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DO PUBLIC BANKS COMPETE WITH PRIVATE BANKS? EVIDENCE FROM CONCENTRATED LOCAL MARKETS IN BRAZIL[§]

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Abstract

We extend the framework of Bresnahan and Reiss (1991a) to measure the competitive effect of the public ownership of banks in concentrated local banking markets in Brazil. We use variation in market size, the number of competitors and their identities to determine how the conduct of private banks is affected by the entry of a public bank. We find that local markets whose structure includes private bank duopolies are more than 35% larger than private monopolies, whereas duopolies containing one public bank and one private bank and private monopolies do not differ with respect to market size. These results suggest that the presence of a rival private bank toughens competition, but the presence of a public bank does not affect the conduct of private banks.

KEYWORDS: banking industry; public versus private ownership; effect of entry.
JEL CODES: L10; L13; L33

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"Lula tells public banks to slash interest rates for consumers"

Folha de São Paulo, January 23, 2009

1. Introduction

Despite widespread privatization in the 1980s and 1990s, state ownership remains significant in the banking industry. According to La Porta et al. (2002), the public sector still owned approximately 40% of banking sector assets worldwide in 1995. In Latin America, this figure is even higher (Levy-Yeyati et al. [2004]). Moreover, state ownership in the banking industry increased after the financial crisis left many private banks insolvent.

The literature has suggested several roles for public banks.[1] Public and private financial intermediation exists to mitigate the problems of informational asymmetry and contract incompleteness (Gorton and Winton [2002]). Public ownership, insofar as it alleviates the pressure to promote profitability, could induce banks to lend to borrowers whose return is socially (but not privately) positive. Two examples of such lending include long-term finance provided by development banks and state-directed cases of short-term microcredit.[2] Additionally, public banks may induce a more competitive conduct in the banking industry. The quote at the top of the page suggests that, at least in terms of rhetoric, the Brazilian federal government intended to use federal banks to induce competition among banks to alleviate the credit crisis in 2009.[3] In this article, we empirically investigate whether public banks indeed induce competition.

From a theoretical perspective, it is unclear whether public banks aggressively compete with private banks. Public banks may have motives that extend beyond profit

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[1] We use the term "public banks" as a synonym for *state-owned* banks and not in the sense of publicly held banks (i.e., banks whose stocks are publicly traded).

[2] An example is the Bank for Agriculture and Agricultural Cooperatives (BAAC), which was established by the government of Thailand to improve access to credit for small farmers. See Ahlin and Townsend (2003).

[3] Lula, the president of Brazil, instructed public banks (through the media) to slash interest rates in the context of increasing spreads as a consequence of the credit crunch produced by the international financial crisis. Lula also stated that "[public banks] cannot charge rates higher than private ones."
Folha de São Paulo is the daily newspaper that boasts the highest circulation in Latin America. Similar newspaper stories abound during the international credit crunch. In early June, Lula fired the CEO of Banco do Brasil apparently due to his lack of aggressiveness in expanding credit during the middle of the credit crunch.

maximization. If these banks value consumer welfare, they may act more competitively than a profit-maximizing bank. However, public ownership may lead to operational inefficiency or product differentiation. In Brazil, both factors appear to be operative. In such cases, public bank ownership may exert little or no competitive pressure on the private side of the industry.

For a number of reasons, Brazil is a convenient setting in which to study the competitive effect of public banks. First, public and private ownership of bank assets co-exist and are equally important in terms of market share (measured by assets or deposits). Even after the privatization of several state-owned public banks during the 1990s, 42.7% of the banking sector assets were still held by the public sector in 2001 (Levy-Yeyati, et al [2004]).[4] The federal government controls the largest commercial bank, Banco do Brasil (BB); the largest savings and loan institution, Caixa Econômica Federal (CEF); and Banco Nacional de Desenvolvimento Econômico e Social (BNDES), a large development bank that is a major source of long-term credit in the country.

Second, privatization has produced local private monopolies and duopolies, which is a rare market structure in countries with an important presence of public banks. Typically, when public and private banks coexist, the local monopolist tends to be a public bank.

Third, the analysis of conduct in the Brazilian banking industry is a topic that merits interest in its own right. The market at the national level is quite concentrated. In 2004, the shares of deposits in the five and three largest banks ($C5$ and $C3$) were 55.1% and 42.6%, respectively. Among cities with fewer than 50,000 inhabitants, the average $C5$ and $C3$ were 98.5% and 99.9%, respectively.[5] The markups are high; the average spreads on corporate loans were 13.8 percentage points during the period from 2003 to 2005. The mark-ups on consumer loans reached a staggering 46.8 percentage points

[4] By state-level public banks, we mean banks controlled by the states. The privatization of state-level public banks occurred under a federally sponsored program, *Programa de Incentivo à Redução da Presença do Estado na Atividade Bancária* ("program to stimulate the reduction of the public sector presence in banking activity"), which consisted of intervention by the banking regulator (the central bank), recovery and privatization.

[5] Among the 2,957 towns with fewer than 50,000 inhabitants in 2004, only 61 towns (2%) had more than 5 banks, and only 564 (16%) had more than three banks. The minimum $C5$ observed in towns with fewer than 50,000 inhabitants was 85%, and the minimum $C3$ observed was 62%. The figures do not change significantly when we examine towns with fewer than 100,000 inhabitants.

(Banco Central do Brasil [2005]). Additional factors certainly contribute to the situation, but structure and performance suggest the possibility of a conduct problem.[6]

Our methodology builds upon the framework of Bresnahan and Reiss (1991a) (BR hereafter) that measures conduct through its effect on entry into local concentrated markets. BR explores variation in both the number of competitors and market sizes to determine how relative profits are affected by entry. The increase in market size induced by the presence of an additional firm is informative regarding its effect on conduct. Consider the case of an entrant in a monopoly market. If entry considerably increases competition, then duopoly markets are much larger than monopoly markets. Similarly, we exploit variation in local bank market sizes and in the number of public and private banks to determine the effect of public banks on competition. A private bank faces tougher (or softer) competition from a public bank compared with a rival private bank if public-private duopolies are larger (smaller) than private-private duopolies. In addition to the BR approach, we study an entry game with heterogeneous firms (Mazzeo [2002], Tamer [2003], Bjorn and Vuong [1984], Jia [2008], Bajari et al [2010]). Beyond the heterogeneity of costs and product characteristics, banks may have different objective functions (i.e., the entry decision of a public bank may not be driven by profit maximization but may be motivated by public policy objectives or political patronage). By focusing on local markets, we can measure the competitive effect of public banks using minimal information; we only need to observe market size and presence. Our approach incurs a cost in terms of external validity because our results apply solely to competition at the local level.

Our estimates suggest a differential competition effect from public and private banks. Estimated entry thresholds imply that private duopolies are on average 35% larger than private monopoly markets. In contrast, private-public duopolies are not larger than private monopolies. This finding suggests that although the presence of a private

[6] In 2005, Bradesco, then the largest private bank in Brazil, reported $5.5 billion in profits, which implied a return on equity of 32%. This return is twice the average return for European and American commercial banks. Other large private banks have similar returns. See "High Living," *The Economist*, May 18, 2006. Other culprits include high reserve requirements, taxation, weak creditor protection and cross-subsidies to earmarked loans for agriculture and housing.

competitor reduces profits, the presence of a public rival has little effect on a private bank.

Besides any implicit mandate, public banks have two explicit mandates: 1) support working capital for agriculture, and 2) support home ownership. We show evidence that suggests that accounting for these two dimensions of differentiation does not fully explain the difference in competitive pressures exerted by public and private banks. We also present some evidence that private banks operate at lower costs. However, normative implications do not follow immediately from these two facts. Public banks could still be serving a different clientele and we are not able to measure it properly. In fact, higher cost may be a manifestation of unobserved differentiation. For example, higher delinquency rates on earmarked loans increase public banks´ costs. Public ownership of banking assets is unambiguously wasteful only if the main mechanism is purely higher costs. With the data available, we are not able to exclude that higher costs are in fact caused by segmentation.

This article is organized as follows. In Section 2, we review the literature pertaining to the performance of public banks. In Section 3, we describe the data and present some summary statistics. The empirical strategy is outlined in Section 4. Section 4 also contains the main results and several robustness tests. Section 5 discusses the results, and Section 6 provides the conclusions.

2. Related Literature

The banking literature has devoted some attention to the issue of public banks. On the normative side, a benign view considers public banks as necessary for substituting private intermediation in projects with positive social returns but negative private returns. This role of public ownership in banks is similar to the role of public ownership in other industries, but the reasons for such ownership are sharper for financial intermediation. The role of public banks differs from that of private banks in terms of intensity rather than substance. Financial intermediaries (i.e., banks) exist to overcome friction (Gorton and Winton [2002]). Public banks, whose goals do not entirely consist of maximizing profits, further alleviate friction and induce financial development, which in turn causes

economic growth. Levy-Yeyati et al. (2004) list all of the normative roles for the existence of public ownership in financial intermediation. This argument has little empirical support. Micco et al. (2007) compare the performance of public and private banks and find that private banks outperform their public counterparts in overhead costs, profitability and non-performing loans. However, lower performance in all three dimensions is compatible with the benign view.[7] Using cross-country data, La Porta et al. [2002] find that a higher percentage of public ownership of bank assets is associated with lower subsequent financial development and economic growth. See Micco et al. (2007) for an excellent survey of the literature.

In addition to their contributions to development goals, public banks may also smooth business cycle fluctuations. Micco and Panizza (2006) offer evidence that lending behavior during the business cycle depends on ownership. More specifically, public bank lending is less responsive to macroeconomic shocks.

A less benign view posits that political economy explains the existence of public banks. Such mechanisms abound: lending directed toward political allies, political lending cycles, and lending directed toward inducing the "good behavior" of firms, among others. Recent literature offers empirical support for this "skeptical" view. Using Italian data, Sapienza (2004) finds that the loans offered by public banks are less expensive in places where the local government is aligned with the central government. Cole (2009) identifies a political cycle component of public banks. Lending increases during the years preceding elections, and the difference is stronger in places where the governing coalition won by a narrow margin in the previous election. Khwaja and Mian (2005) find that public banks favor politically connected firms. Data from Brazil also support the political economy view. Carvalho (2009) finds evidence of political motivation behind the lending of the BNDES.

A third view of public banks is conciliatory. Governments may own banks for the purposes of correcting market failures and encouraging economic development. However, problems may arise in this scenario because government-owned institutions

[7] If public banks fund riskier but socially desirable projects, then they have higher non-performing loans and lower profitability. In terms of costs, a mandate for minimizing costs may conflict with funding longer-term development-oriented projects. See Hart et al. [1997] for a theoretical argument.

face increased agency problems (thus, higher operating costs) and are subjected to more political influence.

We follow the literature in investigating whether and how public banks shift their supply of credit. In contrast with the literature, we focus on the competitive effects of public banks: Do they shift their credit supply by inducing more competition in product markets? With the exception of Micco et al. (2007), who offered a marginal discussion of this issue, our article is, to the best of our knowledge, the first study of the competitive effect of public banks. Moreover, Micco et al. (2007) use a different strategy. They regress the interest margins and profitability of private banks on the share of public ownership at the country level.

We find that the presence of public banks at the local level has little competitive effect on private banks; this finding is compatible with all three views of public banks. We also find evidence that public banks operate at higher costs than private banks. Finally, we show that our results are not driven by cities in which public banks must specialize (by legal mandate) in supplying credit to riskier borrowers. Thus, our results are in line with the more skeptical view of public banks; incidentally, this view is better documented in the empirical literature.

Another piece of related literature examines models of entry in local banking markets. Our paper is not the first study to use BR's methodology to determine the effects of competition in local banking markets. De Juan (2008) uses the framework of BR to measure conduct in Spanish local banking markets. Feinberg (2008) uses the methodology of BR to study the entry decisions of credit unions in American local banking markets. In contrast with previous papers discussing entry in local banking markets, we estimate the competitive effect of public banks. Our work is closely related to the study conducted by Cohen and Mazzeo (2007), who estimate an endogenous entry model in non-MSA banking markets in the U.S. These authors identify important production differentiation between multi-branch banks and thrift and unit branch banks. Cohen and Mazzeo (2007) find that different competitive effects for different types of banks are due to product differentiation.

