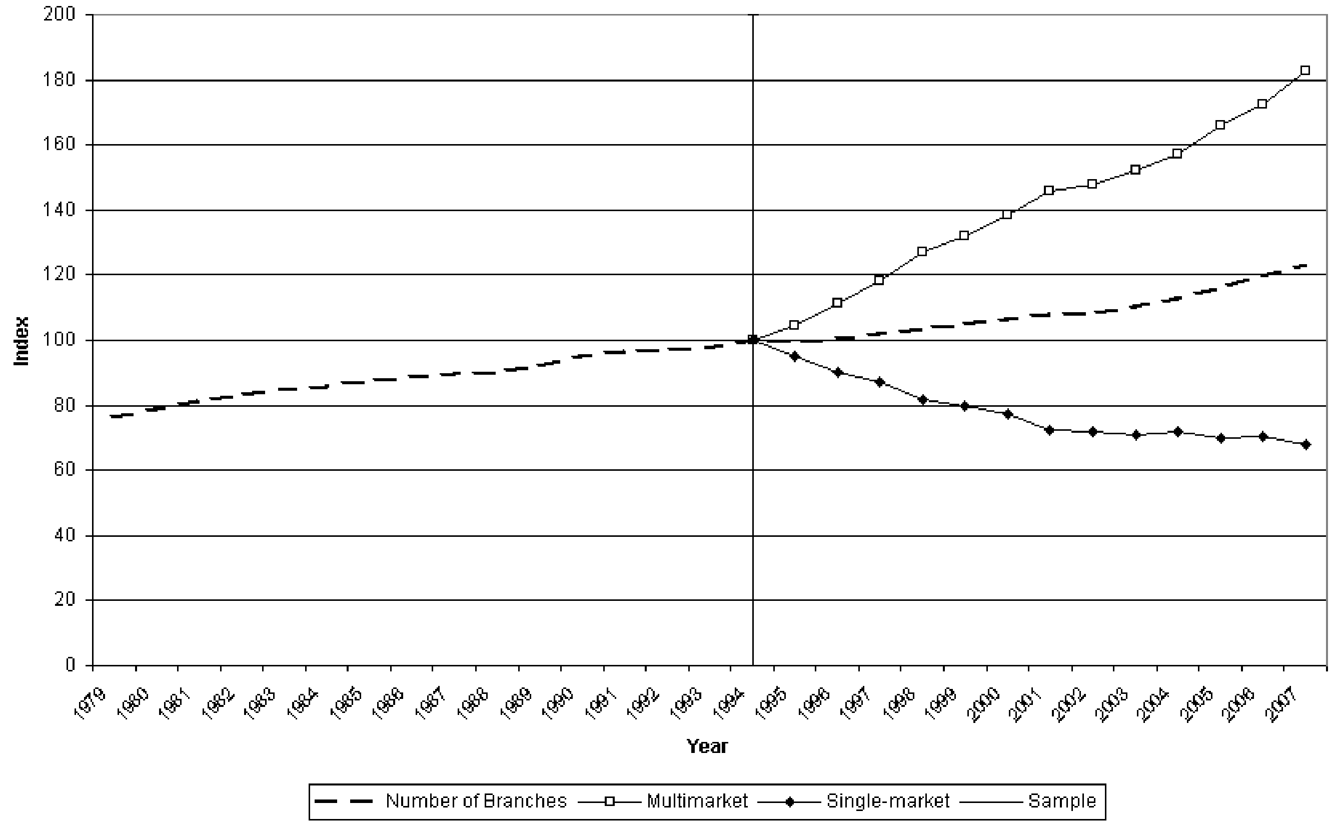

Figure 3: Number of Branches. US Commercial Banks. 1979-2007. Index 1994=100.

