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Are Public Banks pro-Competitive? Evidence from Concentrated Local Markets in Brazil

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Are Public Banks pro-Competitive? Evidence from Concentrated Local Markets in Brazil[§]

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Abstract

We measure the competitive effect of public ownership of banks in concentrated local banking markets in Brazil by extending Bresnahan and Reiss's [1991] framework to measure the effects of entry in concentrated markets. We use variation in market size, the number of competitors *and* their identity to infer how conduct is affected by the entry of a private *vis-à-vis* a public bank. We find that, while local markets whose structure is private bank duopoly are 100% larger than private monopolies, duopolies with one public and one private bank and private monopolies are no different with respect to market size. These results suggest that, while the presence of private banks toughens competition, public banks do not affect conduct.

KEY WORDS: banking industry; public versus private ownership; effect of entry.
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I. Introduction

Despite widespread privatization in 1980s and 1990s, the public sector still owned roughly 40% of banking sector assets worldwide in 1995 (La Porta et al (2002)). In some countries, notably in Latin America and South-East Asia, this figure is higher (Levy-Yeyati, Micco and Panizza (2004)). In this context of significant state ownership, the banking sector is a good setting for studying the benefits of public *versus* private operation of firms.

The literature has suggested several roles for public bank.[1] Financial intermediation, public or private, exists to mitigate problems of informational asymmetry and contract incompleteness (Gorton and Winton (2002)). Public ownership, insofar as it alleviates the pressure for profitability, could induce banks to lend to borrowers whose return is socially (but not privately) positive. Two different examples of this phenomenon could be long-term finance by development banks, and some of the state led examples of short-term microcredit. [2] A third potential role of public banks is to induce a more competitive conduct in the banking industry. Although this could be true in any industry, state ownership in banking is significant (perhaps because of the reasons outlined above), and an increased performance of the banking sector can have important spillover effects on other sectors. This is exactly the empirical question we address in this paper, using data on local concentrated markets in Brazil: does the presence of public bank induce competition in local banking markets?

Brazil is good candidate for an empirical setting to measure competitive effect of public banks. First, both public and private ownership of bank assets co-exist in Brazilian commercial banking industry, and both are significant.[3] Even after the privatization of

[1] We use the term public banks meaning the more precise but longer term *state-owned* banks. Public here should not be confounded with a publicly held bank, i.e., a bank whose stocks are negotiated publicly.

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

[3] Co-existence of public and private banks is not specific to Brazil. Argentina is another good example: The largest and third largest commercial banks (Banco La Nación and Banco de La Provincia de Buenos Aires) are owned by the federal government and by the province of Buenos Aires, respectively. There are several other important provincial banks. However, dollarization and the subsequent convertability crisis of December 2001, which almost destroyed the banking system, turn Argentina into a bad candidate comparing to Brazil.

state-level public banks, they still held 42.7% of the banking sector assets nationally in 2001 (Levy-Yeyati, Micco and Panizza (2004)).[4] The federal government controls the two largest commercial banks, Banco do Brasil (BB) and Caixa Econômica Federal, and a large development bank, BNDES, which until recently was the major (if not the only) source of long-term finance in the country.

A second reason is variation in the local bank market structure according to type of ownership (private versus public). Because of privatization, local private monopolies and duopolies, which are rare in countries where public banks are important, now can be observed. This variation in structure by ownership is crucial for the success of an empirical attempt to measure whether public ownership of banks have a pro-competitive benefit.

Another reason lies in the structure and performance of the Brazilian banking industry. The market at the national level is quite concentrated. The share of deposits in the five largest banks in 2004 was 55%, while the share of the three largest was 42.6%. Local markets are, not surprisingly, even more concentrated. Among cities with less than 50,000 inhabitants, the *C*5 is, on average, 99.9% and the *C3* is, on average, 98.5%[5]. Performance is short of stellar. Spreads on corporate loans were at an average of 67.9% per year over the 2000-2004 period. On consumer loans they were even higher, 123.7% per year (Banco Central do Brasil (2005)). Structure and performance suggest the possibility of a conduct problem, i.e., excessive market power.[6] Thus, it would be reasonable to imagine that the government would use its large presence in the banking

[4] We mean banks whose controllers are the states. Privatization of state-level public banks occurred under a federally sponsored program, Programa de Incentivo à Redução da Presença do Estado na Atividade Bancária (almost literally, it translates to 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] From the 2957 towns that had less than 50,000 inhabitants in 2004, only 61 towns (2%) had more than 5 banks in their market and only 564 (16%) had more than three banks, 2896 (98%) had 5 banks or less and 2476 (84%) had three banks or less. The minimum *C5* observed in towns with less than 50,000 was 85% and the minimum *C*3 observed was 62%. The figures do not change much when we look at towns with less than 100,000 inhabitants.