3. Data and Descriptive Statistics

We use two sources of information to construct the data set. The information pertaining to the local bank market structure at the city level is obtained from the Banking Statistics System of the Central Bank of Brazil (ESTBAN). The data set includes the number of branches that each Brazilian bank possesses in each municipality in December 2000. We match this information with demographics from the census conducted in 2000.

A local market is a city located outside of a metropolitan area. We excluded cities within metropolitan areas because people living in these areas often conduct their banking business near their residence or workplace.

We measure market size by the adult population multiplied by income per capita (i.e., aggregate adult income).[8] Intra city income inequality is high in Brazil, and banking services may be a superior good. Thus, the income measure may overestimate the size of the market in cities with greater income inequality. For robustness, we also measure market size by the aggregate income of those who earn more than three times the minimum wages.[9]

Tables 1 and 2 contain summary statistics. Table 1 lists the mean town characteristics by the total number of banks. Table 1 shows that the number of banks increases according to population and aggregate income, as expected. In both cases, the relationship is monotonic, but it is much more pronounced for aggregate income; this result supports the assumption that aggregate income is a better measure of market size than population. This observation holds for the total income and the aggregate income among those who earn more than three minimum wages.

Table 2 depicts the differences observed across markets according to the number of public and private banks. Private monopolies are smaller than public monopolies, regardless of whether market size is measured by the total income or by the total income

[8] Following the work of BR, we also considered an alternative specification of market size as a function of population, population growth, and the number of inhabitants that commute to and from the city.

[9] The threshold of three times the minimum wages is not arbitrary. Two high-ranked bank executives (from Itaú and Bradesco) reported to one of the authors (Mr. De Mello) that they target clients with this minimum level of income. Changing the definition to 2, 4 or 5 minimum wages does not meaningfully change the results. To ensure conciseness, we omit these results, but they are available upon request.

of those who earn more than 3 minimum wages. This result is intriguing if the role of public banks is to encourage development in small places. However, this finding is compatible with the interpretation that public banks face higher operating costs. Private duopoly markets are almost twice the size of private monopoly markets (98% larger). In contrast, markets with one public bank and one private bank are less than double the size of public monopoly markets (83% larger). Comparing public duopolies to public monopolies, we find that the increase in size is even less pronounced (approximately 60%). In general, the descriptive statistics suggest that private banks are willing to enter smaller markets when their competitor is a public bank; this finding suggests that the presence of public banks may reduce the profitability of private banks.

4. Empirical Strategy

Following the approach of BR, we identify the effect of entry on conduct using the variation in market size and the number of banks in local markets. Let *k* index a market. The profits of private banks in the local market *k* are as follows:

$$\pi_k = \bar{\pi}\left(S_k, N_k^{pub}, N_k^{pri}, X_k\right) + \varepsilon_k$$

Profits are a function of four observables and an additive error term ε_k containing all unobservables that affect city-level bank profits. The observable variables are the size of the market (S_k), the number of public banks (N_k^{pub}) and private banks (N_k^{pri}) in the local market *k*, and a vector of demand and supply shifters that affect profits at the local level (X_k,). Typically, X_k includes demand shifters, such as income and income distribution, and supply shifters, such as region dummies (banks face different fixed costs associated with operating in different parts of the country).[10]. We expect $\bar{\pi}\left(S_k, N_k^{pub}, N_k^{pri}, X_k\right)$ to increase in S_k and to decrease in N_k^{pub} and N_k^{pri}.

[10] Bank executives report that in the northeastern and northern parts of the country, it is more difficult to recruit sufficiently qualified personnel for certain positions, such as loan officers and account managers.

4.1 Modeling Only the Entry of Private Banks

The first estimation method exploits the assumption that private banks maximize profits. We do not model the entry decision of public banks. In principle, public banks can enter or exit a market in response to a variety of objectives: to provide services that are socially beneficial but not lucrative; or to act as a device of political patronage by providing local jobs and unprofitable services in response to political pressure.

For now, we assume the local presence of public banks as given. The identifying assumption is that the presence of public banks is not systematically related to unobserved market characteristics. In Section 4.2, we consider a model in which public banks also make entry decisions to maximize a (possibly different) objective function.

Following BR, we model the entry into market *k* as a simultaneous move game of perfect information: all potential entrants observe the realization of the profitability shock ε_k and simultaneously decide to enter. This game has multiple equilibria, but the number of entrants N_k^{pri} is uniquely determined by the following condition:

$$\pi\left(S_k, N_k^{pub}, N_k^{pri}, X_k\right) + \varepsilon_k > 0 > \pi\left(S_k, N_k^{pub}, N_k^{pri} + 1, X_k\right) + \varepsilon_k \qquad (1)$$

Following BR, we estimate our model by the maximum likelihood of the number of private banks that enter the market. We assume a common shock to all private banks within a market, and this shock is independently and identically (normally) distributed across markets. The realization of the shock determines the equilibrium number of private banks. Abusing notation, let $\bar{\pi}_k(j,i) = \bar{\pi}\left(S_k, N_k^{pub}, N_k^{pri}, X_k\right)$, where $j = Nkpub$, $i = Nkpri$. The probability of observing *i* private banks in market *k* conditional on the number of public banks being *j* is as follows:

$$\begin{aligned}\Pr\left(N_k^{pri} = i\right) &= \Pr\left(-\bar{\pi}_k(j,i) < \varepsilon_k < -\bar{\pi}_k(j,i+1)\right) \\ &= F\left(-\bar{\pi}_k(j,i+1)\right) - F\left(-\bar{\pi}_k(j,i)\right)\end{aligned}$$

where F is the standard normal cumulative distribution function. Thus, we estimate an ordered probit with the number of private banks as the discrete endogenous variable.

We impose the following functional form for the expected profit function:

$$\bar{\pi}\left(S_k, N_k^{pub}, N_k^{pri}, X_k\right) = S_k \times \left(\alpha_1 + \sum_{m=2}^{N_k^{pri}} \alpha_m D_k^m + \beta N_k^{pub} + \eta X_k\right) - \sum_{m=1}^{N_k^{pub}+N_k^{pri}} \gamma_m \widetilde{D}_k^m \quad (2)$$

The term in parentheses is the price-cost margin, which varies according to the following: 1) demand and cost shifters (X_k); and 2) market conduct, which is a function of the presence of other private and public banks. In this specification, the number of public banks N_k^{pub} affects profits linearly through the parameter β.[11] We estimate the competitive effect of private banks flexibly by adding a dummy D_k^m for the presence of m private banks in market k. Thus, α_m represents the marginal effect of the presence of the m-th private bank on profitability.

The final term in (2) is the fixed costs, which depend on the total number $N_k = N_k^{pub} + N_k^{pri}$ of firms present in the market. Hiring good staff or renting prime real estate for branches may be more expensive when other banks already operate in a particular market. Because private banks may be late-comers in some markets, accounting for this possibility is important. $\widetilde{D}_k^m$ is a set of dummies for the total number of banks in market k; thus, the parameters γ_m capture the differences in fixed costs according to the number of banks in the market.

For robustness, we also estimate a model in which the market size does not enter in a multiplicative but in a linear fashion, and it is arguably somewhat more flexible than our main specification (Mazzeo [2002]). We are no longer able to distinguish the demand and cost parameters (the αs and the β from the γs). The main parameters of interest are not the coefficients associated with dummies for different market structures (private monopoly, public monopoly, private-public duopoly, etc).

[11] We adopt a linear specification for the effect of public banks because most cities in the sample have two or fewer public banks. We have also estimated a model in which the effect of public banks was estimated flexibly. See Section 4.2.

4.1.1 Results

Table 3 shows two sets of parameters estimates. First, the results of the maximum likelihood estimates of the parameters in (2). We show three specifications: 1) a baseline model, in which only the conduct effects are considered; and 2) the same model with the addition of monthly income per capita and the Gini coefficient as demand shifters (elements in X_k); 3) the same model with additional controls that may affect market segmentation that affects the entry decision of public banks in particular (additional elements in X_k);[12] they are: rural GDP, rural population, Rural GDP/Total GDP, % of people living below the poverty line, % of home owners, and the Human Development Index (HDI).

Column (1) contains the baseline estimates. All coefficients have the expected signs. The estimated $\alpha's$ are all negative and statistically significant; thus, each additional private bank reduces the profitability of infra-marginal competitors. In line with most oligopoly models and with the results presented by BR, the magnitude of the effect of entry decreases as banks enter the market (i.e., entry has a smaller marginal effect on conduct as the market becomes competitive) ($\alpha_1 > \alpha_2 > \cdots$). The fixed cost parameters γs are all positive and statistically significant; thus, as expected, the fixed costs increase as the number of competitors increases.

$\hat{\beta}$ is negative and statistically significant. Thus, public banks do indeed reduce the profits of private banks. The effect of public banks on conduct is small in magnitude when compared to the impact of other privates banks: $\hat{\beta}$ is close to $\alpha_{5;}$ thus, the effect of a public bank on conduct is similar to the effect of the fifth private entrant. Column (2) contains the estimates when we include of demand controls. As expected, profits increase according to income and more equal levels of income distribution. The competitive effect of a public bank is, if anything, smaller than that presented in column (1). In column (3) we include the additional controls that should correlate more strongly with the presence of public banks. Results are similar. Column (4) shows estimates of a model in which

[12] Public banks have an explicit mandate to forster the agriculture and to support home ownership, as mentioned in the introduction. For a detailed discussion on the issue of product differentiation, see Section 5.

market size enters linearly (Mazzeo, 2002). All estimates on the αs and the β are smaller in magnitude (but they are not comparable with those in columns (1) and (2)). Again, the effect of private banks presence on other private banks' product are much stronger than the public banks' impact (compare again the αs with the β). Again, including a larger set of demand controls does not change results meaningfully.

The effect of entry on conduct can be presented through S_{ij}, the minimum market size that supports i private banks and j public banks.[13] By definition, S_{ij} solves $\bar{\pi}\left(S_{ij}, N_k^{pub} = j, N_k^{pri} = i, X_k\right) = 0$. Using the estimates of the parameters in equation (2), we recover an estimate of S_{ij} conditional on X_k for different values of i and j. Consider two situations: a situation involving one public bank and one private bank (i =1, j = 1) and a situation involving two private banks in the market (i = 2 and j = 0). The estimated minimum market sizes are as follows:

$$\hat{S}_{11} = \frac{\hat{\gamma}_1 + \hat{\gamma}_2}{\hat{\alpha}_1 + \hat{\beta} + \hat{\eta} X_k}$$

and

$$\hat{S}_{20} = \frac{\hat{\gamma}_1 + \hat{\gamma}_2}{\hat{\alpha}_1 + \hat{\alpha}_2 + \hat{\eta} X_k}$$

If $\hat{S}_{11} = \hat{S}_{20}$, then ownership does not affect conduct. If $\hat{S}_{11} > \hat{S}_{20}$, a private bank requires a larger market to support entry when the competitor is a public bank. In this case, public banks intensify competition. To facilitate comparison across market structures, we follow the approach of BR and report the estimated minimum market size per bank. We measure size by total income (divided by 10^7):

$$s_{ij} = \frac{\hat{S}_{ij}}{i+j} = \frac{1}{i+j} \; \frac{\sum_{m=1}^{i+j} \hat{\gamma}_m}{\hat{\eta} X_k + \hat{\beta} j + \sum_{m=1}^{i} \hat{\alpha}_m}$$

Table 4 shows the estimated minimum scale per bank for different market structures. The minimum scale per bank to support private duopolies is 37% larger than

[13]For conciseness, we report minimum market sizes using estimates for the multiplicative of column (2).

the minimum private monopoly scale (s_{20} = 0.15 versus s_{10} = 0.11). The difference is statistically significant. In sharp contrast, the minimum scale per bank to support a public-private duopoly (s_{11} = 0.10) is not larger than the minimum private monopoly scale. The introduction of additional private banks increases the minimum scale per bank, but increasing the number of public banks has no effect on the minimum scale per bank. These results show that public banks have a significantly smaller effect on the profits of private banks compared with the effect of other private banks.