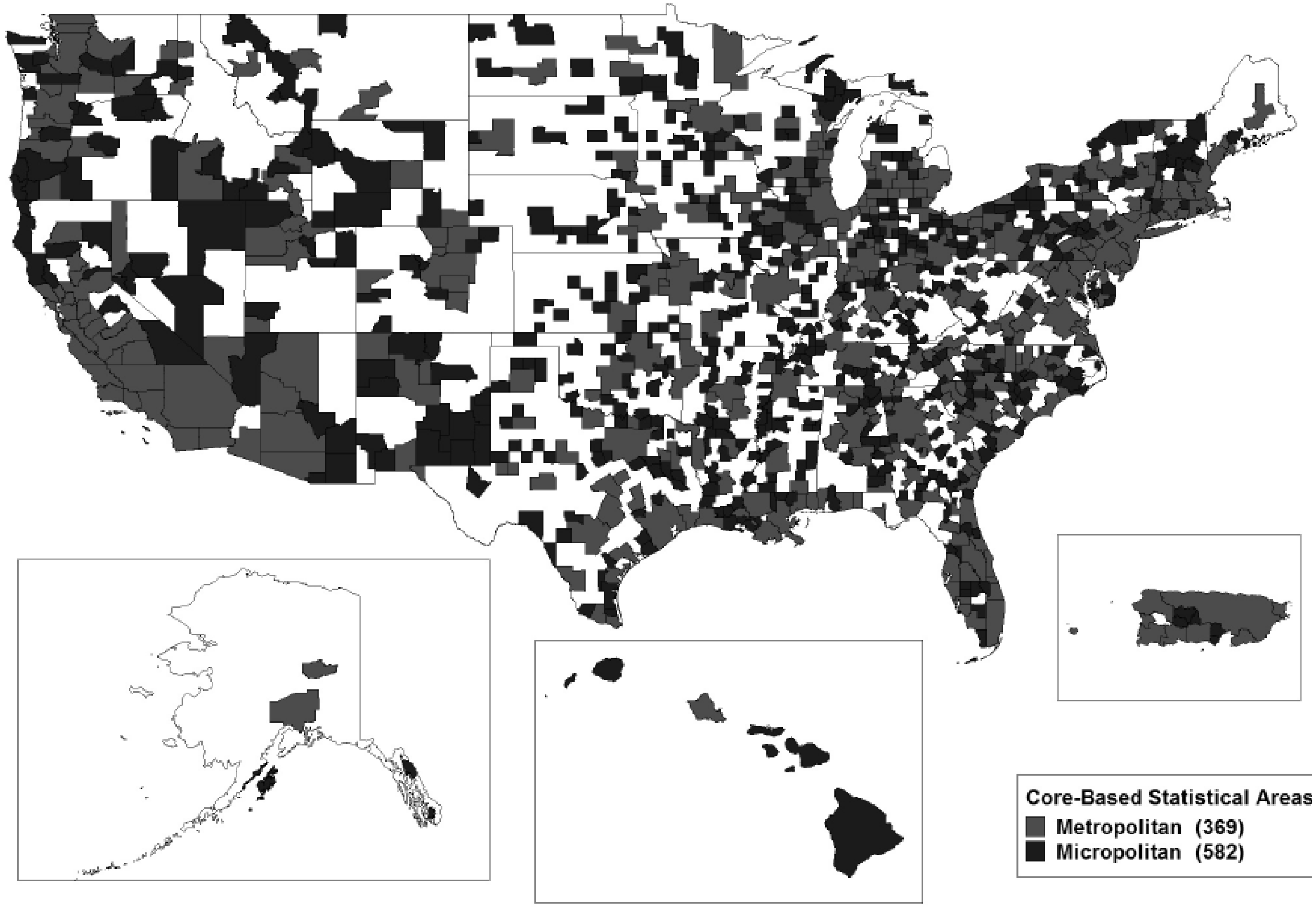

Figure 4: Metropolitan Statistical Areas and Micropolitan Statistical Areas.