[6] Just as an illustration, in 2005, Bradesco, the largest private bank in Brazil, had some $5.5 billion in profits, which implied a return on equity of 32%. This is twice the average return for European and American commercial banks. Other large private banks have similar returns. See "High Living," *The Economist*, May 18th, 2006. As usual, other factors can partially account for the high observed spreads on loan. Reserve requirement, taxation and cross-subsidies to earmarked loans are the other culprits.

sector to induce competition. Or is it that poor performance is caused by this large presence? These are, in short, the questions we can address using Brazilian data.

Our empirical methodology is an extension of Bresnahan and Reiss´s (1991) (BR hereafter) framework for measuring the effect of entry in concentrated markets. Similarly to BR, we use variation on market size and the number of competitors to infer the effect of entry on conduct in concentrated markets. The basic idea is as follows: assuming free entry, profits must equal the fixed cost of entry in a sub-game perfect equilibrium of a game of entry-then-competition.[7] Profits depend, among other things, on two observable variables, number of firms and market size, and, as usual, several unobservable ones, including conduct. Markets of similar sizes but with different number of firms must have different equilibrium profits. If the demand factors and variable costs (the "other things" that determine profits) are properly accounted for, this variation in the number of firms can be attributed to differences in conduct. More specifically, imagine that markets with two firms are much larger than markets with one firm, but markets with three firms are not so much larger than markets with two firms. In this case, one infers that while the entry of a rival in a monopoly market has a large impact on conduct, the effect of the third firm is not so pronounced.

A major advantage of the BR approach it that it is very economical on data. There are only two strict requirements: observing the number of banks operating in the market, and having a measure of market size. This is very important for several reasons. First and foremost, accounting data (revenues, cost, profits) are almost never observed, and even when they are available it is unclear whether one should trust self-reported profit data.[8] First and foremost, even if one trusts accounting data on profits, it is all but impossible to have profits disaggregated at the local level. Second, price and cost data are not always (in fact, normally) not available at the relevant market level. Finally, although quantity data may be available locally, it is not clear how one should aggregate different types of loans or deposits. BR bypasses these problems, at a relative low cost: after properly

[7] This a two-stage game with N players (with N arbitrarily large). In the first stage, the N potential entrants decide to enter or not, incurring in a fixed cost CF if they enter. In the second stage the, the N^E who entered play some oligopoly game.

[8] In fact, it is already the standard in the New Empirical Industrial Organization literature to be suspicious of accounting data.

defining the relevant local market and observing the number of suppliers at the relevant local market, one only needs two weak assumptions: free-entry.[9]

In contrast to BR, the identity of the entrant matters in our application. We are interested how entry by a *public* bank affects conduct *compared* to the impact of entry by a *private* bank. This difference is interpreted as the "competitive" effect of public ownership of banks.

From a theoretical perspective, the impact of public ownership of banks on conduct is ambiguous. On the one hand, public banks may have a goal other than profit maximization: consumer surplus could be part of their objective function. On the other hand, public and private banks may offer differentiated services. Imagine a market with two banks, one private and one public. While crowding out entry by other private banks, the presence of a public bank may be horizontally differentiated from the private bank. Relative to a situation in which there are two private banks, competitive aggressiveness is attenuated. Finally, cost differences in the operation of public and private banks may affect conduct. Political, not economic, reasons may motivate entry by a public bank. For managerial, organizational or technological reasons, private and public banks may operate with different cost structures. In this, equilibrium profits in a market with two private banks are different from equilibrium profits in market with one public and one private bank.

Our results suggest that public ownership of banks adversely impacts conduct. While supporting a private duopoly demands a much larger market size than a private monopoly, a larger market is not necessary to support a private/public duopoly. We estimate that, compared to the minimum market size necessary to support a private monopoly, the minimum size needed to support a second private bank is 1.75 times as large. In contrast, the minimum size is unaffected by entry of a rival public bank. While entry by a private bank reduces profits and markets have to be larger to cover the same amount of fixed costs, entry by a public bank has no impact on profits and, therefore, market sizes remain unchanged.