4.1.2 Robustness Check 1: Regional Effects

Public banks are more prevalent in the northeastern and northern regions, the poorer regions of the country, which is compatible with an implicit mandate to foster intermediation in markets that private banks find uninteresting. Because demand and cost conditions differ across regions, we add regional dummies to allow the price-cost margin and the fixed cost to capture the differences across regions:

$$\pi\left(S_k, N^k_{pri}, N^k_{pub}\right) = S_k \times \left(\begin{array}{l} \alpha_1 + \sum_{m=1}^{N^k_{pri}} D^k_m \alpha_m + \beta \times N^k_{pub} + \eta X_k + \\ \kappa_1 Southeast + \kappa_2 South + \kappa_3 North + \kappa_4 Centerwest \end{array} \right)$$
$$- \sum_{m=1}^{N^k_{pri}+N^k_{pub}} \tilde{D}^k_m \gamma_m + \lambda_1 Southeast + \lambda_2 South + \lambda_3 North + \lambda_4 Centerwest + \varepsilon_k \qquad (3)$$

The omitted category is the northeastern region. Table 5 shows results that are similar to those in Table 3. The price-cost margins are similar across regions: all κs are indistinguishable from zero; this result reflects the finding that income and income inequality already captures most of the relevant variation in demand across regions. In contrast, the fixed costs are higher in regions that are farther away from the southeastern economic center of the country (i.e., São Paulo). The North has the highest fixed costs (λ_3 = 0.66), followed by the Northeast (the omitted category), the South (λ_2 = - 0.65), the Center-west (λ_4 = - 0.73), and the Southeast (λ_1 = - 1.05). This result is consistent with the perceptions in the industry. Table 6 shows the minimum scales. As expected, all banks

require much larger markets to support entry in the Northeast and North than in the Southeast.

4.1.3 Robustness Check 2: Different Definitions of Market Size

We consider two alternative definitions of market size: 1) market size reflects the total income of those who earn more than three minimum wages; and 2) following BR, market size is modeled as a function of several variables. More specifically, market size is defined as follows:

$$S_k = \begin{pmatrix} \text{Population} + \omega_1 \text{Commuters from out of Town} + \\ \omega_2 \text{Commuters to out of Town} + \\ + \omega_3 \text{Positive Growth} + \omega_4 \text{Negative Growth} \end{pmatrix} \times \text{Income Per Capita} \tag{4}$$

where the ω coefficients are to be estimated.[14]

The commuters to a town are the non-resident working population. The commuters to an area outside of a town are the resident population that commutes to work. Positive growth is a dummy that indicates population growth from 1990 to 2000, and negative growth indicates the reverse. The idea is simple: Given a specific population, the market size is larger when more people commute from outside of the town; when fewer people commute to areas outside of the town, the population is growing faster, or the population is declining more slowly.

Table 7 shows the results for the different definitions of market size.[15] The estimates of the private bank dummies and of the number of public banks are similar to those presented in Table 3. The estimated coefficients of the determinants of market size have the expected sign, but the point estimates on the commuters' variables are not precisely estimated. Table 8 has the associated minimum scale thresholds, which are similar to those presented in Table 4.

[14] For conciseness we only report estimates of the multiplicative-market-size model.. Results for the linear-market-size model are available upon request.

[15] The estimates in column (1) are not sensitive to other boundaries, such as the income of those who earn more than two, four and five minimum wages. Again, we only report results for the multiplicative-market – size model. Results for the linear-market-size model and for different definitions of market size are available upon request.

4.1.4 Robustness Check 3: Flexible Specification

The effect of public banks on private banks' profit is linear in (2). One concern is whether functional form drives results. We estimate a specification in which the effect of public banks is flexible. More specifically, we estimate the following model:

$$\bar{\pi}\left(S_k, N_k^{pub}, N_k^{pri}, X_k\right) = S_k \times \left(\alpha_1 + \sum_{m=2}^{N_k^{pri}} \alpha_m D_k^m + \sum_{m=1}^{N_k^{pub}} \beta_m T_k^m + \eta X_k\right) - \sum_{m=1}^{N_k^{pub}+N_k^{pri}} \gamma_m \widetilde{D}_k^m \quad (5)$$

where $T_k^m = 1$, if the number of public banks in market k is m, and zero otherwise. T_k^3 assumes the value 1 for all markets with three or more public banks.[16]

Tables 9 and 10 show the results. The results are similar to the effects reported in Tables 3, 5 and 7. The impact of the first public bank *increases* the profits of private banks, but the effect is small in magnitude and not significant statistically. More in line with expectations, the second public and third public banks reduce the profit of private banks. Again, the impact of public banks is small in magnitude (although significant statistically): the second public entrant is equivalent to the fifth private entrant. The pattern of the minimum scales (Table 10) is similar to those shown in Tables 4, 6 and 8.

4.2 A Model with Strategic Banks

In this section, we estimate a model in which all banks, both public and private, make strategic entry decisions. We allow different profit functions for public banks and private banks, both in the component related to observables (including presence of competitors) and in the unobserved part. For the purposes of tractability, we restrict our attention to market configurations with a maximum of two private banks and one public bank. The profit functions for the public and private banks are as follows:

[16] In practice, more than two public banks means almost always three public banks (see Table 2).

$$\pi_k^{pub}\left(S_k, N_{pri}^k, N_{pub}^k\right) = S_k \times \left(\alpha_1^{pub} D_{1k}^{pub} + \alpha_2^{pub} D_{1k}^{pri} + \alpha_3^{pub} D_{2k}^{pri} + \eta_{pub} X_k\right) - (\gamma_1^{pub} D_{1k}^{pub} + \gamma_2^{pub} D_{1k}^{pub} + \gamma_3^{pub} D_{2k}^{pub}) + \varepsilon_k^{pub} \quad (5)$$

$$\pi_k^{pri}\left(S_k, N_{pri}^k, N_{pub}^k\right) = S_k \times \left(\alpha_1^{pri} D_{1k}^{pri} + \alpha_2^{pri} D_{1k}^{pub} + \alpha_3^{pri} D_{2k}^{pri} + \eta_{pri} X_k\right) - (\gamma_1^{pri} D_{1k}^{pri} + \gamma_2^{pri} D_{1k}^{pub} + \gamma_3^{pri} D_{2k}^{pri}) + \varepsilon_k^{pri} \quad (6)$$

where

$D_{1k}^{pub} = 1$, if the number of public banks in town k is 1.
$D_{1k}^{pub} = 0$, otherwise.

$D_{1k}^{pri} = 1$, if the number of private banks in town k is 1 or 2.
$D_{1k}^{pri} = 0$, otherwise.

$D_{2k}^{pri} = 1$, if the number of private banks in town k is 2.
$D_{2k}^{pri} = 0$, otherwise.

α_2^{pub} is the first private bank competitive effect on a public bank's variable profit, α_3^{pub} is the second private bank competitive effect on a public bank's variable profit, α_2^{pri} is the public bank competitive effect on a private bank's variable profit, and α_3^{pri} is the private bank competitive effect on another private bank's variable profit. The γ coefficients are again interpreted as fixed costs. In equations (5) and (6), we allow local market characteristics to affect private and public bank profits differently (i.e., income per capita may affect public and private objective functions differently). As assumed in the previous model, we assume that the configuration of market *k* is the Nash equilibrium of a perfect information game of simultaneous moves. Both public and private observe ε_k^{pub} and ε_k^{pri}, the shocks to the profitability of public and private banks, respectively. Then, they simultaneously decide whether to enter the market.

As noted in the previous section, multiple equilibria may exist, and because players are heterogeneous, the number of firms that enter in equilibrium may not be

identical across equilibria. Because the model does not predict a unique number of private and public banks in equilibrium for all realizations of ε_k^{pub} and ε_k^{pri}, the likelihood of the model is not yet fully defined.

To account for this problem, we add an equilibrium selection mechanism to the econometric model (Bjorn and Vuong [1984], Jia [2008], Bajari et al [2010]). In our model, there are three situations where equilibrium multiplicity arises, each with two possible equilibria: in the first region, there is either a single public bank or a single private bank, but not both; in the second region, there is either a duopoly with two private banks or a duopoly with a private and a public bank; and in the third region, here is either a duopoly of private banks or a monopoly with a public bank (See the appendix and figures 2 and 3 for details). We add an equilibrium selection mechanism as follows: we add three parameters, δ_1, δ_2, and δ_3. For example, if the profits fall in the first region of multiplicity, the model selects the private bank monopoly equilibrium with probability δ_1, and the public bank monopoly equilibrium with probability 1 - δ_1; likewise for the other regions.

Imposing this selection mechanism, the likelihood of the model is fully defined, and all parameters, including the equilibrium selection parameters δ_1, δ_2 and δ_3 , can be estimated by maximum likelihood. We assume the error terms ε_k^{pub} and ε_k^{pri} are jointly normal. We estimate the model assuming both independence and an arbitrary correlation between the error terms. The appendix contains additional details regarding the likelihood function and our treatment of the regions of multiplicity.

In summary, we propose a method that is valid under the following assumptions: (i) the error terms in ε_k^{pub} and ε_k^{pri} (equations (5) and (6), respectively) are jointly normal; (ii) the outcome probabilities in the multiplicity regions are constant across towns; (iii) two entrants of the same type (public or private) have the same profits in a given town *k*; and (iv) profits decrease according to the number of competitors.

4.2.1 Results

Tables 11 and 12 show the estimated parameters of the private and public banks, respectively. Results are in line with our previous estimates. Consider the case of independence of error terms (the first columns in Tables 11 and 12). The presence of a private bank has an adverse effect on the profits of other private banks ($\hat{\alpha}_3^{pri} = -2.16$). The effect of the presence of a public bank is negligible ($\hat{\alpha}_2^{pri} \approx 0$)). Allowing for arbitrary correlation between error terms yields similar results (the second columns in Tables 11 and 12).

Table 13 shows the minimum efficient scale for each type of bank based on the estimates of the model that assumes zero correlation between the error terms.[17] The markets of private duopolies are much larger than those of private monopolies. Public banks do not compete with private banks: the per-bank market size for a private duopolist competing with a public bank is *smaller* than the per-bank market size for a private monopolist. In fact, $s_{11}^{pri} = s_{10}^{pri}$; thus, when faced with one public competitor, private banks still behave as monopolists. The remaining estimated scales show that the strategic model yields results that are similar to those of the non-strategic model.

5. Discussion

Why do public banks exert little competitive pressure on private banks? The results reported thus far have been silent regarding the underlying mechanism. There are two possible mechanisms: product differentiation and cost differences. We offer evidence that both mechanisms are operative. First, we describe how public banks´ legal mandates create product differentiation. Thus, the existence of differentiation is not up for debate, only possibly its empirical importance. Data suggest that private banks operate at lower costs than public banks. Focusing on markets in which legal mandated differentiation explains part of the difference in competitive pressure between public and private banks,

[17] Minimum efficient scales using the estimates of the model that allows for an arbitrary correlation, which are very similar, are available upon request.

but a large fraction remains unaccounted for (Table 15). However, this is only indirect evidence against the "differentiation hypothesis" because, as we argue below, the legal mandate itself may cause increases in public banks´ costs.

5.1 Differentiation by Legal Mandate and its Consequences

Public banks have an explicit mandate to promote the development of two market segments: rural credit and mortgages. In most of our mixed duopoly cities, Banco do Brasil (BB) operates as the public bank. By law, 25% of all demand deposits must be allocated to financing working capital to farmers (the "rural credit"). Otherwise, this funding must be deposited at the Central Bank and does not accrue interest. Normally, private commercial banks "leave this money on the table" because delinquency costs tend to be sufficiently high to encourage these banks to leave the money idle as compulsory deposits (Costa and Nakane [2005]). In contrast, Banco de Brasil (BB), which has the largest (both in absolute and relative terms) demand deposit base, allocates 50% to rural credit due to an implicit mandate, thus far exceeding the legally mandated 25% minimum.

The earmarked credit scheme has several implications for pricing and competition. First, it increases the marginal funding cost for the banks and thus renders the non-earmarked credit segment more expensive; this phenomenon has already been documented by analysts at the Brazilian Central Bank (e.g., Costa and Lundberg [2004], Costa and Nakane [2005]). Panel A in Table 16 provides further evidence. Loans to the agricultural sector constitute almost 25% of public banks´ firm credit (mainly BB), but no more than 9.3% of private banks´ portfolio. Thus, agricultural lending differentiates BB from private commercial banks because private banks often avoid serving the agricultural sector. In addition, because the agricultural sector drains a significant amount of BB´s funding to a low profitability segment, its funding costs at non-earmarked sectors increase. Finally, delinquency in rural credit is higher than in ordinary working capital (the most comparable category), suggesting its focus on the rural sector burdens BBs costs. In summary, the rural earmarked credit operations both increase the marginal cost of *non-earmarked operations* and differentiate Banco do Brasil.

