Entry and competition in highly concentrated banking markets

Nicola Cetorelli

Introduction and summary

What determines the number of banks operating in a market? What is the relationship between the number of banks in a market and competitive conduct? These are important questions, whose answers define the industrial organization characteristics of a banking market. They are also questions of fundamental policy relevance for antitrust regulation.

In this article, I address these questions by focusing specifically on very highly concentrated banking markets. I focus on these markets because this is where we would expect to observe the least competitive conditions. Indeed, if there is any likelihood of establishing and maintaining a *cartel*, where firms explicitly or tacitly collude in order to behave as one monopolist, it will be in markets with the fewest firms. It is in these markets, therefore, that firms should be able to impose the highest mark-ups; and, by definition, these markets should raise special antitrust concerns in the event of a merger application. How anticompetitive are highly concentrated banking markets? Is there any evidence of actual collusive behavior? Also, how quickly do markets approach a competitive benchmark, that is, how many additional entrants does it take before we observe higher degrees of competition?

Answers to these questions contribute to the policy debate on competitive conditions in the banking industry and provide information on the current practice for assessing market competition in merger analysis. As is widely known, the procedures to evaluate the competitive impact of merger proposals require an evaluation of the concentration of deposit market shares held by banks operating in the market affected by the merger. According to the so-called structure–conduct–performance paradigm (Bain, 1951), one would expect to observe increasingly anticompetitive conduct where market shares are more concentrated. Market concentration is commonly measured by the Herfindahl-Hirschman Index (HHI), which is defined as the sum of the squared market shares of all banks in the market. The HHI index is bounded from below at zero in the (hypothetical) case of a very large number of extremely small banks and bounded from above in the other extreme case of a monopolist, where the index would then be equal to $100^2 = 10{,}000$. According to the current guidelines for antitrust analysis in banking, if a merger brings a market HHI above the value of 1,800, it has the potential for anticompetitive consequences, thus triggering further analysis before approval. In other words, any market with an HHI above 1,800 is considered highly concentrated and, therefore, more likely to be characterized by anticompetitive conduct. To have a better idea of how an HHI around 1,800 translates in reality, consider that a market with five banks, each controlling an equal share of the deposits market, has an HHI equal to $20^2 + 20^2 + 20^2 + 20^2 + 20^2 = 2{,}000$. As I show below, the average HHI across all the markets I analyze in this article is about 4,000, and 90 percent have an HHI greater than 1,800. Hence, the focus of this article is exactly on the markets that raise special antitrust concerns.

How can we evaluate competitive conduct in such highly concentrated markets? What we would like to measure is what Sutton (1992) defines as the *toughness of price competition*, that is, by how much market prices vary as the number of competing firms increases. If it is really the case that incumbent firms collude and maximize joint monopoly profits, then the entry of an additional firm would not have *any* effect on prices. This extreme model features the *least intense*

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level of competition (really the lack thereof) and thus represents a good benchmark against which to compare actual market behavior. Any other model of competition will typically assume some price response by incumbents to the decision of an additional firm to enter the market. The general prediction of such models is that prices gradually decrease from the monopoly level as the number of firms increases, converging—at higher or slower speed—to marginal cost, the level predicted by the model of *perfect competition*.

The question then is: How quickly do prices drop from the monopoly level? Figure 1 depicts alternative paths for the price level as a function of the number of firms in the market for different competitive models. According to what I illustrated above, the joint monopoly model does not predict any change in prices as N increases. The other two paths (C1 and C2), from top to bottom, are for two alternative models with increasing intensity of competition.

Ideally, we would like to be able to estimate the empirical relationship between price and the number of firms. However, doing so requires accurate information on price and cost variables, information that is typically unavailable, especially at the required level of disaggregation (that is, focusing on local markets). The methodology I adopt here, proposed by Bresnahan and Reiss in a series of papers (1987, 1990, 1991), exploits the fact that there is a close association between the "price to number of firms" relationship (unobservable) and the relationship between the number of firms and the corresponding minimum market size needed to accommodate one firm, two firms, three firms, and so on. These levels of market size are defined as *entry thresholds*.[1]

In the following sections, I show that one can estimate entry thresholds and, therefore, that one can observe the relationship between the number of firms in a market and the entry thresholds. By analyzing this relationship, one can infer the characteristics of the relationship between the number of firms and the price. Estimating entry thresholds for a cross-section of U.S. local banking markets, I find no evidence consistent with collusive behavior leading to maximization of joint monopoly profits, even in those markets with only two or three banks in operation. Instead, the evidence shows substantial increases in the intensity of competition as markets see the entry of a third or fourth bank and gradual convergence toward more competitive behavior as more banks enter.

Description of the methodology

The following graphical illustrations are helpful in clarifying the concept of market-size entry threshold, its relationship with the number of competing firms, and how this relationship varies according to the underlying competitive behavior of market participants.