[9] Free-entry is not "entry free of charge": sunk and fixed costs of entry are a big part of the story here. Free-entry means that anyone can enter, implying that profits are driven down to zero in any sub-game perfect equilibrium of the game described in footnote 7.

Although privatization transferred a significant amount of assets to the private sector, public and private ownership still co-exist in other industries as well. In Brazil, fuel distribution is another example. While the banking sector has specificities that make it difficult to generalize any result to other industries, our results are indicative about the impact of public ownership on competition on other industries. Given the current trend in some countries (most notably Venezuela and Bolivia) towards increasing participation of the public sector in some industries, our results suggest further investigation on the (possibly) adverse effects of nationalization of companies on competition.

The paper is organized as follows. In section II we describe the data and present some summary statistics. The empirical strategy is outlined in section III.. Section III also contains the main results and several robustness tests. Section IV discuss the results and concludes.

II. Data and Descriptive statistics

We use two databases: the first gives information on local bank market structure at the town level, and the second provides town demographic characteristics. Local bank market structure data comes from Central Bank of Brazil, a database called ESTBAN (Banking Statistics). This dataset contains information about the number of branches that each Brazilian bank has on each Brazilian town. The main dependent variable in the empirical procedures is the number of different private and public banks in a town. In all procedures, we use a cross-section of towns of December of 2000, the year for which demographic characteristics are available from the 2000 census. We use town-level information on adult population and per capita income. The market size is measured by multiplying these two variables.

Differently from BR, which measure size by population, our measure of market size is adult population multiplied by income per capita (that is, total income).[10] Brazilian cities can be quite poor, and income per capita varies wildly across cities. Since banking

[10] We also model the market à la BR, as a function of population, populational growth and the number of inhabitants that commute in and out of the city. Results are very similar. For robustness we change the market size to be the total income of those who earn more that three minimum wages.

services tend to be a superior good, it is important that the measure of size contains income: a town with a large population but with low income may not be profitable enough for a private bank to enter.[11]

The sample is composed of all towns that are not part of any metropolitan areas. The reason for excluding metropolitan areas is measurement of the relevant banking market. A client of a bank in the main city (where she works, for example) may well live in another city that is part of the same metropolitan area. Another reason to eliminate metropolitan areas is that, similarly to BR, the competitive effects are more relevant in relatively concentrated markets, i.e., smaller towns.

The main idea and results of the paper can be seen in tables 1 and 2, which show some summary statistics on towns' characteristics. Cities are divided into groups according to the total number of banks, the number of private, and the number of public banks operating in the town.

First important thing that emerges from table 1 is that adult population alone is a poor measure of scale. Population varies less than desired across groups. Since decision entry should depend on income, as well population, we chose to measure size of markets by total income (population times income *per capita*). For robustness, the total income of those who earn more than three minimum wages are also used as a measure of market size.[12] Inspection of table 1 also shows that, as expected, population and total income are positively related to the number of banks operating in the market. In fact, in both cases the relationship is monotonic, although much more pronounced for total income. This is true for total income and for total income of those who earn more than three minimum wages.

[11] One might wonder whether the relevant total income at the hands of those who have some money, since banking services should be a superior good at low levels of income. Since income distribution between and within cities in Brazil is very high, using total income could be misleading in the sense that, for a given level of income, the size of more unequal cities would be overblown. To assess whether this can affect our results in a significant way, we also run our models with market size defined as total income of those who earn more than 3 minimum wages, arriving at very similar results (There is nothing particularly special about 3 minimum wages, except that two high ranked bank executives (from Itaú and Bradesco) reported to one of the authors (Mr. De Mello) that they start targeting people at this level of income.)

[12] See footnote 12. Changing the definition to 2, 4 or 5 minimum wages (the three that we attempted) does not change results meaningfully. For conciseness we omit the results, which are available upon request.

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.