Similar to the S&L institutions in the U.S. in the 1980s, savings accounts in Brazil pay low regulated interest rates. They carry an implicit complete guarantee from the National Treasury. Although funding from savings accounts are inexpensive, 65% of the funding is earmarked to mortgages. In net terms, private banks achieve better results when they choose not to focus on savings because they find long-term mortgages expensive even with the subsidy in savings accounts.[18]

The federal government owns and controls the largest S&L institution, the Caixa Econômica Federal (CEF). The CEF alone possessed 27% of all savings deposits in the country (and represented 24% of its total liabilities) in 2000 (our sample year). Thus, by construction, the CEF focuses primarily on mortgages. Again, Panel A in Table 16 sheds light on the impact of mortgage lending on differentiation and costs. While mortgages represent 12% of private banks´ consumer lending, it amounts to more than 25% of public banks´ consumer loans. Delinquency rates are quite high on mortgages, especially for public banks, which is an additional drag on their ability to compete through higher funding costs. In summary, and similarly to agricultural loans, mortgages both differentiate public banks and most likely increase their costs.

In summary, product differentiation – which is uncontroversial - has two consequences. First, it reduces cross-price elasticity and reduces the competitive pressure that public banks exert over private banks; this is the direct effect of differentiation. Second, data suggest that differentiation increases public banks´ costs, which mitigates competition; this is the indirect effect.

We measure the direct effect of differentiation by focusing on cities in which rural credit and mortgages are less relevant. In those cities credit demand should induce less segmentation than in the whole sample.

We rank towns according to total rural and housing credit divided by municipal GDP. We then select sub-samples according to the prevalence of rural and housing

[18] Mortgage markets are very under-developed in Brazil due to the long history of high inflation that corroded confidence levels in regard to entering into long-term, fixed-rate contracts.

credit.[19] Finally, we estimate the linear model with demand controls (income per capita and Gini) in these sub-samples.

Table 14 shows the descriptive statistics pertaining to rural and mortgage credit by bank type. The total rural and mortgage credit is 4.3% of the GDP for public monopolies and 0.8% for private monopolies.

Table 15 shows the results. The first column represents the entire sample. In the second column, the top 5% of cities in terms of the rural and housing credit are eliminated from the sample. The pattern is similar for subsequent columns. $\hat{\beta}$ increases monotonically as we discard cities with high rural and housing credits, showing that segmentation does explain our results, at least partially. The estimated coefficient using the entire sample is -0.41, and -0.65 using only the bottom 50% of the sample. The last line shows the ratio of minimum scales per bank of a private-public duopoly to a private monopoly. This ratio increases as we eliminate more cities with high ratios of rural-and-housing-credit-to-GDP. For the 50% sample, the minimum efficient scale is 3% larger in a public-private duopoly as compared with a private monopoly.

As expected, we find stronger competition exerted by public banks where segmentation is less important. However, segmentation explains only a partially the competitive differences between public and private banks. For the entire sample, private duopolies are 3.33 times larger than private-public duopolies. For the bottom 50% sample, private duopolies are 2.90 times larger than private-public duopolies. Thus, differentiation directly explains some 15% of the difference. Our data do not allow us to gauge how much of the remaining difference is due to increased cost induced by differentiation (the indirect channel).

5.2 Other Dimensions of Differentiation?

In addition to the formal channels of differentiation, public banks could be used to fund riskier projects or projects whose social and private returns differ. In this case,

[19] The condition of having at least one public bank is irrelevant for our purposes. For example, for the 232 towns ranked with the 10% highest values of total rural and housing credit, only 2 towns did not have at least one public bank serving the market. The same is true for the other sample cuts.

public banks would serve different borrowers using different products. Panel B of Table 15 depicts the information on credit assets of public versus private banks based on the type of credit (average weighted interest rate, % of portfolio and delinquency rates) excluding rural and mortgage loans (the two legally mandated sources of differentiation)..

Public and private banks have a similar composition of portfolio across credit products and type of borrowers (firm versus consumer). Public and private banks are charge similar interest rates, and face similar delinquency rates in all credit products. Finally, the first row in Panel B shows the market share of the public banks for the non-earmarked credit segments. Public and private banks have roughly similar market shares in non-earmarked loans (40% public and 60% private); these similar shares reflect the deposit market shares. Thus, public and private share non-earmarked lending markets. Overall, evidence in Table 15, Panel B is suggests that public and private banks do not operate in different segments of the market, except for earmarked lending.

5.3 Are there Cost Differences between Public and Private Banks?

We now compare private and public banks in terms of inputs and outputs. An extensive analysis of cost and productivity differences is outside the scope of this paper. Costa and Nakane [2005] conduct an in-depth analysis that includes the estimation of a multi-product production function for private and public banks and have found that public banks operate at higher costs than private banks. Our purpose here is to provide simple suggestive evidence on private and public banks´ costs per unit of output.

Using balance sheet data for the banks in our sample, we compare measures of input and output for public and private banks.[20] Figure 1 conveys several graphs containing the results. Data cover the period running from 2000 through 2006. For every employee, private banks issue more deposits and underwrite more loans.[21] For loans, the difference ranges from 10% to 70%; for deposits, the difference ranges from 7% to 62%. Using another measure of output – the number of bank accounts – the difference is never

[20] Balance sheet data are obtained from the Brazilian Central Bank (more precisely, COSIF).
[21] The deposit statistics exclude the FGTS (the payroll tax deposited compulsorily at Caixa) resources for settling judicial disputes, which are mandatorily deposited at BB.

lower than 60%. The next three graphs depict the total labor costs per asset and deposit (the number for deposits is similar); again, public banks spend more per unit of credit underwritten and significantly more per bank account. Public banks appear to spend more per employee, but the difference is small (i.e., the higher labor costs result from hiring more people). The last two graphs show public banks also spend more on administrative costs.

Finally, Table 17 contains the accounting cost differences between public and private banks at the city level. We focus on the most relevant market structures in the sample. The top-left cell shows that public monopolies spend 25% more than private monopolies, but public monopolies operate in larger cities than private monopolies. Interestingly, in the cities with the same number of public and private banks (cells in bold), the cost differences range from 14% (private – public duopoly) to 95% (3 private – 3 public oligopoly). With the exception of one market structure shown in Table 14, public banks have operating costs that are higher than private banks.

Overall, data suggest that private banks operate at lower costs per unit of output than public banks. However, this evidence does not allow us to conclude that public banks are inefficient relative to public banks because their mandate to support certain markets may increase public banks´ costs.

6. Conclusion

We adapt the framework of Bresnahan and Reiss [1991a] to measure the competitive effect of entry by public banks in local banking markets in Brazil. The baseline estimation treats the presence of public banks as exogenous and assumes that private banks are non-strategic. The per-bank market size in private duopolies is 35% larger than in private monopolies. In contrast, the per-bank size of public-private duopolies is the same as that of private monopolies. These results suggest that the presence of private banks toughens competition, whereas public banks are neutral to conduct. The results remain unchanged when we add regional differences and demand controls. We also estimate a model with strategic banks that allows for heterogeneity and multiplicity of equilibria, and the results remain similar.

The results are compatible with both the segmentation and higher costs of public banks. In Brazil, public banks have explicit mandates to promote the development of the credit market sectors. Thus, product differentiation must be part of the explanation. Furthermore, the legal mandate entails a cross-subsidy for earmarked projects, which implies a higher marginal cost of funding the non-earmarked loans underwritten by public banks. In addition, we present evidence of the following: 1) the mandate to support rural credit and mortgage markets explain only partially the lower competitive pressure exerted by public banks; 2) at the aggregate level, public banks require more inputs to produce the same amount of output; 3) at the local level, the accounting costs associated with public banks are 46% higher than those of private. Thus, evidence suggests that cost differences explain why public banks exert less competitive pressure on private banks. However, our results do not warrant normative a normative judgment against public banks because differentiation may be the reason why public banks operate at higher costs.

Appendix: The likelihood function for the model with strategic banks

This appendix details the likelihood used to obtain the estimates reported in Section 4.2. The profit functions for private and public banks are specified as follows:

$$\pi_k^{pri}(S_k,1,0) = S_k\left(\alpha_1^{pri} + \eta_{income}^{pri} income + \eta_{gini}^{pri} gini\right) - \gamma_1^{pri} - \varepsilon_k^{pri}$$

$$\pi_k^{pri}(S_k,1,1) = S_k\left(\alpha_1^{pri} + \alpha_2^{pri} + \eta_{income}^{pri} income + \eta_{gini}^{pri} gini\right) - \gamma_1^{pri} - \gamma_2^{pri} - \varepsilon_k^{pri}$$

$$\pi_k^{pri}(S_k,2,0) = S_k\left(\alpha_1^{pri} + \alpha_3^{pri} + \eta_{income}^{pri} income + \eta_{gini}^{pri} gini\right) - \gamma_1^{pri} - \gamma_3^{pri} - \varepsilon_k^{pri}$$

$$\pi_k^{pri}(S_k,2,1) = S_k\left(\alpha_1^{pri} + \alpha_2^{pri} + \alpha_3^{pri} + \eta_{income}^{pri} income + \eta_{gini}^{pri} gini\right) - \gamma_1^{pri} - \gamma_2^{pri} - \gamma_3^{pri} - \varepsilon_k^{pri}$$

$$\pi_k^{pub}(S_k,0,1) = S_k\left(\alpha_1^{pub} + \eta_{income}^{pub} income + \eta_{gini}^{pub} gini\right) - \gamma_1^{pub} - \varepsilon_k^{pub}$$

$$\pi_k^{pub}(S_k,1,1) = S_k\left(\alpha_1^{pub} + \alpha_2^{pub} + \eta_{income}^{pub} income + \eta_{gini}^{pub} gini\right) - \gamma_1^{pub} - \gamma_2^{pub} - \varepsilon_k^{pub}$$

$$\pi_k^{pub}(S_k,2,1) = S_k\left(\alpha_1^{pub} + \alpha_2^{pub} + \alpha_3^{pub} + \eta_{income}^{pub} income + \eta_{gini}^{pub} gini\right) - \gamma_1^{pub} - \gamma_2^{pub} - \gamma_3^{pub} - \varepsilon_k^{pub}$$

Given the assumption that an increase in the number of present firms always weakly reduces profits, we have that, for public banks, $\pi_k^{pub}(S_k,0,1) \geq \pi_k^{pub}(S_k,1,1) \geq \pi_k^{pub}(S_k,2,1)$. For private banks, $\pi_k^{pri}(S_k,1,0) \geq \pi_k^{pri}(S_k,1,1)$, $\pi_k^{pri}(S_k,1,0) \geq$

$\pi_k^{pri}(S_k, 2,0) \geq \pi_k^{pri}(S_k, 2,1)$, but either $\pi_k^{pri}(S_k, 1,1) \geq \pi_k^{pri}(S_k, 2,0)$ or $\pi_k^{pri}(S_k, 1,1) \leq \pi_k^{pri}(S_k, 2,0)$ are possible.

Write $\bar{\pi}_k^{pri}(S_k, x, y) = \pi_k^{pri}(S_k, x, y) - \varepsilon_k^{pri}$, $\bar{\pi}_k^{pub}(S_k, x, y) = \pi_k^{pub}(S_k, x, y) - \varepsilon_k^{pub}$. The expression of the likelihood function depends on whether or not $\bar{\pi}_k^{pri}(S_k, 2,0) > \bar{\pi}_k^{pri}(S_k, 1,1)$ for a given set of parameter values. Figures 4 and 5 describe the equilibria that may arise as a function of ε_k^{pub} and ε_k^{pri}. Figure 4 represents the case $\bar{\pi}_k^{pri}(S_k, 2,0) > \bar{\pi}_k^{pri}(S_k, 1,1)$, and Figure 5 represents the case $\bar{\pi}_k^{pri}(S_k, 2,0) \leq \bar{\pi}_k^{pri}(S_k, 1,1)$.