Consider an economy with identical firms facing the same cost structure and producing the same homogeneous good. Figure 2, panel A depicts the average cost function, AC, and the marginal cost function, MC, of a prospective entrant in a market with $N - 1$ firms already in operation. The downward sloping lines D1 and D2 represent alternative levels of *residual demand*, that is, the demand schedule that the entrant would face given the price–quantity decisions of the $N - 1$ incumbents (or, in other words, total market demand minus the total quantity produced by the incumbents). Assume that the existing firms maximize joint monopoly profits and that they would continue to do so after the Nth firm enters. I denote the equilibrium monopoly price as $p = p_m$. At that price, if the residual demand schedule is D1, the Nth firm could not enter and survive in the long run, since it would not be able to cover average costs (even though it could be making a handsome price–cost margin, as depicted by the vertical difference between price and the marginal cost function at $q = q_1$). However, at price $p = p_m$ and residual demand schedule D2, the firm could enter, produce q_m, and break even. Hence, given incumbent competitive behavior, if there is a sufficient *per firm* market size, expressed in terms of number of consumers generating a level of demand equal to q_m, then the Nth firm is able to enter the market and join

FIGURE 1

Relationship between price and number of firms

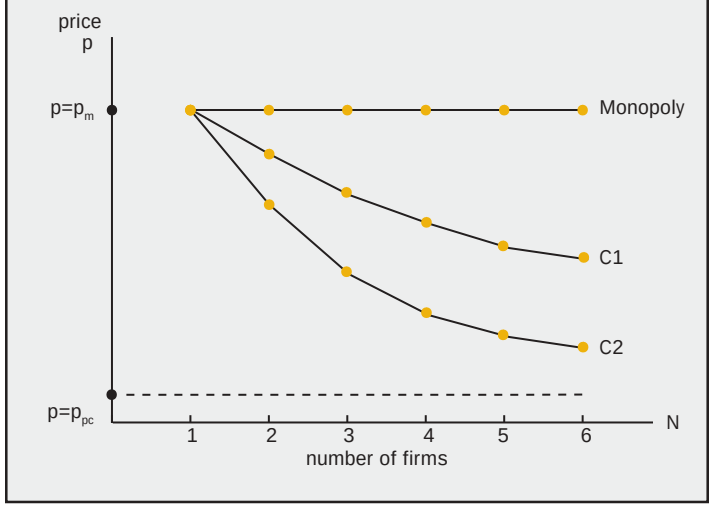
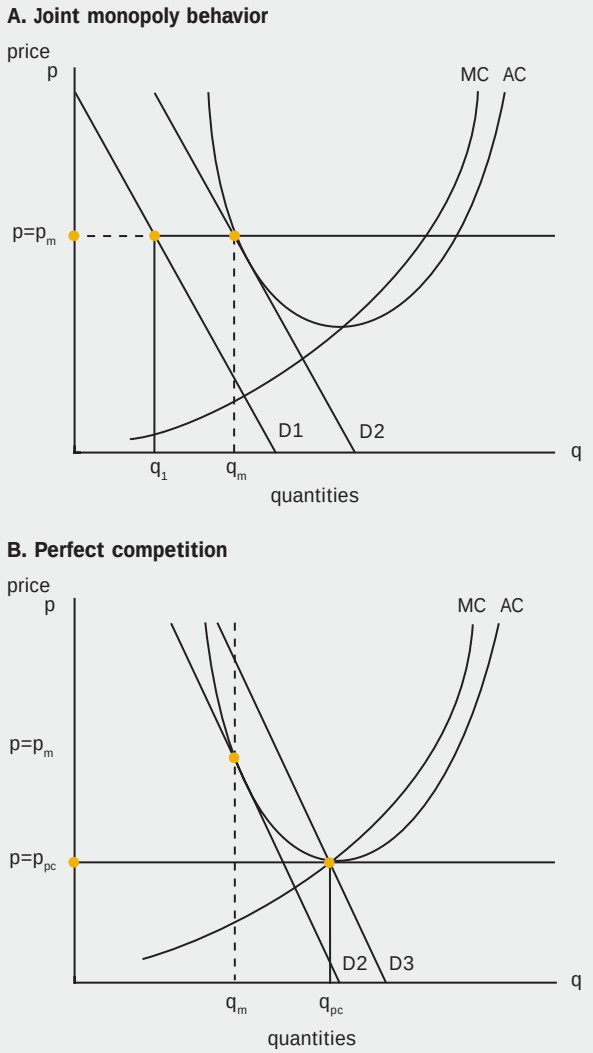


FIGURE 2

Entry conditions



the monopoly agreement. Such a minimum level of per firm market size, conditional on joint monopoly behavior, defines the entry threshold for the *N*th firm, which we denote as $s_N(m)$ (where *m* indicates that this is the per firm entry threshold under joint monopoly behavior).