Differences across markets with public banks and markets without public banks are depicted in table 2. The first noticeable thing is that private monopolies are smaller than public monopolies, regardless of whether market size is measured by total income or by total income of those who earn more than 3 minimum wages. While this is intriguing if public banks were fulfilling a role of boosting the development of small places, it is compatible with the interpretation that public face higher operating costs, as we shall see in section III. Inspection of the table shows some other interesting results. Private duopoly markets are almost twice of 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). When one compares public duopolies to public monopolies the increase in size is even less pronounced (only 60%). In general, the descriptive statistics suggest that private banks are willing to enter in smaller markets when the competitor is a public bank, which would indicate that public banks are anti-

competitive. In section III, we model the (equilibrium) decision to be present at a market, which will confirm the suggestion from table 2.[13]

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	644	5013	175	1248186	706267
0	1	690	8700	151	1694606	869730
2	0	41	7848	209	2422345	1538200
1	1	277	10228	204	2991379	1877827
0	2	241	11398	175	2650867	1520034
3	0	4	11920	281	5148405	3824287
0	3	73	17789	181	4165787	2409891
2	1	126	11810	226	4147927	2818520
1	2	103	15132	208	4427244	2796329
0	4	8	32414	99	5579006	2604738
3	1	17	14897	268	6163945	4453611
1	3	61	20715	235	6572511	4288537
2	2	138	17128	241	5895076	3962661
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.

III. Empirical strategy and Identification Assumptions

Following BR, the empirical strategy consists of exploring variation on market size and the number of banks in a local market to identify the effect of entry on conduct.

Let $\pi\left(S, N_{pub}, N_{pri}, X, \varepsilon\right)$ be gross profits (before subtracting fixed costs) for a local market. Profits are function of four observables, and ε, which contains all

[13] In fact, suggestion may be misleading. Public-Private duopolies are larger than pure private duopolies, for example. The results from formal model estimation will help decide between these (seemingly) contradictory results.

unobservables that affect city-level bank profits. The observable variables are the size of the market (*S*), and the number of public bank and private banks with operations in the local market, N_{pub} and N_{priv}, respectively, and a vector of demand and supply shifter that affect profits at the local level. In the specifications, *X* will include variables such as income and income distribution, which affect price-cost margin, insofar as it shifts the demand; and the regions of the country, which should affect the fixed cost of operating on local bank markets.[14] An important unobservable variable is conduct, i.e., the level of competitiveness in the market, holding the market fixed. This is ultimately what we will estimate.

For the vast majority of models of rivalry, and for the majority of reasonable demand systems, the profit function has the following characteristics:

$\pi(S, N_{pub}, N_{pri}, X, \varepsilon)$ increases with *S*, and decreases with, N_{pub} and N_{priv} (1)

All other unobserved effects are captured in ε, which include demand factors and cost shifters not included in *X*. Let $N = N_{pub} + N_{pri}$ and let FC_N be the fixed cost of operating in a local market with *N* banks, the free-entry number of private banks in equilibrium is the largest integer that satisfies the following condition[15]:

$$\pi(S, N_{pub}, N_{priv}, \varepsilon) \geq FC_N \quad (2)$$

Since we are unsure as to the nature of optimization problem of public banks, we will, for the moment, be agnostic about determinants of the entry decision of public banks.

[14] Bank executives say that, in the Northeast and North parts of the country, it is notoriously more difficult to recruit sufficiently qualified personnel for positions such as loan officer and account manager.
[15] While profits gross of fixed costs do depend on the identity (public *versus* private) of banks, there is an implicit assumption that the fixed cost of operating on given city does not depend on the identity of the bank.

III.A Exogenous Public Bank presence

We first assume entry by public banks is exogenous, in the sense that they do not base their decision on (1). Entry by public banks may have motivations other than economic, such as the establishment of a political base and local development.[16] If their presence is exogenous, the effect of public banks on local market profitability can be inferred by comparing the predicted sizes of markets according to the number of public banks in the markets. For an illustration consider S_{11} and S_{20} solve the following two equations

$$\begin{aligned} \pi\left(S_{11}, N_{pub}=1, N_{priv}=1, \varepsilon\right) &= FC_N \\ \pi\left(S_{20}, N_{pub}=0, N_{priv}=2, \varepsilon\right) &= FC_N \end{aligned} \tag{3}$$

If a duopoly with a one public bank is larger than duopoly with two private banks ($S_{11} > S_{20}$), then (2) implies that public banks are pro-competitive, because it takes a larger market to produce the same amount of profits. Generally, let i stand for the number of private banks, and j index the number of public banks in a local bank market. We are interested in comparing S_{ij} and $S_{i+1\,j-1}$ for $i \geq 1$ and $j \geq 1$.