The figures contain three regions of indeterminacy: for example, if $-\varepsilon^{pri} \in [\bar{\pi}^{pri}(2,0), \pi^{pri}(1,0)]$ and $-\varepsilon^{pub} \in [\bar{\pi}^{pub}(1,1),\ \pi^{pub}(0,1)]$, then the market is either a monopoly with a private bank or a monopoly with a public bank. We resolve the indeterminacy by assuming a constant unknown probability in which the selected equilibrium is the private bank.

$$\delta_1 = \Pr\left(N_k^{pri} = 1, N_k^{pub} = 0 / \pi_k^{pri}(S_k,1,0) > 0 \,\&\, \pi_k^{pri}(S_k,1,1) < 0 \,\&\, \pi_k^{pub}(S_k,0,1) > 0 \,\&\, \pi_k^{pub}(S_k,1,1) < 0\right)$$

where δ_1 is a parameter to be estimated. Similarly, we define

$$\delta_2 = \Pr\left(N_k^{pri} = 1, N_k^{pub} = 1 / \pi_k^{pri}(S_k,2,0) > 0 \,\&\, \pi_k^{pri}(S_k,2,1) < 0 \,\&\, \pi_k^{pub}(S_k,1,1) > 0 \,\&\, \pi_k^{pub}(S_k,2,1) < 0\right)$$

for the second region of indeterminacy.

If the parameters are such that $\bar{\pi}_k^{pri}(S_k, 2,0) \leq \bar{\pi}_k^{pri}(S_k, 1,1)$, there is a third region of indeterminacy, and again we define

$$\delta_3 = \Pr\left(N_k^{pri} = 0, N_k^{pub} = 1 / \pi_k^{pri}(S_k,1,1) > 0 \,\&\, \pi_k^{pri}(S_k,2,0) < 0 \,\&\, \pi_k^{pub}(S_k,1,0) > 0 \,\&\, \pi_k^{pub}(S_k,2,1) < 0\right)$$

Let θ be the vector of parameters to be estimated. Let *A* be an indicator for the event $\bar{\pi}_k^{pri}(S_k, 1,1) \geq \bar{\pi}_k^{pri}(S_k, 2,0))$. Let $L_k(x, y|\theta)$ be the contribution to the likelihood of observation *k*, where in market *k* there are *x* private banks and y public banks. Then, we have the following expressions:

$$L_k(0,0|\theta) = \left[1 - F\left(\bar{\pi}_k^{pri}(S_k, 1,0)\right)\right]\left[1 - F\left(\bar{\pi}_k^{pub}(S_k, 0,1)\right)\right]$$

$$L_k(2,1|\theta) = \left[F\left(\bar{\pi}_k^{pri}(S_k,2,1)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,2,1)\right)\right]$$

$$\begin{aligned}L_k(1,0|\theta) = {} & \left[F\left(\bar{\pi}_k^{pri}(S_k,1,0)\right) - F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right)\right]\left[1 - F\left(\bar{\pi}_k^{pub}(S_k,0,1)\right)\right] \\ & + A\left[F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right) - F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right)\right]\left[1 - F\left(\bar{\pi}_k^{pub}(S_k,1,1)\right)\right] \\ & + \delta_1\left[F\left(\bar{\pi}_k^{pri}(S_k,1,0)\right) - F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,0,1)\right) - F\left(\bar{\pi}_k^{pub}(S_k,1,1)\right)\right]\end{aligned}$$

$$\begin{aligned}L_k(1,1|\theta) = {} & \left[F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right) - F\left(\bar{\pi}_k^{pri}(S_k,2,1)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,2,1)\right)\right] \\ & + A\left[F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right) - F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,1,1)\right)\right] \\ & + \delta_2\left[F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right) - F\left(\bar{\pi}_k^{pri}(S_k,2,1)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,1,1)\right) - F\left(\bar{\pi}_k^{pub}(S_k,2,1)\right)\right]\end{aligned}$$

$$\begin{aligned}L_k(0,1|\theta) = {} & \left[1 - F\left(\bar{\pi}_k^{pri}(S_k,1,0)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,0,1)\right)\right] \\ & + \left[1 - F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,1,1)\right)\right] \\ & + (1-\delta_1)\left[F\left(\bar{\pi}_k^{pri}(S_k,1,0)\right) - F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,0,1)\right) - F\left(\bar{\pi}_k^{pub}(S_k,1,1)\right)\right] \\ & + (1-A)\left[F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right) - F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,2,1)\right)\right] \\ & + \delta_3(1-A)\left[F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right) - F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,0,1)\right) - F\left(\bar{\pi}_k^{pub}(S_k,2,1)\right)\right]\end{aligned}$$

$$\begin{aligned}L_k(2,0|\theta) = {} & \left[F\left(\bar{\pi}_k^{pri}(S_k,2,1)\right)\right]\left[1 - F\left(\bar{\pi}_k^{pub}(S_k,2,1)\right)\right] \\ & + \left[F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right) - F\left(\bar{\pi}_k^{pri}(S_k,2,1)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,1,1)\right)\right] \\ & + (1-\delta_2)\left[F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right) - F\left(\bar{\pi}_k^{pri}(S_k,2,1)\right)\right]\left[F\left(\bar{\pi}_k^{pub}(S_k,1,1)\right) - F\left(\bar{\pi}_k^{pub}(S_k,2,1)\right)\right] \\ & + (1-A)\left[F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right) - F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right)\right]\left[1 - F\left(\bar{\pi}_k^{pub}(S_k,0,1)\right)\right] \\ & + (1-\delta_3)(1-A)\left[F\left(\bar{\pi}_k^{pri}(S_k,2,0)\right) - F\left(\bar{\pi}_k^{pri}(S_k,1,1)\right)\right] \times \\ & \left[F\left(\bar{\pi}_k^{pub}(S_k,0,1)\right) - F\left(\bar{\pi}_k^{pub}(S_k,2,1)\right)\right],\end{aligned}$$

where F is the standard normal cumulative distribution function.

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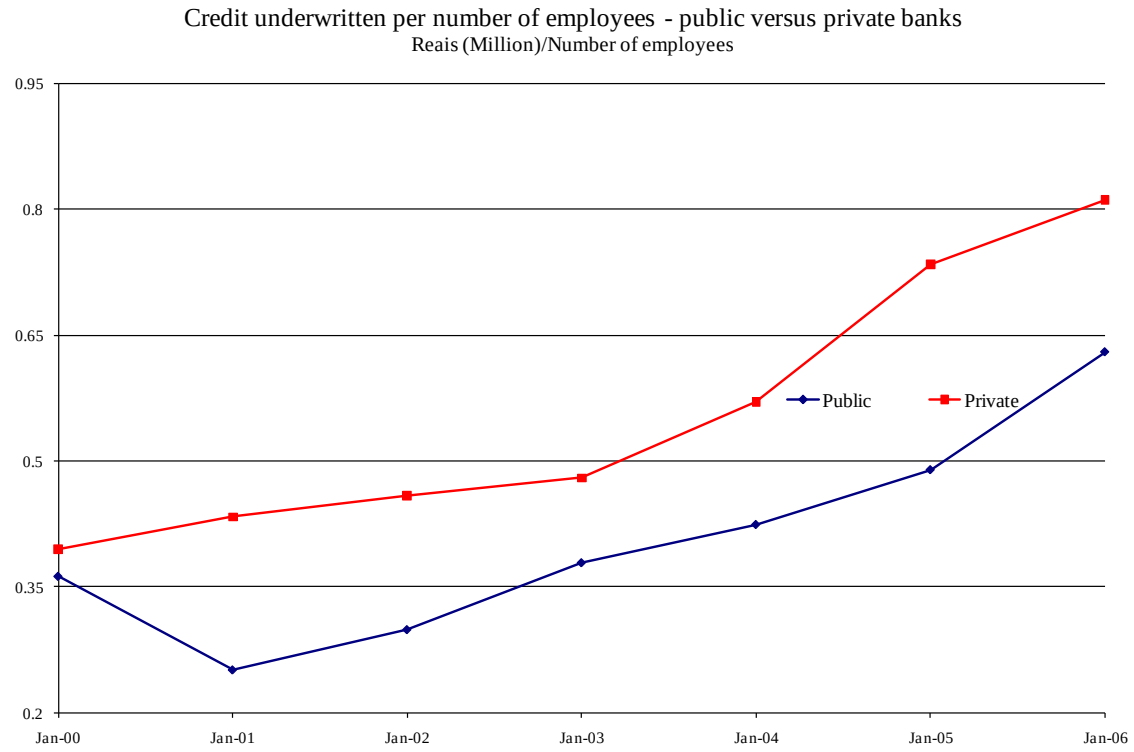
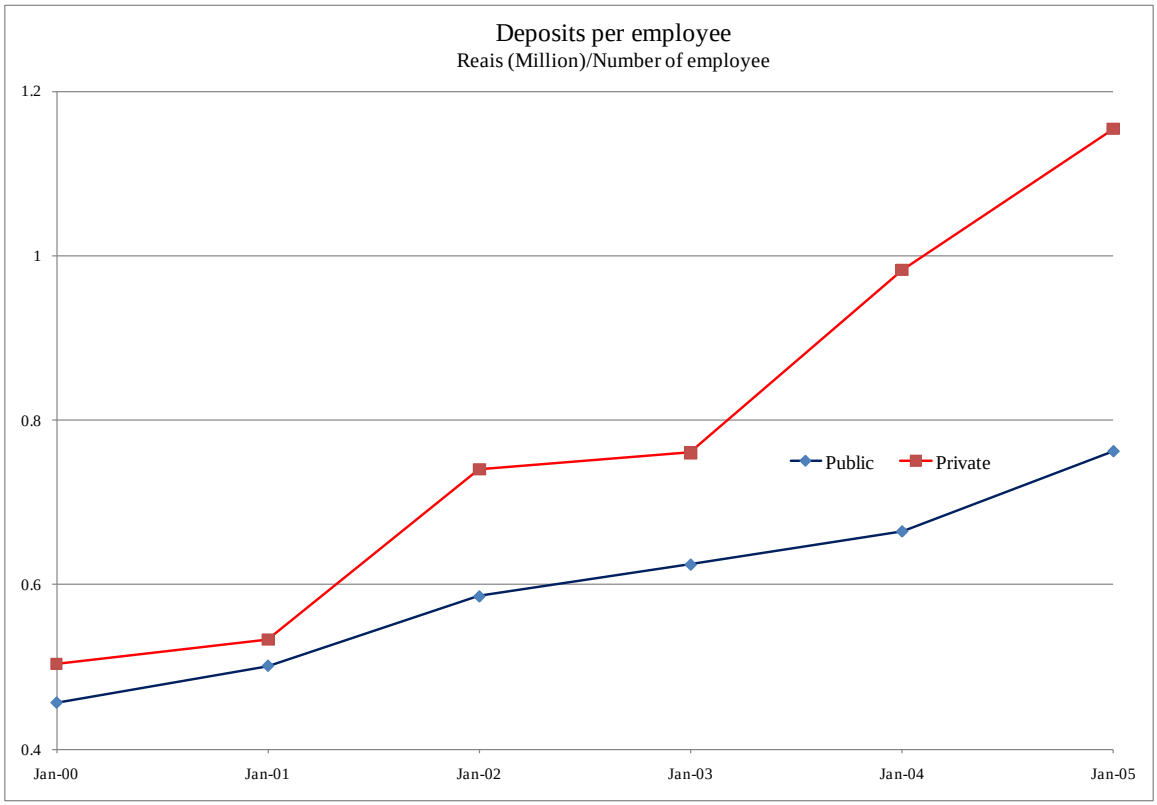
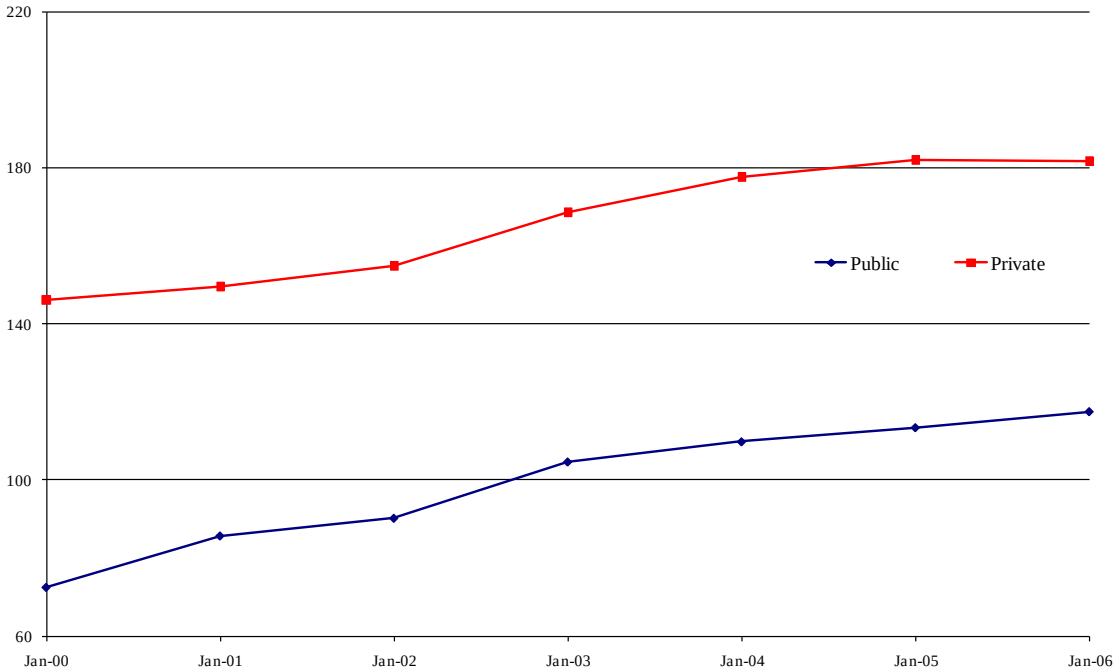
Figure 1: Public versus Private Banks: inputs and outputs