Table 1: Evolution of Concentration, and Number of Banks. US Commercial Banks. 1994-2007. Aggregate level and mean over markets.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Aggregate level														
C4	0.08	0.07	0.08	0.10	0.13	0.14	0.15	0.16	0.17	0.18	0.21	0.26	0.25	0.26
HHI	33	32	36	53	71	78	107	114	126	137	157	221	210	215
Number of Banks	12,928	12,221	11,630	11,125	10,677	10,288	10,060	9,703	9,433	9,219	9,034	8,825	8,733	8,567
Single-market	11,325	10,564	9,929	9,413	8,908	8,507	8,246	7,865	7,559	7,296	7,101	6,873	6,749	6,535
Multimarket	1,602	1,656	1,700	1,711	1,768	1,780	1,813	1,837	1,873	1,922	1,932	1,951	1,983	2,031
Number of Branches	75,468	75,692	76,412	77,651	78,856	79,946	81,121	81,716	82,411	83,556	85,542	87,855	90,435	92,824
Single-market	39,155	37,389	35,541	34,258	32,252	31,498	30,327	28,460	28,215	27,847	28,230	27,350	27,652	26,455
Multimarket	36,300	38,290	40,858	43,379	46,589	48,434	50,780	53,242	54,181	55,694	57,297	60,489	62,766	66,353
Metropolitan Markets														
C1	0.25	0.25	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.27	0.26	0.26
HHI	1,440	1,461	1,491	1,498	1,519	1,512	1,507	1,505	1,505	1,503	1,518	1,538	1,514	1,505
Number of Banks	29	28	27	27	27	27	27	27	27	27	27	27	28	29
Single-market	19	18	17	17	16	15	15	15	14	14	14	14	14	14
Multimarket	9	10	10	10	11	11	12	13	13	13	13	14	14	15
Non-metropolitan Markets														
C1	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
HHI	3,585	3,567	3,555	3,549	3,537	3,532	3,517	3,500	3,494	3,495	3,488	3,471	3,438	3,437
Number of Banks	5	5	5	5	6	6	6	6	6	6	6	6	6	6
Single-market	3	3	3	3	2	2	2	2	2	2	2	2	2	2
Multimarket	2	3	3	3	3	3	3	3	4	4	4	4	4	4

Source: FDIC Summary of Deposits.

(i) C1: Largest deposit share in market, C4: Deposit market share of the 4 largest firms in the market, HHI: Herfindahl-Hirschman index multiplied by 10,000 based on deposit shares.

(ii) Banks are defined as FDIC-insured banks.

(iii) Single-market banks are banks that hold more than .8 of its total deposits in a single market. Multimarket banks are banks not classified as single-market banks.

(iv) U.S. include the 50 states and D.C., except Alaska and Hawaii.

(v) Based on bank-market-year observations.

Table 2: Entry and Exit by Multimarket and Single-market Banks in Metropolitan markets. US Commercial Banks. 1994-2007. % over the number of incumbents.

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
All banks														
Open a Branch	3.5	4.0	5.5	5.0	4.7	4.2	3.9	3.6	3.9	4.8	5.0	5.0	4.9	4.5
Close a Branch	3.4	3.1	3.9	3.5	3.3	2.6	3.2	2.6	2.1	1.8	1.7	1.5	1.8	2.6
Bank M&A	6.6	9.4	13.4	11.5	7.1	11.0	5.9	6.4	3.2	4.7	10.2	1.9	5.3	7.3
Branch Ownership Change	1.7	2.0	1.4	1.5	1.8	1.5	1.6	1.5	0.7	1.3	0.9	0.5	0.8	1.3
Single-market banks														
Open a Branch	4.0	4.6	5.9	5.8	6.2	5.8	5.4	5.3	4.9	4.9	5.7	6.4	6.1	5.4
Close a Branch	3.0	2.7	3.3	2.3	2.2	2.1	2.0	2.2	1.8	1.6	1.4	1.2	1.4	2.2
Net Bank M&A	-3.7	-5.0	-4.7	-4.9	-5.0	-6.0	-4.8	-2.8	-1.7	-2.9	-2.3	-2.0	-3.8	-3.9
Net Branch Ownership Change	0.8	0.7	0.5	0.5	0.7	0.4	0.2	0.4	0.2	0.2	0.1	0.1	-1.6	0.3
Net Switch SM to MM	2.5	3.2	1.9	5.2	1.1	2.1	5.1	1.0	2.2	-1.9	5.5	1.2	3.6	2.6
Multimarket banks														
Open a Branch	3.0	3.5	5.2	4.4	3.7	3.2	3.0	2.7	3.3	4.7	4.6	4.4	4.4	3.9
Close a Branch	3.7	3.5	4.4	4.3	4.0	2.9	3.8	2.8	2.3	1.9	1.8	1.6	2.0	2.9
Net Bank M&A	3.9	4.8	3.9	3.8	3.4	3.8	2.8	1.4	0.9	1.5	1.1	0.9	1.7	2.4
Net Branch Ownership Change	-0.8	-0.7	-0.4	-0.4	-0.5	-0.3	-0.1	-0.2	-0.1	-0.1	0.0	0.0	0.7	-0.2
Net Switch MM to SM	-2.6	-3.0	-1.6	-4.0	-0.8	-1.3	-3.0	-0.5	-1.2	0.9	-2.7	-0.5	-1.6	-1.6

Source: FDIC Summary of Deposits.