Consider now the opposite extreme scenario, where the *N*th firm would face the most intense competitive response from the $N-1$ incumbents. Figure 2, panel B describes the cost functions of the *N*th prospective entrant, its residual demand schedule, and the market price $p = p_{pc}$. This price, equal to the minimum of the average cost function, is the lowest possible that can be set in the industry while allowing firms to break even in the long run. This is the level of price predicted by the model of *perfect competition*. If the residual demand schedule is D2, at price p_{pc} the firm could not meet the long-run profitability condition. The firm could enter only if residual demand were high enough so that it could produce at least a quantity $q = q_{pc}$. As in the previous case, a corresponding per firm market-size entry threshold conditional on perfectly competitive behavior and denoted as $s_N(pc)$ generates the required quantity level.

As one can see from the two graphs, for a given number of market incumbents and a given cost structure, $s_N(pc) > s_N(m)$. This is no accident; it shows that a more intense level of competition necessarily corresponds to a larger per firm entry threshold. This observation is fundamental to learning how to draw an inference from the entry threshold–number of firms relationship to the price–number of firms relationship.

To explore this correspondence further, I use a model characterized by an "intermediate" degree of competitive behavior, the well-known Cournot model. Under Cournot behavior, prospective entrants know that incumbents will not modify their production levels as a consequence of their entry into the market. Hence, given a downward sloping market demand function, the post-entry equilibrium price will necessarily be lower than it was ex ante. Because prices fall as *N* increases, the Cournot model also predicts that profitability is decreasing in the number of competing firms. But if profitability is decreasing in *N*, it follows that each consecutive entrant will require an increasingly larger entry threshold in order to enter and survive in the long run.

For example, consider the case where identical firms have cost function $C = cq_n + F$, where cq_n is variable cost and *F* is a fixed cost component (start-up costs plus additional costs unrelated to the scale of production). Firms face a linear (inverse) demand function, $q(p) = (a - bp)\,S$, where *q* is total output, $(a - bp)$ is the demand of a representative consumer, and *S* is the total number of consumers.[2] Under Cournot behavior, each firm chooses the optimal level of production in order to maximize profitability, that is,

$$\underset{q_n}{Max}\ \pi_n = p(q)\,q_n - c\,q_n - F.$$

It can be easily shown[3] that equilibrium profit for each firm n in a market with N firms is

$$1) \quad \pi^*_n = \left(\frac{a-bc}{N+1}\right)^2 \frac{S}{b} - F.$$

As one can see, firms' profitability decreases in N. Therefore, for an "intermediate" model of competition, such as Cournot, the "price to number of firms" relationship follows a decreasing path, such as either C1 or C2 in figure 1. Equation 1 also indicates that, for a given N, profits are increasing in total market size, S.

At what point could the Nth firm enter? As stated above, entry is possible so long as the residual demand for the Nth firm is large enough for revenues to cover average cost. I can express this formally by saying that entry is granted if the following condition is met:

$$2) \quad \pi_N = p_N(a - bp_N)\frac{S}{N} - c(a - bp_N)\frac{S}{N} - F \geq 0,$$

where p_n is the resulting market price after entry of the Nth firm, $(a - bp_N)\frac{S}{N}$ is the quantity produced by firm N, and $\frac{S}{N}$ is the *per firm* market size.

Solving equation 2 in $\frac{S}{N}$ with an equality sign defines the per firm entry threshold:

$$3) \quad s_N = \frac{S}{N} = \frac{F}{[p_N - c](a - bp_N)} = \frac{F}{VP_N},$$

where VP_N denotes per customer variable profits.

Thus, the per firm entry threshold needs to be larger if fixed costs are higher or if variable profitability is lower.