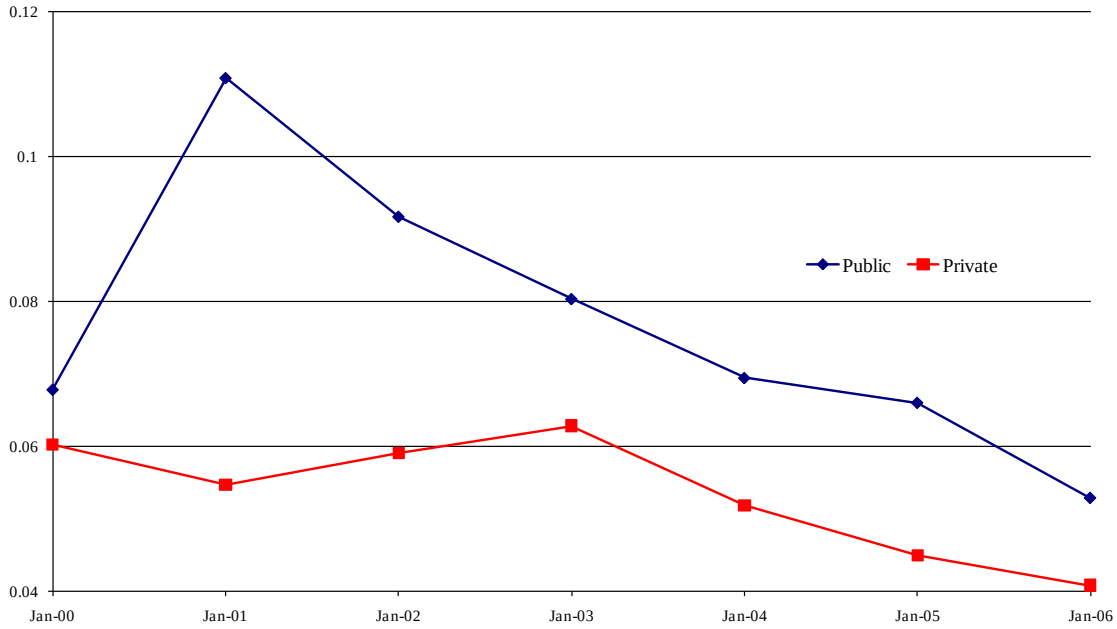
Number of accounts per employee - public versus private banks

Number of accounts/Number of employees



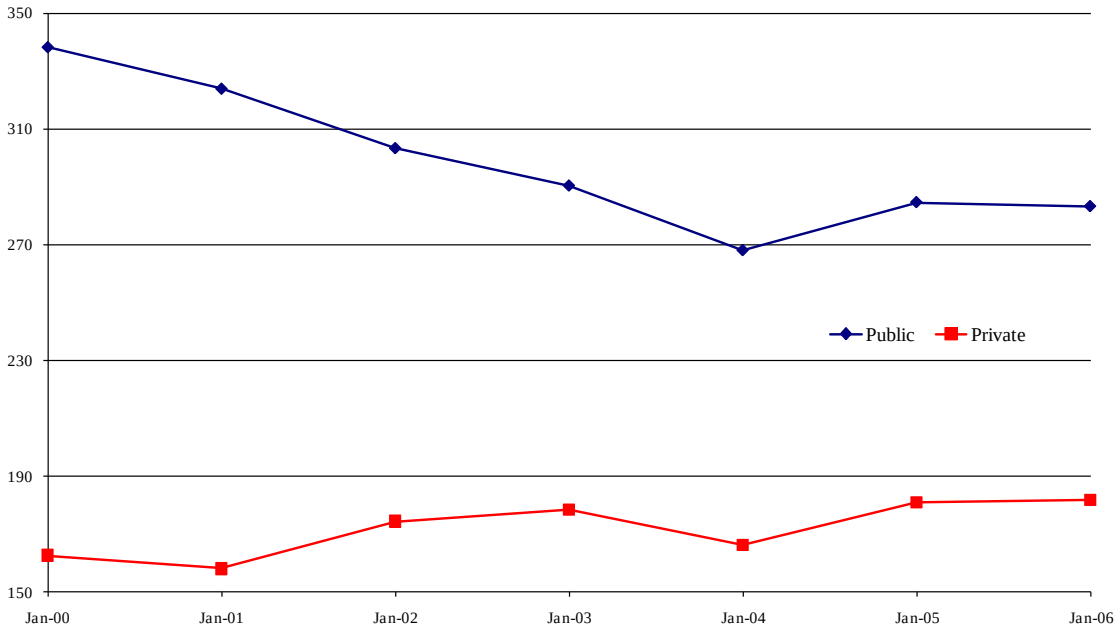
Payroll costs per credit underwritten - public versus private banks

Reais/Reais



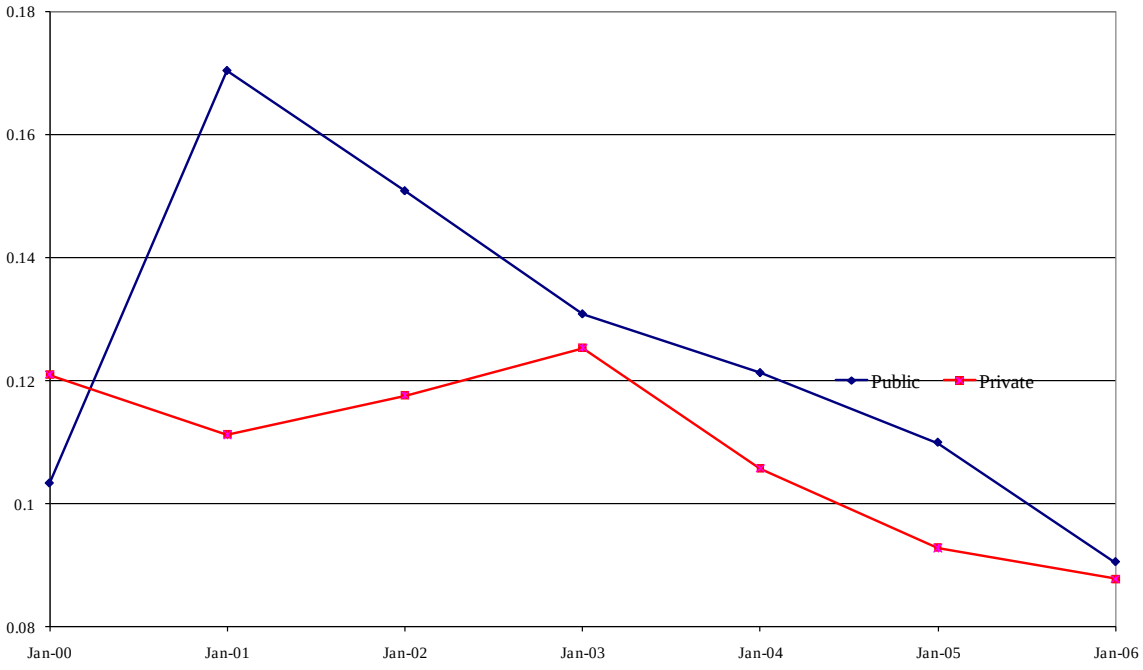
Payroll costs per number of accounts - public versus private banks

Reais/Number of accounts



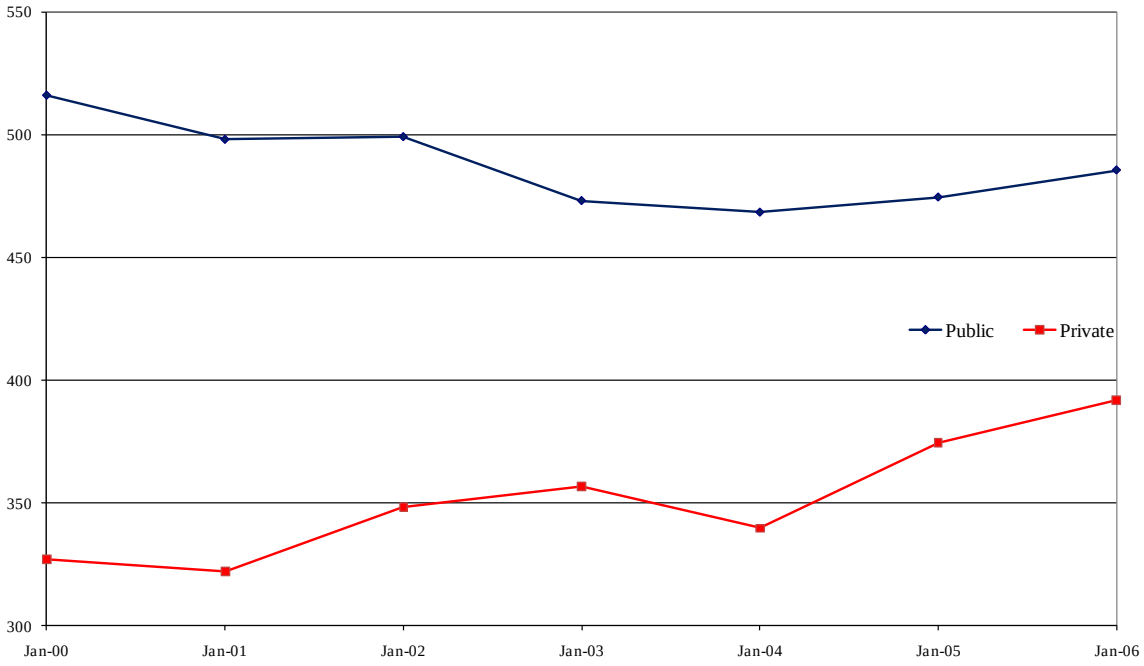
Administrative costs per credit underwritten - public versus private banks