(i) Open a branch: a bank opens a branch, Close a branch: a bank closes a branch, Bank M&A: a bank is acquired by another bank, Branch Ownership Change: an branch changes its owner, and Switch SM to MM: a Single-market bank becomes a Multimarket bank.

(ii) Banks are defined as FDIC-insured commercial banks or thrift institutions.

(iii) Single-market banks are banks that hold more than .8 of its total deposits in a single market. Multimarket banks is a bank not classified as a single-market bank.

(iv) U.S. include the 50 states and D.C., except Alaska and Hawaii.

Table 3: Entry and Exit by Multimarket and Single-market Banks in Non-metropolitan markets. US Commercial Banks. 1994-2007. % over the number of incumbents.

	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
All banks														
Open a Branch	2.9	3.0	3.3	3.9	3.4	3.1	2.8	2.3	2.2	1.9	2.1	2.3	2.3	2.7
Close a Branch	2.1	1.9	1.6	2.4	2.1	2.0	2.0	2.0	1.8	1.4	1.2	1.2	1.2	1.7
Bank M&A	5.6	5.4	7.9	7.8	5.6	7.4	5.5	4.6	1.5	3.7	5.6	1.9	3.7	5.1
Branch Ownership Change	1.3	1.5	1.1	2.1	1.4	1.3	1.2	1.2	0.7	1.3	0.8	0.5	0.5	1.1
Single-market banks														
Open a Branch	2.9	3.5	3.8	4.1	3.9	4.1	3.4	3.0	3.0	2.7	2.8	2.9	3.5	3.4
Close a Branch	1.6	1.5	1.5	1.8	1.5	1.4	1.4	1.4	1.5	0.9	0.6	0.9	0.9	1.3
Net Bank M&A	-3.7	-3.0	-3.3	-3.3	-4.4	-3.1	-3.7	-2.4	-1.4	-1.0	-1.8	-1.7	-2.4	-2.8
Net Branch Ownership Change	0.6	0.4	0.3	0.5	0.3	0.3	0.1	0.7	-0.1	0.3	0.3	0.1	-0.1	0.3
Net Switch SM to MM	2.9	2.5	3.2	4.2	3.3	3.0	4.0	2.9	3.3	3.0	2.9	2.5	4.3	3.2
Multimarket banks														
Open a Branch	2.8	2.4	2.8	3.7	3.0	2.4	2.4	1.9	1.7	1.5	1.8	1.9	1.8	2.3
Close a Branch	2.7	2.4	1.6	2.9	2.5	2.4	2.4	2.3	2.0	1.6	1.5	1.3	1.3	2.0
Net Bank M&A	4.3	3.1	3.1	2.8	3.3	2.1	2.4	1.4	0.7	0.5	0.9	0.8	1.1	1.9
Net Branch Ownership Change	-0.6	-0.4	-0.3	-0.4	-0.2	-0.2	0.0	-0.4	0.1	-0.2	-0.2	-0.1	0.0	-0.2
Net Switch MM to SM	-3.4	-2.6	-3.0	-3.6	-2.5	-2.0	-2.5	-1.6	-1.8	-1.6	-1.5	-1.2	-1.9	-2.1

Source: FDIC Summary of Deposits.

(i) Open a branch: a bank opens a branch, Close a branch: a bank closes a branch, Bank M&A: a bank is acquired by another bank, Branch Ownership Change: an branch changes its owner, and Switch SM to MM: a Single-market bank becomes a Multimarket bank.

(ii) Banks are defined as FDIC-insured commercial banks or thrift institutions.

(iii) Single-market banks are banks that hold more than .8 of its total deposits in a single market. Multimarket banks is a bank not classified as a single-market bank.

(iv) U.S. include the 50 states and D.C., except Alaska and Hawaii.

Table 4: Local Markets: Descriptive Statistics.

Variable	**Mean**	**SD**	**Median**	**P1**	**P99**
Population	20,097	16,916	15,044	844	78,184
Population Density (per squared mile)	37	90	23	1	169
Income per Capita (2007 $)	21,545	4,381	21,164	13,234	34,387
Average Wage (2007 $)	23,295	3,928	22,853	16,438	35,383
Number of Employees	7,633	7,221	5,172	290	33,834
Number of Establishments	470	418	343	17	1,951

(i) Sample: Small cities and rural markets with less than 100,000 inhabitants, less than 8 SM banks, and less than 8 MM banks.