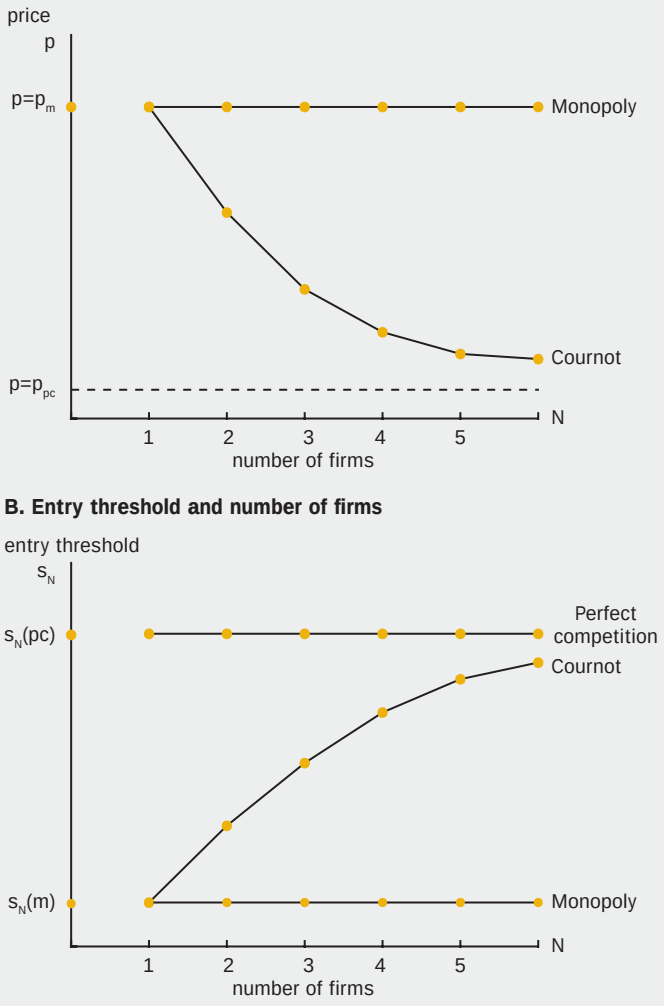
With this last piece of information, I am ready to establish my basic prediction regarding the relationship between entry thresholds and number of firms and in particular how this relationship varies as a function of the intensity of market competition. First, in the benchmark case of joint monopoly behavior, prices do not change with the entry of additional firms. Assuming that each firm has identical cost structure, it follows that under joint monopoly behavior variable profitability does not vary with entry. From equation 3, we see that so long as each firm faces the same cost function, under joint monopoly behavior per firm entry thresholds will be *constant* in the number of competing firms, that is,

$$s_1 = s_2 = s_3 = s_4 = \cdots.$$

For example, suppose that it takes s_1 = 2,000 consumers for the first firm to enter. Under joint monopoly behavior, the second firm will require an additional

FIGURE 3

Relationship of price, entry threshold to number of firms



2,000 customers before it can enter, and the same holds true for each additional firm.

Still observing equation 3, under Cournot behavior, because profitability decreases in N, per firm size thresholds will actually *increase* in N. In addition, recall that as N grows unbounded, the Cournot equilibrium converges to perfect competition. But from our previous graphical illustration, under perfect competitive conditions the per firm entry threshold is equal to s_{pc}. Therefore, under Cournot:

$$\lim_{N \to \infty} s_N = s_{pc},$$

and consequently,

$$s_1 < s_2 < s_3 \cdots < s_{pc}.$$

Figure 3 describes the predicted path of s_N as a function of N for alternative models of competition (panel B) and the direct correspondence with the "price to number of firms" relationship (panel A). Under Cournot, the path is increasing in N, but it converges to its upper bound s_{pc}. Actual market behavior may show more or less intensity of competition than Cournot; therefore, an actual path for s_N may lie above that for the Cournot economy or below it. The goal of this article is to estimate the empirical path for consecutive per firm threshold ratios and infer changes in competitive "toughness" as N increases.

Data and estimation details

The methodology adopted in this paper allows me to estimate consecutive entry thresholds in local banking markets using a very parsimonious dataset, allowing me to infer the intensity of competition facing new market entrants.

My empirical analysis is based on a cross-section of local U.S. markets, defined as rural counties. Rural counties and metropolitan statistical areas (MSAs) are typically considered reasonable approximations of local banking markets.[4] However, I exclude MSAs from the analysis because this methodology may not be appropriate for markets of relatively large size (see Campbell and Hopenhayn, 2002).[5]

I collected information for the year 1999 on the number of banks, both commercial banks and savings institutions, competing in each U.S. county, from the Summary of Deposits database and matched it with county-level demographic variables from the Regional Economic Information System (REIS) dataset of the Bureau of Economic Analysis. The Summary of Deposits dataset has information through 2001, but the REIS dataset only goes up to 1999. By focusing on a recent year, I have access to a cross-section of markets that have become more and more harmonized in terms of the regulatory playing field. Both intrastate and interstate restrictions to branching and to the creation of *de novo* banks existed to differing degrees in all U.S. states in previous decades. However, the relaxation of these restrictions, culminating in 1994 with the passage of the Riegle–Neal Interstate Banking and Branching Efficiency Act, has led to greater homogeneity of local banking markets across state borders. Hence, one should find more uniform entry conditions for the sample of markets in 1999 and need not be concerned with cross-state differences in the intensity of regulatory entry barriers.

I analyze the likelihood that there is only one bank in a market, two banks, three, four, five, and six or more. The dataset includes 2,257 rural counties. Table 1 illustrates the frequency of bank monopolies, duopolies, and other oligopolies across the total number of counties. In 1999, there were 147 markets with only one banking institution, 281 duopolies, 339 markets with three banks, 313 with four banks, 267 with five banks, and the residual 910 markets with six or more banks. The rural counties with the largest number of banking institutions were La Salle, Illinois, and Dodge, Wisconsin, with 23 banks each.