The ideal experiment would be the following. Start with two identical cities, *A* and *B*. In city *A* the incumbent (monopolist) is a public bank (I_{pub}), in city *B* the incumbent is private (I_{pri}). There is a potential private entrant (E_{pri}). Now imagine we double size of the two cities, and call this new size 2S (they were identical, and therefore they have the same sizes). Suppose we observe that E_{pri} decide to enter in city *B*, where the private bank is incumbent, *but not* in *A*, where the public bank is incumbent. This is evidence that the public bank is pro-competitive. Why? E_{pri} revealed a preference towards entering against a private competitor, which shows that he anticipates making money against the private competitor but not the public one. Everything else constant, it must be that competition will be tougher against the public competitor.[17] In other words:

[16] The expansion of Banco do Brasil branch network in Northeast region during the late 1970s is attributed to the military government's strategy to solidify a conservative political base in the most backward part of the country, in anticipation to democratization. Another evidence of motives besides profit is the strong presence of the public banks of earmarked loans to real estate (CAIXA) and agricultural loans (Banco do Brasil), which generally are money losers. See Levy-Yeyati, Micco and Panizza (2004) for a survey on the theoretical reasons why a public bank would not maximize profits.

[17] The reverse would also be true, evidently.

$$\pi\left(2S, N_{priv}=2, \varepsilon\right) > FC_2 > \pi\left(2S, N_{pub}=1, N_{priv}=1, \varepsilon\right)$$

In this perfect experiment, all the demand and cost shifter in ε and accounted for. Therefore, the only thing that could be different is conduct, another component of ε.

Unfortunately, this ideal experiment is not available in general (if ever). While the ideal experiment has a time-series flavor (increase the market size of a city), our adaptation of BR is a method for emulating the ideal experiment by using cross-section variation in city sizes at one point in time (the year 2000), as outlined now.[18]

Differences in estimated market sizes are only interpretable as evidence of differences in conduct if: i) unobservable factors that affect profits, ε, do not vary systematically with N_{pub} and N_{pri}. The error term contains, for example, demand and cost shifters other than income and income inequality. If public banks are present in markets in which the demand for banking services is particularly high (or in markets that are more costly to service), results would be biased towards finding an adverse effect of public banks on conduct. Empirically, however, this does not seem to be the case in our sample. Public bank presence is widespread. Looking at table 2, one sees that public banks are in cities where the income per capita (which is controlled for in our specifications) is slightly lower, but the population is somewhat larger. These differences, however, do not seem very pronounced. In fact, public banks presence, after accounting for income, income inequality and the regions of the country, is likely to be exogenously determined. In fact, if anything, private banks tend to shy away from markets where demand is low, and cost of servicing is high. After (somewhat) controlling for cost of servicing by

[18] ESTBAN, the central bank data on the number of competitors in the local markets in available for years other than 2000 (it goes back to the 1980s, and the latest available year is 2005). City-level market size, however, can only be computed with census data, which is decennial. Therefore adding other years would be "more of the same", since there would be no variation in market size. Worse than that, since city definitions have changed over the 1990s and 2000s (mostly because after the 1998 constitution allowed districts to leave a city), additional years can be bad variation. Another approach would be using the year 1991, when the previous census was administered. In 1991, however, Brazil was under hyperinflation, which could affect banks' entry decisions significantly (in an hyperinflationary environment, banks could stay in a city only for deposit recruitment reasons, in order to acquire revenues from inflationary floating.)

including regional dummies, the presence of public banks (N_{pub}), if anything, should bias results towards finding that public banks are pro-competitive.[19]

Let k be a bank market (city). To estimate S_{jj} and $S_{i+1\ j-1}$, we impose structure on relation (1):

$$\hat{\pi}_{ij}^{k} = S_k \times \left(\alpha_1 + \sum_{m=1}^{N_{pri}^{k}} D_m^k \alpha_m + \beta \times N_{pub}^{k} + \eta X_k \right) + \varepsilon_k \qquad (4)$$

S_k is the size of market k (as measured by total income), N_{pub}^{k} and N_{pri}^{k} are the number of public and privates banks in market k, respectively. X_k includes income and income distribution in market k. D_m^k is a set dummies for the number of private banks in the market k, i.e.:

$$D_m^1 = \begin{cases} 1, \text{ if there is at least } m \text{ private banks in the market } k \\ 0, \text{ otherwise} \end{cases}$$

α_2 is the entry effect of the second bank; α_3 is the third bank entry effect and so on. S_{ij} is market size in market k.