Table 5: Single-market and Multimarket banks: Descriptive Statistics. Mean values in %.

	1994		2007	
	SM	**MM**	**SM**	**MM**
Bank				
Number of Markets	1	14	2	73
Number of States	1	2	1	5
Number of Branches	4	60	6	570
Employees/Branches	12	13	12	18
Multibank Holding Company	31	50	25	58
Loans & Leases/Assets	53	61	62	69
Real Estate Loans/Loans & Leases	50	58	62	65
Agricultural Loans/Loans & Leases	20	11	13	8
Commercial & Industrial Loans/Loans & Leases	13	13	14	15
Loans to Individuals/Loans & Leases	17	18	10	9
Loans to Small Businesses/Loans & Leases	23	22	26	20
Loans to Small Businesses/Loans to Businesses	97	77	86	59
Loans to Small Farms/Loans & Leases	29	16	21	12
Loans to Small Farms/Loans to Farms	93	80	83	65
Non-performing Loans/Loans & Leases	1.0	0.9	1.1	1.0
Equity/Assets	10.0	8.1	11.4	10.3
ROE	12.1	11.9	10.7	11.1
ROA	1.2	0.9	1.1	1.1
Deposit Interest Rate	2.6	2.5	2.5	2.3
Loan Interest Rate	6.9	6.8	6.6	6.3
Bank-Market				
Number of Branches	1.7	1.7	1.7	1.8
Deposits per Branch	27,460	23,474	34,934	33,729

(i) SM are Single-market banks, MM are Multimarket banks.

(ii) Sample: Small cities and rural markets with less than 100,000 inhabitants, less than 8 SM banks, and less than 8 MM banks.

(iii) For variables computed at the bank level I compute means weighted by the number of branches in the selected sample, for variables computed at the bank-market level I compute simple means.

Table 6: Market Structure: Descriptive Statistics. % of total market-year observations.

		Number of Multimarket banks									
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
	0	0.9	3.8	4.6	4.2	3.4	2.1	1.7	0.8	0.2	21.7
	1	2.7	4.7	5.8	4.4	3.2	2.6	1.4	0.8	0.2	25.8
Number	**2**	2.7	4.9	3.7	3.6	2.7	2.0	1.2	0.7	0.2	21.7
of	**3**	1.7	2.4	2.8	3.0	1.9	1.2	0.9	0.3	0.1	14.4
Single-market	**4**	0.9	1.1	1.8	1.4	1.2	0.9	0.5	0.2	0.1	8.2
banks	**5**	0.4	0.7	0.8	0.8	0.7	0.5	0.3	0.1	0.1	4.3
	6	0.1	0.5	0.5	0.5	0.4	0.3	0.1	0.1	0.0	2.5
	7	0.1	0.2	0.2	0.2	0.3	0.2	0.0	0.0	0.0	1.1
	8	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.4
	Total	9.5	18.3	20.3	18.1	13.9	9.8	6.2	3.0	0.9	100.0

(i) Sample: Small cities and rural markets with less than 100,000 inhabitants, less than 8 SM banks, and less than 8 MM banks.

Table 7: Entry and Exit Statistics.

Number of Incumbents	**Entry Proportion (%)**			**Exit Rate (%)**		
	All	**SM**	**MM**	**All**	**SM**	**MM**
1	3.52	5.15	2.29	0.69	0.81	0.60
2	2.19	2.41	2.02	0.43	0.26	0.56
3	1.90	2.47	1.47	0.51	0.45	0.55
4	1.78	2.07	1.59	0.67	0.51	0.78
5	1.89	2.64	1.42	0.70	0.55	0.79
6	1.44	1.94	1.12	0.53	0.51	0.55
7	1.53	1.95	1.25	0.55	0.43	0.62
8	1.53	1.93	1.24	0.63	0.48	0.74
9	1.12	1.38	0.90	0.57	0.35	0.75
10 or +	1.10	1.30	0.90	0.62	0.52	0.71
Total	**1.62**	**2.06**	**1.32**	**0.59**	**0.47**	**0.67**

(i) SM are Single-market banks, MM are Multimarket banks, Entry Proportion is the ratio of Entrants to Incumbents, Entry Proportion for SM (MM) is the ratio of SM (MM) Entrants to SM (MM) Incumbents, Exit Rate is the ratio of Exits to Incumbents, and Exit Rate for SM (MM) is the ratio of SM (MM) Exits to SM (MM) Incumbents.