My emphasis here is on the number of banking institutions that have a presence in a market and not on the total number of bank offices that may be located in a certain market. Certainly the same institution may have multiple branches located in the same market, but my underlying assumption is that within

TABLE 1

Number of banks, markets, and average market size

Number of banks	Number of markets	Frequency	Cumulative percentage	Average market size
1	147	6.51	6.51	3,879
2	281	12.45	18.96	8,656
3	339	15.02	33.98	12,139
4	313	13.87	47.85	16,980
5	267	11.83	59.68	21,713
6+	910	40.31	100	26,429

Notes: Number of banks is the sum of commercial and savings banks in a market. Markets are defined as rural U.S. counties. Average market size is the average population across markets with the same number of banks. Data are for 1999.

the same local market, branches follow a homogeneous strategy vis-à-vis other competitors. Moreover, treating individual branches as independent competitors and estimating conditions of entry would imply that the decision to add an additional branch in a market would be based on competitive considerations against a bank's existing offices, which seems rather implausible.

As pointed out in the introduction, the average HHI across the markets under analysis is about 4,000; 90 percent of the markets have an HHI above 1,800, the level that, if reached as a consequence of a merger, would trigger special scrutiny by antitrust authorities. Hence, my presumption is that if there is any evidence of collusive behavior in banking, this is the sample of markets where it is most likely to show up.

TABLE 2

Estimated entry thresholds

Entry thresholds (000s)		Per bank entry thresholds (000s)		Per firm entry threshold ratios	
S_2	2.170	$S_2/2$	1.085		
S_3	5.782	$S_3/3$	1.927	s_3/s_2	1.776205
S_4	11.211	$S_4/4$	2.803	s_4/s_3	1.454294
S_5	17.091	$S_5/5$	3.418	s_5/s_4	1.219625
S_6	23.825	$S_6/6$	3.971	s_6/s_5	1.161692

Notes: Entry thresholds are obtained using formula 8 in the appendix. S_N denotes the minimum total market size necessary to accommodate N banks. $s_N = S_N/N$ is the per bank entry threshold. Figures are obtained using the maximum likelihood estimated coefficients from table A2 and the sample mean values of the regressors.

Empirical results

The details of the methodology and the econometric analysis are reported in the appendix. In this section, I focus directly on the end product, that is, the estimated entry thresholds reported in table 2.

The results rule out the extreme model of collusion leading to joint monopoly profit maximization. As the estimates indicate, the per bank entry thresholds display a clearly increasing path (see also figure 4). The results are consistent with the predictions of intermediate oligopolistic behavior, where the intensity of competition is sufficiently strong that the entry of each consecutive bank requires significant increases in per bank market size to achieve long-run profitability. More precisely, the entry of a third bank requires the per bank threshold to be about 78 percent higher than that needed in two-bank markets (I obtain this by computing the ratio s_3/s_2). Furthermore, the entry threshold for a fourth bank needs to be an additional 45 percent higher than that for three-bank markets (computed as s_4/s_3). As reported in the last column in table 2, these consecutive per firm entry threshold ratios indicate substantial changes in competitive conduct going from duopolistic market structures to markets with five or six banks. Indeed, the estimates suggest that the per bank entry threshold needed to accommodate a sixth bank is about four times as large as that needed for a duopolist (s_6/s_2, not reported in the table).

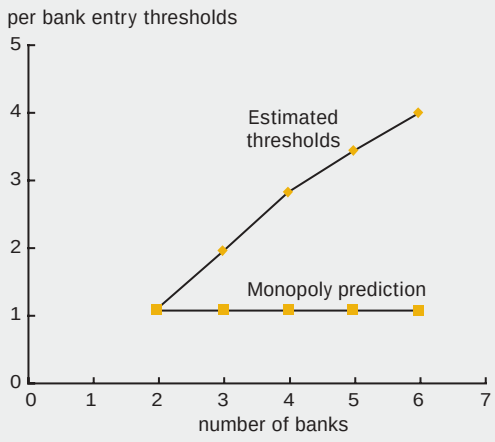
However, the results also suggest that much more of the action, in terms of competitive changes, occurs with the entry of a third or fourth bank than with the entry of a fifth or sixth bank (s_3/s_2 and s_4/s_3 are substantially larger than s_5/s_4 and s_6/s_5). This observation may actually reinforce the justification for setting the HHI threshold level at 1,800 for antitrust regulation: Recall that this number approximately refers to a market with five banks (each one with equal market share). These results suggest that, in fact, with five, six, or more banks, there is not much change in terms of competitive conditions; this implies that there may not be a need for regulatory action in those markets in the case of a merger request.