Different fixed costs for different number of private banks in the market are introduced by allowing (4) to have different intercepts. Net profits in market k are:

$$\pi_{ij}^{k} = S_k \times \left(\alpha_1 + \sum_{m=1}^{N_{pri}^{k}} D_m^k \alpha_m + \beta \times N_{pub}^{k} + \eta X_k \right) - \sum_{m=1}^{i} \tilde{D}_m^k \gamma_m + \varepsilon_k \qquad (5)$$

where $\tilde{D}_m^k$ are dummies similar to D_m^k except that they refer to the total number of banks, not the number of private banks. The γs measure differences in fixed costs: γ_1 is the fixed cost in a monopoly market, $\gamma_1 + \gamma_2$ is the fixed cost in the duopoly market, and so on.

[19] Since public banks are in less profitable places for unobservable reason, markets in which public banks are present will be larger than otherwise would be were these other unobservables accounted for. Since larger markets mean more competition, public banks would "induce competition".

Finally, the parameter β measures the competition effect of the presence of public banks. We are interested in comparing this effect with the private bank competition effect (the αs.)

We implicitly assume homogeneity across private banks: two private banks in a town have the same profit. This assumption buys uniqueness of the equilibrium number of private banks. There is a large literature discussing issues of multiplicity in this kind of setting.[20] If we were to consider heterogeneous agents in a general way, the number of firms in equilibrium is not unique, and multiplicity would have to be dealt with explicitly. We are not interested in measuring the effect on conduct of different private banks (or different public banks), but only how public banks in general differ from private banks. Allowing for heterogeneity among private banks would introduce unnecessary complexity, and we decided to treat private bank 1 and private bank 2 as undistinguishable. Public banks, however, are treated differently: what motivates their entry decision is unknown, and assumed to be exogenous with respect to profit. Both development and political view of public bank ownership would predict that public bank decision will be based on other social or political criteria.[21]

An ordered probit is estimated. Assuming entry does not dampen competition, the monopoly profits are no smaller than the duopoly profit, duopoly profits are no smaller than the profit with three competitors, and so on. The following inequalities are true:

$$\pi_1 \geq \pi_2 \geq \pi_3 \geq \cdots \qquad (6)$$

Assuming that the error term ε in the net profit equation (5) follows a standard normal distribution, the probability of observing markets with no banks equals:

$$\Pr\left(N_{pri} = 0\right) = \Pr\left(\pi_1 < 0\right) = 1 - \Phi\left(\overline{\pi}_1\right)$$

where $\Phi(\bullet)$ is the normal cumulative distribution and $\pi = \overline{\pi} + \varepsilon$.

The probability of observing a monopoly is:

[20] See for example Bresnahan and Reiss (1990), Berry (1992), Seim (2002), Mazzeo(2002), Tamer (2003) and Cilliberto and Tamer (2006). Berry and Tamer (2007) is a good survey of this literature.
[21] See Levy-Yeyati, Micco and Panizza (2004).

$$\Pr\left(N_{pri}=1\right)=\Pr\left(\pi_2<0<\pi_1^t\right)=\Phi\left(\overline{\pi}_1\right)-\Phi\left(\overline{\pi}_2\right)$$

In general, the probability of observing a market with N private banks firms is:

$$\Pr\left(N_{pri}=N\right)=\Pr\left(\pi_{N_{priv}}<0<\pi_N\right)=\Phi\left(\overline{\pi}_N\right)-\Phi\left(\overline{\pi}_{N+1}\right) \tag{7}$$

These probabilities define a likelihood function:

$$\prod_{k=1}^{K}\left(\Phi\left(\overline{\pi}\left(N_{pri}=N_{pri}^k+1\right)\right)-\Phi\left(\overline{\pi}\left(N_{prii}=N_{pri}^k\right)\right)\right) \tag{8}$$

where K is the total number of cities in our sample. The estimated parameters (5) are the maximands of (8).

As BR put, ideally one would have enough time-series variation so that the same market would fluctuate in size to produce enough variation in the number of firms. As in BR, we do not have this type of variation, so we emulate this ideal experiment by using cross-section variation in market size and number of banks. An observation is a local market in December 2000. Table 3 presents the results.