Reais/Reais



Administrative costs per number of accounts - public versus private banks

Reais/Number of accounts



Payroll costs per employee - public versus private banks

Reais (annual)/Number of employees

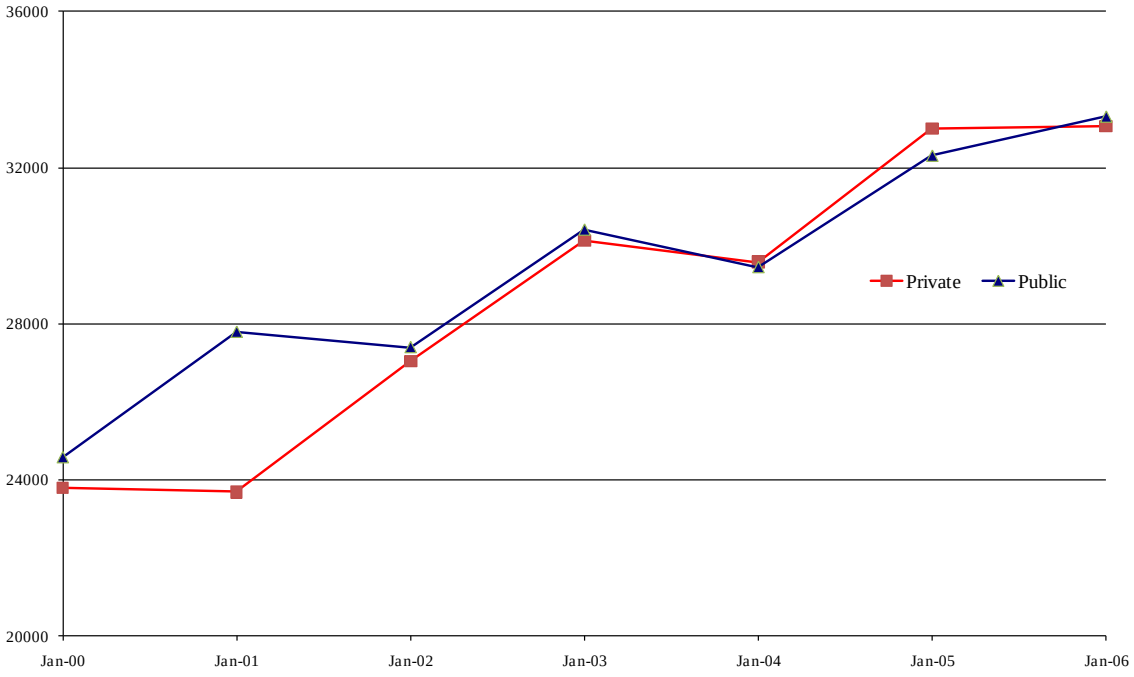


Figure 2: Equilibria when $\bar{\pi}_k^{pri}(S_k, 2, 0) > \bar{\pi}_k^{pri}(S_k, 1, 1)$

	$\bar{\pi}^{pub}(0,1) < -\varepsilon^{pub}$	$-\varepsilon^{pub} \in [\bar{\pi}^{pub}(1,1),\ \bar{\pi}^{pub}(0,1)]$	$-\varepsilon^{pub} \in [\bar{\pi}^{pub}(2,1),\ \bar{\pi}^{pub}(1,1)]$	$-\varepsilon^{pub} \leq \bar{\pi}^{pub}(2,1)$
$-\varepsilon^{pri} \leq \bar{\pi}^{pri}(2,1)$		(2,0)		(2,1)
$-\varepsilon^{pri} \in [\bar{\pi}^{pri}(2,1), \bar{\pi}^{pri}(2,0)]$			(2,0) or (1,1)	
$-\varepsilon^{pri} \in [\bar{\pi}^{pri}(2,0), \bar{\pi}^{pri}(1,1)]$	(1,0)			(1,1)
$-\varepsilon^{pri} \in [\bar{\pi}^{pri}(1,1), \bar{\pi}^{pri}(1,0)]$		(0,1) or (1,0)		
$\bar{\pi}^{pri}(1,0) < -\varepsilon^{pri}$	(0,0)	(0,1)		

Figure 3: Equilibria when $\bar{\pi}_k^{pri}(S_k, 2, 0) > \bar{\pi}_k^{pri}(S_k, 1, 1)$

	$\bar{\pi}^{pub}(0,1) < -\varepsilon^{pub}$	$-\varepsilon^{pub} \in [\bar{\pi}^{pub}(1,1),\ \bar{\pi}^{pub}(0,1)]$	$-\varepsilon^{pub} \in [\bar{\pi}^{pub}(2,1),\ \bar{\pi}^{pub}(1,1)]$	$-\varepsilon^{pub} \leq \bar{\pi}^{pub}(2,1)$
$-\varepsilon^{pri} \leq \bar{\pi}^{pri}(2,1)$		(2,0)		(2,1)
$-\varepsilon^{pri} \in [\bar{\pi}^{pri}(2,1), \bar{\pi}^{pri}(1,1)]$			(2,0) or (1,1)	(1,1)
$-\varepsilon^{pri} \in [\bar{\pi}^{pri}(1,1), \bar{\pi}^{pri}(2,0)]$		(0,1) or (2,0)	(0,1) or (2,0)	
$-\varepsilon^{pri} \in [\bar{\pi}^{pri}(2,0), \bar{\pi}^{pri}(1,0)]$	(1,0)	(0,1) or (1,0)		
$\bar{\pi}^{pri}(1,0) < -\varepsilon^{pri}$	(0,0)	(0,1)		

Table 1: Town Characteristics, by number of banks

# banks	# obs	Adult population	Income per capita	Total income	Total income: 3 minimum wages
0	2056	4219	116	704051	319043
1	1334	6920	163	1479093	790816
2	559	10558	192	2802839	1698663
3	306	14356	210	4259284	2726715
4	224	18481	236	6088673	4040166
5	162	27351	250	9468834	6482181
>5	321	74706	311	36300000	28300000
Total	4962	12243	165	4203181	2929745

Source: Banco Central do Brasil (number of banks) and 2000 Census(adult population,income per capita, total income and total income above 3 minimum wages). Number of banks is the amount of different banks in each town. Income per capita is monthly and measured in R$ of 2000. Total income is the total monthly income of the adult population of the town. Total income above 3 minimum wages is the total income of adults that had income above 3 minimum wages in 2000.

Table 2: Town Characteristics, by number of public and private banks

# private banks	# public banks	# obs	Adult Population	Income per capita	Total Income	Total income: 3 minimum wages
0	0	2056	4219	116	704051	319043
1	0	602	5026	174	1236487	694241
0	1	732	8477	153	1678613	870240
2	0	41	7848	209	2422345	1538200
1	1	257	10382	203	3021521	1896381
0	2	261	11157	178	2647191	1529477
3	0	4	11920	281	5148405	3824287
0	3	77	17705	182	4217712	2456003
2	1	109	12014	226	4196201	2846053
1	2	116	14417	210	4314307	2756602
0	4	8	32414	99	5579006	2604738
3	1	17	14897	268	6161199	4453611
1	3	73	20405	235	6587183	4322901
2	2	126	16966	241	5820995	3911364
Number of banks >4		483	58823	291	27300000	21000000
Whole sample		4962	12243	165	4203181	2929745

Source: Banco Central do Brasil (number of banks) and 2000 Census (adult population,income per capita, total income and total income above 3 minimum wages). Number of banks is the amount of different banks in each town. Income per capita is monthly and measured in R$ of 2000. Total income is the total monthly income of the adult population of the town. Total income above 3 minimum wages is the total income of adults that had income above 3 minimum wages in 2000.

Table 3: Exogenous public banks

	(1)	(2)	(3)	(4)	(5)
	Base model: multiplicative market size	Model with linear market size and basic demand controls	Model with linear market size and additional demand controls	Model with linear market size and basic demand controls	Model with linear market size and additional demand controls
α_1	11.02	12.96	8.00	-1.31	0.11
	(0.12)***	(0.6)***	(0.4)***	(0.21)***	(0.26)
α_2	-3.54	-3.61	-1.89	-1.21	-1.33
	(0.1)***	(0.11)***	(0.09)***	(0.04)***	(0.03)***
α_3	-2.14	-2.24	-1.42	-1.07	-1.11
	(0.11)***	(0.12)***	(0.08)***	(0.05)***	(0.05)***
α_4	-1.23	-1.32	-0.84	-1.10	-1.04
	(0.08)**	(0.09)**	(0.06)***	(0.07)***	(0.07)***
α_5	-0.53	-0.60	-0.42	-0.75	-0.70
	(0.06)***	-0.1	(0.05)***	(0.08)***	(0.07)***
γ_1	1.26	1.23	3.53		
	(0.03)***	(0.03)***	(0.1)***		
γ_2	0.93	0.92	0.77		
	(0.04)***	(0.04)***	(0.05)**		
γ_3	0.30	0.31	0.05		
	(0.04)***	(0.04)***	(0.05)		
γ_4	0.22	0.23	-0.01		
	(0.05)***	(0.05)***	(0.06)		
γ_5	0.23	0.26	0.02		
	(0.06)	(0.06)	(0.06)		
β	-0.54	-0.40	-0.31	-0.06	-0.16
	(0.05)***	(0.05)***	(0.04)***	(0.02)***	(0.01)***
Total Income†				3.67	3.26
				(0.06)***	(0.07)***
Income per capita		0.51	0.24	0.49	2.79
		(0.06)***	(0.04)***	(0.02)***	(0.19)***
Gini		-6.01	-1.67	-0.65	-0.20
		(0.88)***	(0.54)***	(0.35)*	(0.04)***
Rural GDP			-0.01		0.19
			(0.04)		(0.07)**
Rural Population			0.24		1.41
			(0.11)**		(0.18)***
Rural GDP/GDP			-0.08		-1.22
			(0.05)		(0.07)***
Rural Pop/Pop			-0.24		-1.54
			(0.04)***		(0.06)***
Poverty (%)			-0.08		-2.76
			(0.03)***		(0.2)***
Home owners (%)			-0.12		-0.79
			(0.06)**		(0.09)**
HDI			0.73		0.89
			(0.05)***		(0.30)***

Source: Banco Central do Brasil and 2000 Census. Ordered probit estimates of the model (5), robust standard deviations in parentheses. *** = significant at the 1% level, ** = significant at the 5% level, * = significant at the 10% level. † Total income is the measure of market size, which enters linearly in columns (4) and (5).

Table 4: Minimum efficient scales*

s_{10}			
0.12			
s_{20}	s_{11}		
0.16	0.11		
s_{30}	s_{12}	s_{21}	
0.18	0.09	0.11	
s_{40}	s_{13}	s_{22}	s_{31}
0.21	0.07	0.09	0.13

* s_{ij} - minimum efficient scale with i private and j public banks. Minimum scales computed from estimates in table 3, second column (Model with demand Control). Income and income distribution evaluated at the mean values.

Table 5: Exogenous public banks with regional dummies

α_1	11.02	β	-0.25
	(0.62)***		(0.06)***
α_2	-3.90	Income	0.05
	(0.13)***		(0.09)
α_3	-2.33	Gini	-0.60
	(0.12)***		(0.9)
α_4	-1.38	κ_1 (Southeast)	0.33
	(0.09)**		(0.19)*
α_5	-0.61	κ_2 (South)	0.23
	(0.1)***		(0.21)
γ_1	1.76	κ_3 (North)	0.07
	(0.06)***		(0.41)
γ_2	1.03	κ_4 (Centerwest)	-0.46
	(0.04)***		(0.20)**
γ_3	0.32	λ_1 (Southeast)	-1.05
	(0.04)***		(0.07)***
γ_4	0.26	λ_2 (South)	-0.65
	(0.05)***		(0.07)***
γ_5	0.28	λ_3 (North)	0.64
	(0.06)***		(0.22)***
		λ_4 (Centerwest)	-0.36
			(0.09)***

Ordered probit estimates, robust standard deviations in parentheses. *** = significant at the 1% level, **= significant at the 5% level, * = significant at the 10% level. Source: Banco Central do Brasil and 2000 census.

Table 6: Minimum efficient scales by region

	Northeast	Southeast	South	North	Centerwest
s_{10}	0.16	0.06	0.10	0.22	0.14
s_{20}	0.20	0.12	0.15	0.25	0.19
s_{30}	0.23	0.14	0.17	0.27	0.23
s_{40}	0.27	0.17	0.20	0.31	0.28
s_{11}	0.13	0.08	0.10	0.16	0.12
s_{12}	0.10	0.06	0.08	0.12	0.09
s_{13}	0.08	0.06	0.07	0.10	0.08
s_{21}	0.14	0.08	0.10	0.17	0.13
s_{22}	0.11	0.06	0.08	0.13	0.10
s_{31}	0.16	0.09	0.12	0.20	0.16

* s_{ij} - minimum efficient scale with i private and j public banks. Minimum scales computed with estimates in table 5.