Conclusion

This article analyzes the conditions of entry and the competitive conduct in a cross-section of highly concentrated U.S. banking markets. The empirical

FIGURE 4

Estimated entry thresholds vs. those implied by joint monopoly behavior



results show, first of all, no evidence consistent with collusive behavior. Indeed, duopolist markets seem already sufficiently competitive. The continuous increase in per bank entry thresholds as additional banks access markets provides further evidence that entry, or the threat of it, improves market competition. By the time a sixth bank has entered, the per bank entry threshold is about two and a half times as high as that needed to accommodate a duopolist. My results, therefore, suggest that U.S. local banking markets have tended to approach fairly high competitive levels rather quickly in recent years, as the number of competing banks has increased. Presumably, by eliminating important barriers to entry, the process of deregulation in banking has enhanced the conditions for market competition.

NOTES

[1]The basic intuition behind this methodology can also be found in Sutton (1992), pp. 27–37.

[2]Bresnahan and Reiss (1991) use a demand function with such characteristics.

[3]See, for example, Mas-Colell, Whinston, and Green (1995), pp. 387–407.

[4]There is a broad list of empirical studies using MSAs and rural counties to define the geographical boundaries of banking markets. Rural counties can be defined as integrated local markets with respective county seats acting as focal points of economic activity. Metropolitan areas are defined as large population nuclei, with adjacent communities having a high degree of social and economic integration with the core. Metropolitan areas comprise one or more entire counties, except in New England, where cities and towns are the basic geographic units.

[5]The median MSA has a population of about 900,000, while the median rural county has a population of about 16,000.

APPENDIX: ESTIMATION OF THE ENTRY THRESHOLDS

The only industry information I need using the methodology proposed by Bresnahan and Reiss (1987, 1990, 1991) is the number of banks operating in each market. Suppose we observe that a market has only two banks in operation. Then they must both be profitable (or in any case the long-run profitability condition for entry for each one of them was met), but a third bank entering the market would have negative profits. More generally, if we observe N banks in a market, we assume their profitability but not that of a potential N + 1st entrant.

Consequently, I can estimate the likelihood that a market had one bank, two banks, three banks, and so on as a function of a set of variables that should affect bank profitability. This observation suggests the use of a *qualitative response* model, where the dependent variable is the number of banks operating in each market (that is, it takes values 1, 2, 3, 4, 5, or 6, where 6 actually clusters all markets with six *or more* banks). The function to estimate is a profit function similar to equation 2, written in a more general form as

$$4) \quad \Pi_N = S_N V_N(X, \alpha, \beta) - F_N(W, \delta, \gamma) + \varepsilon = 0,$$

where $V_N(X, \alpha, \beta)$ is per customer variable profits for the Nth bank, and $F_N(W, \delta, \gamma)$ is fixed costs. X and W are vectors of market-specific variables affecting variable profits and costs, α, β, δ, and γ are profit function parameters to be estimated, and ε is an error term.

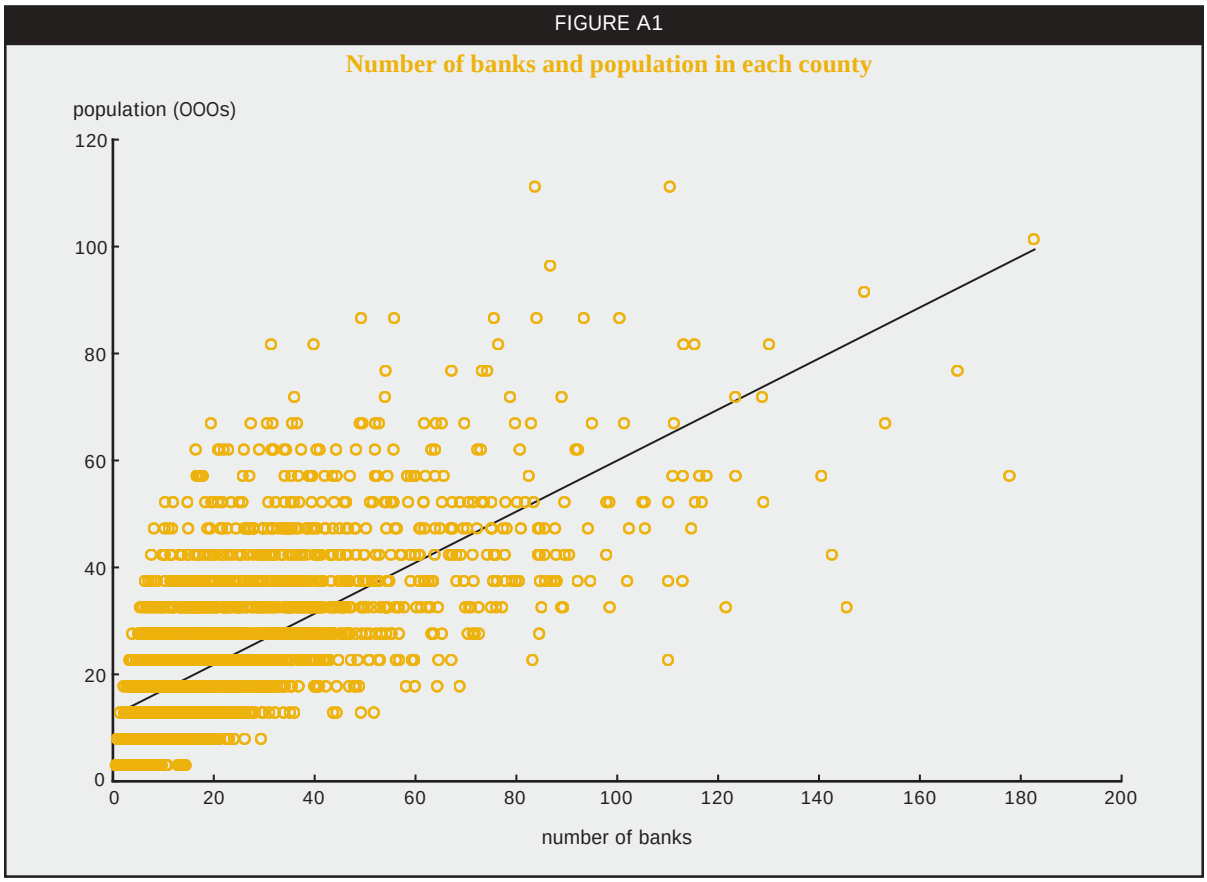
Market size, S_N, is proxied by county total population. Figure A1 shows a scatter plot of market population size and the corresponding number of banks in operation. As expected, we see a positive relationship between market population and number of banks in the market. Indeed, the simple correlation between the two variables is 0.69.