Table 3: Exogenous public banks

	Base model	Model with demand controls
α_1	19.72 (0.79)***	22.50 (1.02)***
α_2	-13.08 (0.80)***	-13.47 (0.82)***
α_3	-1.25 (0.24)***	-1.39 (0.28)***
α_4	-0.86 (0.39)**	-0.89 (0.39)**
α_5	-0.37 (0.29)	-0.39 (0.29)
γ_1	1.65 (0.06)***	1.64 (0.06)***
γ_2	0.50 (0.08)***	0.49 (0.08)***
γ_3	0.74 (0.19)***	0.75 (0.22)***
γ_4	0.43 (0.33)	0.50 (0.33)
γ_5	0.27 (0.24)	0.35 (0.25)
β	-0.54 (0.06)***	-0.41 (0.06)***
Income		0.58 (0.07)
Gini		-7.15 (0.94)

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
Source: Banco Central do Brasil and 2000

Start with column (1), where results of the estimates of model (5) are shown, but X_k is omitted. All coefficients have the expected signs. α_s are all negative, meaning that more banks in a market of a given size is associated with lower profits. Except for α_5 all

of them are statistically significant. The absolute value of the parameters falls as the number of banks in a market increases, which is expected since the effect of bank entry on conduct should be lower when there already are several competitors in the market.[22]

The point estimates of the parameters that measure fixed costs (the γ_s) are positive and statistically significant for the first three of them. This means that fixed costs increase as the number of competitors increase. This is reasonable because there are inputs specific to banking, such as skills in finance, which are harder to recruit for an entrant than for the incumbent banks.

Finally, the estimate of the parameter β: the estimated coefficient is negative (and statistically significant), meaning that public banks reduce industry profits, and suggesting that the presence of public banks have increases competition. However, the competitive effect of public banks is small in magnitude. Comparing $\hat{\beta}$ with the the estimated effects of private banks (the α's), one sees that the effect of the presence of a public bank on profits is weaker than the effect of the first three private entrants (α_2, α_3 and α_4), but slightly stronger than the effect of the fifth private entrants (α_5).[23] Therefore, the presence of a public, in terms of competition, is roughly equivalent the presence of the fifth private bank.

In column (2), X_k is introduced. All estimates are very similar to those in column (1). IThe only noticeable thing is the estimates on income and income distribution. As one would expect, price-cost margin is higher in richer cities (where the demand schedule should be outwards), and, for a given level of income, lower where income distribution is more unequal.

With estimates of the parameters in the profit function (5), one can compute the minimum efficient market size to support a given number of private and public banks (the S_{ij} defined above). For example imagine two situations: one public bank and one private bank (i =1, j = 1), and two private banks in the market (i = 2 and j = 0). The estimated minimum size (averaged over the sample) implied by (5) are:

[22] BR estimate that once the market has from three to five competitors, entry has little effect on conduct.
[23] This is true because we assumed linearity of the effect of the public bank entry. Since only very few cities in the sample have more than 2 public banks, the issue of non-linearity is less serious.

$$\hat{S}_{11}^{k} = \frac{\hat{\gamma}_1 + \hat{\gamma}_2}{\left(\hat{\alpha}_1 + \hat{\beta} + \hat{\eta} X_k\right)} \text{ and } \hat{S}_{20} = \frac{\hat{\gamma}_1 + \hat{\gamma}_2}{\left(\hat{\alpha}_1 + \hat{\alpha}_2 + \hat{\eta} X_k\right)}$$

In general, the estimated (average) minimum market size per bank is:

$$\hat{s}_{11}^{k} = \frac{\hat{S}_{11}^{k}}{N_{pri}^{k} + N_{pub}^{k}} = \frac{\sum_{m=1}^{N_{pri}^{k}} \hat{\gamma}_m}{\left(\sum_{m=1}^{N_{pri}^{k}} \hat{\alpha}_m + \hat{\beta} N_{pub}^{k}\right)} \Big/ \left(N_{pri}^{k} + N_{pub}^{k}\right)$$

If, as in BR, population was used as the size variable, this ratio would represent the minimum population per bank necessary to support a given equilibrium. This is the break even population, the minimum amount of population per bank that guarantees non-negative profits for all banks in the market. In our case, the measure of scale is the adult population multiplied by per capita income, which is approximately the total income of the town.[24] Table 4 has the estimated (average) minimum scale per bank for different market structures.