Table 7: Different Definitions of Market Size

	3 minimum wages†	BR modeling of scale‡
α_1	14.09	15.78
	(0.52)***	(0.02)***
α_2	-3.21	-3.46
	(0.10)***	(0.15)***
α_3	-1.96	-2.15
	(0.11)***	(0.11)***
α_4	-1.14	-1.22
	(0.08)***	(0.08)***
α_5	-0.50	-0.57
	(0.06)***	(0.06)***
γ_1	1.03	1.96
	(0.03)***	(0.04)***
γ_2	0.88	0.91
	(0.04)***	(0.04)**
γ_3	0.31	0.22
	(0.04)***	(0.05)***
γ_4	0.23	0.16
	(0.04)***	(0.05)***
γ_5	0.28	0.18
	(0.06)***	(0.06)***
β	-0.20	-0.48
	(0.05)***	(0.05)***
Income	0.09	0.04
	(0.05)	(0.04)
Gini	-9.16	-8.37
	(0.74)***	(0.37)***
Commuters from out of town		0.79
		(1.61)
Commuters to out of town		-1.97
		(0.18)***
Positive populational growth		0.04
		(0.01)***
Negative populational growth		0.05
		(0.01)***

† = Ordered probit estimates with market size defined as the total city income for those with income above three minimum wages. Robust standard deviations in parentheses. ‡ = Ordered probit estimates using BR market size definition. Robust standard deviations in parentheses. *** = significant at the 1% level, ** = significant at the 5% level, * = significant at the 1% level. Source: Banco Central do Brasil and 2000 Census.

Table 8: Minimum efficient scale, modeling market size*

Panel A: Minimum efficient scale, 3 minimum wages

s_{10}			
0.11			
s_{20}	s_{11}		
0.16	0.11		
s_{30}	s_{12}	s_{21}	
0.19	0.09	0.11	
s_{40}	s_{13}	s_{22}	s_{31}
0.22	0.07	0.09	0.13

Panel B: Minimum efficient scale, BR scale

s_{10}			
0.176			
s_{20}	s_{11}		
0.186	0.13		
s_{30}	s_{12}	s_{21}	
0.186	0.10	0.13	
s_{40}	s_{13}	s_{22}	s_{31}
0.188	0.08	0.11	0.14

* s_{ij} - minimum efficient scale with i private and j public banks. Minimum scales computed with estimates of column (1) and column (2) of table 7.

Table 9: Exogenous public banks with non linear effects	
α_1	12.64 (0.64)***
α_2	-3.58 (0.12)***
α_3	-2.24 (0.12)***
α_4	-1.32 (0.09)**
α_5	-0.59 (0.07)**
γ_1	1.21 (0.03)***
γ_2	0.93 (0.04)***
γ_3	0.32 (0.04)***
γ_4	0.24 (0.05)***
γ_5	0.26 (0.06)***
β(1 pub. bank)	0.06 (0.15)
β(2 pub. banks)	-0.21 (0.11)*
β(>2 pub. bank)	-0.30 (0.07)***
Income	0.52 (0.06)***
Gini	-6.15 (0.9)***

Ordered probit estimates, robust standard deviations in parentheses. *** = significant at the 1% level, ** = significant at the 5% level, * = significant at the 1% level.
Source: Banco Central do Brasil and 2000 Census.

Table 10: Minimum efficient scales*

s_{10}			
0.12			
s_{20}	s_{11}		
0.17	0.11		
s_{30}	s_{12}	s_{21}	
0.19	0.08	0.11	
s_{40}	s_{13}	s_{22}	s_{31}
0.23	0.07	0.08	0.13

* s_{ij} - minimum efficient scale with i private and j public banks based on estimates in Table 9. Income and income distribution evaluated at the mean values.

Table 11: Endogenous Entry by Public Banks (Multiple Equilibria)

Estimates of the Private Banks' Parameters		
α_1^{pri} (intercept)	14.70 (1.65)***	14.82 (0.02)***
α_2^{pri} (effect of public bank)	0.00 (1.00)	0.00 (0.00)
α_3^{pri} (effect of second private bank)	-1.27 (0.46)***	-1.01 (0.01)***
γ_1^{pri} (first private bank fixed cost)	1.30 (0.06)***	1.29 (1)
γ_2^{pri} (public bank fixed cost)	0.00 (0.10)	-1.E-10 (75)
γ_3^{pri} (second private bank fixed cost)	1.34 (0.09)***	1.37 (0.3)***
Income	1.32 (0.15)***	1.30 (0.05)***
Gini	-15.83 (2.30)***	-16.13 (0.004)***
Correlation		0.25 (0.10)**

Ordered probit estimates of the model (5) and (6), robust standard deviations in parentheses. *** = significant at the 1% level, ** = significant at the 5% level, * = significant at the 1% level. Source: Banco Central do Brasil and 2000 Census.

Table 12: Endogenous Entry by Public Banks (Multiple Equilibria)

Estimates of the Public Banks' Parameters		
α_1^{pub} (intercept)	27.25 (2.43)***	24.69 (0.01)***
α_2^{pub} (effect of private bank)	-11.25 (1.17)***	-14.05 (0.001)***
α_3^{pub} (effect of second public bank)	0.00 (0.61)	0.00 (0.00)
γ_1^{pri} (first public bank fixed cost)	2.08 (0.05)***	2.13 (0.76)***
γ_2^{pri} (private bank fixed cost)	-0.04 (0.15)	-0.03 (0.23)
γ_3^{pri} (second public bank fixed cost)	0.00 (0.11)	0.00 (111.00)
Income	-0.11 (0.23)	0.28 (0.42)
Gini	-6.84 (3.88)*	0.00 (0.40)
Correlation		0.25 (0.10)**

Ordered probit estimates of the model (5) and (6), robust standard deviations in parentheses. *** = significant at the 1% level, ** = significant at the 5% level, * = significant at the 1% level. Source: Banco Central do Brasil and 2000 Census.

Table 13: Minimum efficient scales *

Private banks	Public banks
s_{10}^{pri}	s_{01}^{pub}
0.17	0.09
s_{11}^{pri}	s_{11}^{pub}
0.08	0.08
s_{20}^{pri}	
0.21	
s_{21}^{pri}	s_{21}^{pub}
0.14	0.06

* s_{ij}^{priv} - minimum efficient scale of a **private** bank in a market with i private and j public banks. s_{ij}^{pub} - minimum efficient scale of a **public** bank in a market with i private and j public banks. Minimum scales computed from estimates in the first columns of tables 11 and 12. Income and income distribution evaluated at the mean values.

Table 14: Total rural and housing credit

# private banks	# public banks	# obs	Average	Standard Deviation
1	0	602	0.8	2.1
0	1	732	4.3	9.3
2	0	41	3.0	6.8
0	2	241	12.2	16.7
1	1	261	8.6	10.8

Source: Banco Central do Brasil (number of banks and total rural and housing credit) and IBGE (GDP at municipal levels). Number of banks is the amount of different banks in each town.The total rural and housing credit comes from a database called Estban (document number 4500, monthly banking statistics).

Table 15: Exogenous public banks - droping towns with the highest rural and housing credit

	Whole sample	bottom 95%	bottom 90%	bottom 75%	bottom 65%
α_1	12.96	12.89	12.82	13.04	16.95
	(0.6)***	(0.64)***	(0.74)***	(1.3)***	(2.2)***
α_2	-3.61	-3.46	-3.48	-3.29	-2.97
	(0.11)***	(0.11)***	(0.12)***	(0.19)***	(0.29)***
α_3	-2.24	-2.16	-2.20	-2.37	-1.89
	(0.12)***	(0.13)***	(0.14)***	(0.24)***	(0.30)***
α_4	-1.32	-1.32	-1.33	-1.38	-1.79
	(0.09)**	(0.09)***	(0.10)***	(0.16)***	(0.3)***
α_5	-0.60	-0.65	-0.71	-0.62	-0.56
	-0.1	(0.07)***	(0.08)***	(0.14)***	(0.44)
γ_1	1.23	1.24	1.26	1.32	1.40
	(0.03)***	(0.03)***	(0.03)***	(0.03)***	(0.04)***
γ_2	0.92	0.96	1.01	1.17	1.27
	(0.04)***	(0.04)***	(0.04)***	(0.05)***	(0.07)***
γ_3	0.31	0.32	0.33	0.41	0.50
	(0.04)***	(0.04)***	(0.05)***	(0.07)***	(0.11)***
γ_4	0.23	0.25	0.23	0.16	0.16
	(0.05)***	(0.05)***	(0.06)***	(0.09)*	(0.18)
γ_5	0.26	0.30	0.23	0.12	-0.20
	(0.06)	(0.07)***	(0.07)***	(0.13)	(0.18)
β	-0.40	**-0.44**	**-0.52**	**-0.68**	**-1.11**
	(0.05)***	(0.05)***	(0.07)***	(0.11)***	(0.20)***
Income	0.51	0.5	0.6	0.6	0.18
	(0.06)***	(0.06)***	(0.07)***	(0.13)***	(0.21)
Gini	-6.01	-5.9	-5.8	-6.1	-11.40
	(0.88)***	(0.9)***	(1.1)***	(1.9)***	(3.2)***
s_{11}/s_{10}	**0.91**	**0.93**	**0.95**	**1.01**	**1.06**

Ordered probit estimates of (5), removing towns with 5%, 10%,25% e 35% largest values of rural and housing credit divided by GDP, respectively; robust standard deviation in parentheses

*** = significant at 1%

** = significant at 5%

* = significant at 10%

Source: Banco Central do Brasil and 2000 Census.

Table 16: Composition of Credit Assets by Type

	Panel A: All loan types						
	Market Share	% Portfolio	Mean Interest Rate	Delinquency	% Portfolio	Mean Interest Rate	Delinquency
			Public Banks			**Private Banks**	
Consumer Credit							
Personal Loans		17.8%	69.5%	11.4%	23.3%	67.7%	10.3%
Overdrafts		6.2%	147.3%	14.5%	8.4%	156.5%	12.4%
Mortgages		25.4%	12.0%[A]	14.7%	8.2%	12.0%[A]	7.4%
Firm Credit							
Working Capital		12.2%	63.4%	6.0%	24.4%	55.0%	5.1%
Trade Finance		13.4%	24.9%	0.2%	24.5%	23.8%	0.6%
Long-term Finance		0.1%	38.2%	6.1%	2.0%	35.0%	8.2%
Rural Credit		24.9%	8.75%[B]	6.4%	9.3%	8.75%[B]	7.5%
	Panel B: Excluding Mortgages and Rural Credit						
		% Portfolio	Mean Interest Rate	Delinquency	% Portfolio	Mean Interest Rate	Delinquency
			Public Banks			**Private Banks**	
Consumer Credit							
Personal Loans	37.0%	35.8%	69.5%	11.4%	28.3%	67.7%	10.3%
Overdrafts	35.8%	12.4%	147.3%	14.5%	10.2%	156.5%	9.7%
Firm Credit							
Working Capital	37.2%	24.5%	63.4%	6.0%	29.5%	55.0%	5.1%
Trade Finance	25.8%	27.0%	24.9%	0.2%	29.7%	23.8%	0.6%
Long-term Finance	56.1%	0.2%	38.2%	6.1%	29.7%	35.0%	8.2%
Overall non-earmarked	39.1%						

Source: Banco Central do Brasil. Delinquency is the % of notional stock of loans delinquent more than 30 days. Mean interest rate is the average interest rate charged weighted by the notional lending (flow over the year 2002). A: rates on earmarked mortgages are defined by a formula: *Taxa Referencial* (TR) + 12%. The TR is an index of commercial banks' cost of fund (rates on three-month Certificates of Deposit), multiplied by a time-varying "reductor" (typically 80%). In practice, TR is somewhere between inflation and banks' cost of funds. B = nominal rate.

Table 17: Accounting Costs Differences: Public versus Private Banks*

Pub_{01}/ Pri_{10}				
1.25				
Pub_{02}/ $Priv_{20}$	**Pub_{11}/ Pri_{11}**			
0.91	**1.14**			
Pub_{12}/ Pri_{12}	Pub_{21}/ Pri_{21}	**Pub_{22}/ Pri_{22}**		
1.23	1.32	**1.27**		
Pub_{13}/ Pri_{13}	Pub_{31}/ Pri_{31}	Pub_{32}/ Pri_{32}	**Pub_{33}/ Pri_{33}**	
1.64	1.51	1.46	**1.95**	
Pub_{14}/ Pri_{14}	Pub_{41}/ Pri_{41}	Pub_{42}/ Pri_{42}	Pub_{43}/ Pri_{43}	Pub_{34}/ Pri_{34}
1.55	N/A	1.66	1.92	1.66

* Pub_{ij} = total cost per bank of public banks at the city level when the structure has *i* private and *j* public banks. Pri_{ij} = total cost per bank of private banks at the city level when the structure has *i* private and *j* public banks. – means no such market structure exists in our sample.