As proxies of demand conditions, I have included the levels of farm income per capita, nonfarm income per capita, and the employment rate. Since markets are represented by rural counties, I have included both farm and nonfarm income per capita as proxies of demand conditions. The prior is that markets with higher per capita income levels should be indicators of more prosperous local economies, which should be reflected in higher demand for banking products; this, in turn, enhances the likelihood of bank entry (for given market size). Similarly, I have also included the county employment rate as an indicator of overall economic activity, which should have the same prediction on the likelihood of entry of the income variables. In order to take into account cost characteristics, I have included a measure of the going wage rate in each county and a measure of land value in the state as indicators of input costs that a potential entrant would face in a particular market. My prediction is that the likelihood of bank entry should be lower in markets exhibiting higher wage rates or land value. Table A1 (on page 26) reports summary statistics for the main variables.

I model firms' variable profits as a linear function of the number of firms and economic variables:

$$5) \quad V_N = \alpha_1 + X\beta - \sum_{n=2}^{N} \alpha_n.$$

FIGURE A1



In particular, this expression allows for variable profitability to progressively decrease in the number of firms operating in the market. More precisely, the variable profits for a monopolist would be $V_1 = \alpha_1 + X\beta$; in the case of a duopolist market it would be $V_2 = \alpha_1 + X\beta - \alpha_2$; in a three-firm market, $V_3 = \alpha_1 + X\beta - \alpha_2 - \alpha_3$, and so on. The decrease in variable profitability could be the result of increased competition or lower efficiency of the subsequent entrants.

I also assume fixed costs are a linear function of the number of firms and of market variables and allow them to be progressively larger for subsequent entrants:

$$6) \quad F_N = \gamma_1 + W\delta + \sum_{n=2}^{N} \gamma_n,$$

so that, $F_1 = \gamma_1 + W\delta$, $F_N = \gamma_1 + W\delta + \gamma_2$, $F_N = \gamma_1 + W\delta + \gamma_2 + \delta_3$, and so on. The increase in fixed costs captures the possible presence of barriers to entry for an additional firm.

Assuming that the error term in equation 4 has a normal distribution, the likelihood to observe N banks in a market is estimated through an *ordered probit* model, where, as noted earlier, the categorical dependent variable is the number of banks reported in operation in each market, and the corresponding probabilities for each category are estimated maximizing a likelihood function whose arguments are those of the profit function in equation 4.

Note that estimating the probability of observing markets with only one bank in operation would require the observation of markets with *no* banks. Given our definition of local markets, there are no rural counties with a count of zero banks in them. Consequently, the first entry threshold that I can actually estimate is that for a second entrant.