(ii) Sample: Small cities and rural markets with less than 100,000 inhabitants, less than 8 SM banks, and less than 8 MM banks.

Table 8: Market State Variable: Descriptive Statistics.

Market State	Number of Obs.	Population	Income per Capita	Number of Banks	Number of SM Banks	Number of MM Banks	Population per Bank	Operating Profit per Bank
1	2,430	2.208	22.313	1.73	0.82	0.91	1.437	1.077
2	2,430	4.990	22.074	2.78	1.39	1.39	2.236	1.435
3	2,430	7.821	21.418	3.34	1.60	1.74	3.026	1.561
4	2,430	10.693	20.885	3.81	1.84	1.97	3.529	1.842
5	2,430	13.976	20.801	3.83	1.70	2.13	4.481	2.169
6	2,430	17.725	21.472	4.39	1.94	2.44	4.727	2.389
7	2,431	22.745	21.373	4.93	2.01	2.92	5.335	2.669
8	2,430	30.170	21.503	5.56	2.24	3.32	6.276	2.980
9	2,430	39.437	22.260	6.05	2.19	3.86	7.451	3.394
10	2,433	60.554	22.629	6.71	2.27	4.44	9.966	4.270

(i) Mean over market-year observations for Population, Income per Capita, Number of Banks, SM Banks, and MM Banks, and Population per Bank, and mean over bank-market-year for Operating profits per Bank. Number of observations is number of market-year observations.

(ii) Sample: Rural markets with less than 100,000 inhabitants, less than 8 SM FDIC-insured banks, and less than 8 MM FDIC-insured banks.

Table 9: Profit estimation.

Dependent Variable: Bank-market Operating Profits (in million of 2007 $)

Variable	Coefficient	s.e.
Dummy SM bank	0.205	0.039***
First SM competitor on SM	-0.086	0.036**
Second SM competitor on SM	-0.091	0.076
Each additional SM competitors on SM	-0.137	0.014***
First MM competitor on SM	-0.040	0.025
Second MM competitor on SM	-0.141	0.025***
Each additional MM competitors on SM	-0.101	0.042**
First SM competitor on MM	-0.117	0.034***
Second SM competitor on MM	-0.153	0.016***
Each additional SM competitors on MM	-0.081	0.015***
First MM competitor on MM	-0.072	0.026***
Second MM competitor on MM	-0.087	0.036**
Each additional MM competitors on MM	-0.141	0.016***
Market variables		
Log(Population)	-0.320	0.103***
Log(Income per capita)	-0.184	0.072**
Log(Wage)	0.042	0.072
Log(N of Establishments)	0.178	0.073**
Log(N of Employees)	0.369	0.070***
Market fixed effects	Yes	
Number of Observations	111,484	
Number of Markets	1,678	
Mean of dependent variable	0.703	

(i) Asymptotic standard errors robust to heteroscedasticity, and time series and within market correlation.

(ii) Sample: Rural markets with less than 100,000 inhabitants, less than 8 SM FDIC-insured banks, and less than 8 MM FDIC-insured banks.

(iii) *** is a 1% significance level, ** is a 5%, and * is a 10%.

Table 10: Entry costs and sell-off value estimation.

Sell-off Value and Sunk Cost of Entry Parameters (in million of 2007 $).

	Entry Def. 1		Entry Def. 2	
Variable	coefficient	s.e.	coefficient	s.e.
Mean Sunk Cost of Entry				
Single-market bank	10.374	1.037***	10.434	0.972***
Multimarket bank	7.058	0.632***	7.070	0.623***
Single-market bank x Market size	1.189	0.261***	1.197	0.265***
Multimarket bank x Market size	1.387	0.315***	1.396	0.325***
Mean Sell-off value				
Single-market bank	0.000	0.180	0.000	0.181
Multimarket bank	0.008	0.014	0.008	0.013
Number of Observations		22,425		
Number of Markets		1,725		

(i) Minimum distance estimator with weighting matrix that replicates GMM in POB. Optimization using Compass Search.

(ii) Bootstrap standard errors with 100 simulations.

(iii) Sample: Rural markets with less than 100,000 inhabitants, less than 8 SM FDIC-insured banks, and less than 8 MM FDIC-insured banks.

(iv) *** is a 1% significance level, ** is a 5%, and * is a 10%.