With this consideration in mind, and using equations 5 and 6, the profit function to estimate is

$$\begin{aligned} 7) \quad \Pi_N = \; & S_N[\alpha_2 + \beta_1 \, Nonfarm\,Income + \\ & \beta_2 \, Farm\,Income\,Per\,Capita + \\ & \beta_3 \, Employment\,Rate - \sum_{n=3}^{N} \alpha_n] - \\ & [\gamma_2 + \delta_1 \, Market\,Wage\,Rate + \\ & \delta_2 \, Land\,Value + \sum_{n=3}^{N} \gamma_n] + \varepsilon. \end{aligned}$$

TABLE A1

Demographic variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
Population	2,257	24.03209	22.9808	0.412	182.399
Nonfarm income	2,257	19.82249	3.854842	8.15167	65.64529
Farm income	2,231	0.870377	1.981094	–7.85946	30.1501
Employment rate	2,257	0.526713	0.151423	0.145826	2.487055
Wage rate	2,257	15.91700	4.486300	4.215000	59.87400
Land value	2,257	933.6611	540.5683	159	6,304

Notes: County population is in thousands. County nonfarm and farm personal income, in thousands of dollars, indicates income levels from nonfarm and farm activities per total county population, respectively. The employment rate is the ratio of total employment and total population in a county. The wage rate is the ratio of total wages, in thousands of dollars, and total employment in a county. Land value is an average across each state. All data are for 1999.

The subscripts for the αs and the γs indicate that the first coefficients to estimate, and the first threshold to calculate, are those for duopolist markets. In view of equation 5, we expect α_2 to be positive, α_i, (i = 3, ..., 6) to be negative, and the βs to be positive. In view of equation 6, we expect the γs and δs to be negative (there is a negative sign outside the second bracket in equation 7). Also, following Bresnahan and Reiss, since we allow for constant terms in the V_N function, the coefficient for market population is set equal to one. This is a normalization that expresses units of market demand into units of market population.

Table A2 shows the estimation results for the ordered probit regression model. As the table indicates, all the variables display the expected effect on the probability of bank entry. Entry is more likely in markets with higher levels of both farm and nonfarm income per capita and with higher employment rates, as denoted by the positive and significant coefficients of both income variables and the employment variable. Accordingly, entry is less likely in markets characterized by higher input costs, as indicated by the negative and significant coefficients for the two cost variables. Also, as expected, the variable profitability of each subsequent entrant is estimated to be progressively declining (the $\widehat{\alpha}_i$, i = (3, ..., 6) are negative and significant). At the same time, additional entry is also associated with

TABLE A2

Estimation of the maximum likelihood function

Regressor	Coefficient	Standard error	Z-value	p > Z-value
Nonfarm income	0.00131	0.00048	2.740	0.006
Farm income	0.00730	0.00155	4.700	0.000
Employment rate	0.00019	0.00002	12.330	0.000
Wage rate	–56.27922	7.05996	–7.970	0.000
Land value	–0.00011	0.00006	–1.950	0.051
α_2	0.13115	0.01824	7.190	0.000
γ_2	–0.38973	0.12557	3.100	0.002
α_3	–0.11398	0.01711	6.660	0.000
γ_3	–0.28753	0.09289	3.100	0.002
α_4	–0.03500	0.00649	5.390	0.000
γ_4	–0.41147	0.06537	6.290	0.000
α_5	–0.02126	0.00384	5.530	0.000
γ_5	–0.30051	0.05483	5.480	0.000
α_6	–0.01589	0.00295	5.380	0.000
γ_6	–0.23454	0.05351	4.380	0.000
Observations	2,231			

Notes: This table reports the coefficient estimates of the profit function (equation 7). The model is an ordered probit, where the dependent variable takes values, 1, 2, 3, 4, 5, 6, for the number of banks in each cluster of markets. The last cluster groups markets with six or more banks. A p value below 0.05 expresses statistical significance at the 5 percent level or higher.

increasingly higher fixed costs (the $\hat{\gamma}$ coefficients are also negative and significant).

Once the ordered probit model is estimated, I calculate the entry thresholds using the following formula, obtained by rearranging terms in equation 7:

$$8) \quad S_N = \frac{\hat{\gamma}_2 + \bar{W}\hat{\delta} + \sum_{n=3}^{N} \hat{\gamma}_n}{\hat{\alpha}_2 + \bar{X}\hat{\beta} - \sum_{n=3}^{N} \hat{\alpha}_n},$$

where the circumflex indicates the maximum likelihood estimated coefficients and the upper bar indicates the sample mean values of the regressors in the ordered probit model.

So, for instance, using the actual numbers from the regression results in table A2, the entry threshold for duopolists is calculated as $S_2 = \frac{\hat{\gamma}_2 + \bar{W}\hat{\delta}}{\hat{\alpha}_2 + \bar{X}\hat{\beta}} = 2{,}170.$ In per bank terms, $S_2/2 = 1{,}085$. Accordingly, $S_3 = \frac{\hat{\gamma}_2 + \bar{W}\hat{\delta} + \hat{\gamma}_3}{\hat{\alpha}_2 + \bar{X}\hat{\beta} - \hat{\alpha}_3} = 5{,}782$, $S_3/3 = 1{,}927$, and so on.

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