[24] A simple example helps to illustrate the point. In a *Cournot* model with linear demand and quadratic cost, the minimum efficient scale per bank in a market with two banks is higher than the minimum efficient scale in a market with one bank. If the monopoly and duopoly minimum scale per bank were the same, this would be evidence of cartel. This occurs because, if the entry of a bank increases competition, rational banks anticipate that after the entry of the second bank the profit will be less than in monopoly, which means that the scale with two banks has to be higher than the scale in monopoly given the linearity of demand. In other words, if there are competition effects with the entry of a second bank in a monopoly market, then the total scale of the market with two banks has to be more than double of the scale in the monopoly market.

Table 4: Minimum efficient scales*

s_{10}			
0.08			
s_{20}	s_{11}		
0.18	0.06		
s_{30}	s_{12}	s_{21}	
0.21	0.05	0.13	
s_{40}	s_{13}	s_{22}	s_{31}
0.23	0.05	0.10	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.

Numbers in the table 4 (and all subsequent tables) that contain minimum efficient scales should be read as follows. To facilitate computing the model, to income was divided by 10^7. In table 4, a monopoly threshold of 0.08 means that the minimum total monthly income for a bank serve a town is of R$800,000, in 2000 reais.

Table 4 shows that the minimum efficient scale per bank is higher when a private bank enters a market than a public one enters, at least in the more concentrated markets. Before we start, notice that, as expected, the private duopoly occur on markets that are, on average, larger than markets in which the structure is a private monopoly ($s_{20} > s_{10}$).

s_{20} (0.18) is much larger than s_{11} (0.06), meaning that the minimum efficient scale with two private banks is much larger than the minimum scale to support one private and one public bank. Similarly, the minimum efficient scale in a market with three private banks (s_{30}) is higher than the minimum efficient scales in markets with three banks and that have at least one public bank (s_{12} and s_{21}). Therefore, in markets with at most three banks, the effect of entry by private banks is higher than public banks' effects. In markets with more than three banks (among private and public), the competitive effect of entry is indistinguishable between public and private banks. These results suggest that, at least in concentrated markets, entry by private banks induce a stronger effect on competition than entry by public banks. The following sub-sections contain some sensitivity analysis.

Robustness 1: Regional Effects

There is regional heterogeneity in the importance of public banks in local bank markets. Public banks are more important in the Northeast region, the poorest and most unequal region in the country, and in the North region, the least populated. Thus, public bank presence is more likely to be exogenous after controlling for regional effects. For example, poorer towns are less profitable, and public bank presence may capture this adverse effect on profitability. To account for regional effects, we estimate the following model:

$$\pi_{ij}^{k} = S_k \times \left(\begin{array}{l} \alpha_1 + \sum_{m=1}^{N_{pri}^{k}} D_m^k \alpha_m + \beta \times N_{pub}^{k} + \eta X_k + \\ \kappa_1 Southeast + \kappa_2 South + \kappa_3 North + \kappa_4 Centerwest \end{array} \right) \qquad (9)$$
$$- \sum_{m=1}^{i} \widetilde{D}_m^k \gamma_m + \lambda_1 Southeast + \lambda_2 South + \lambda_3 North + \lambda_4 Centerwest + \varepsilon_k$$

Northeastern towns are the omitted category. Table 5 present the estimated parameters of model (8).

Table 5: Exogenous public banks with regional dummies	
α_1	21.39 (1.13)***
α_2	-13.97 (0.92)***
α_3	-1.42 (0.27)***
α_4	-1.00 (0.40)**
α_5	-0.44 (0.32)
γ_1	2.23 (0.08)***
γ_2	0.64 (0.08)***
γ_3	0.81 (0.20)***
γ_4	0.49 (0.33)*
γ_5	0.30 (0.26)
β	-0.26 (0.07)***
Income	0.08 (0.09)
Gini	-2.86 (1.07)***
κ_1 (Southeast)	0.34 (0.20)
κ_2 (South)	0.24 (0.24)
κ_3 (North)	0.58 (0.66)
κ_4 (Centerwest)	0.39 (0.26)
λ_1 (Southeast)	-1.12 (0.08)***
λ_2 (South)	-0.70 (0.08)***
λ_3 (North)	1.22 (0.40)***
λ_4 (Centerwest)	-0.52 (0.10)***

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
Source: Banco Central do Brasil and 2000 Census.

Results in table 5 show that estimates in table 3 are robust to controlling for regional effects: estimated coefficients on the effects of public and private banks on price-cost margin are all but similar to those in both columns of table 3. Estimated coefficients suggest that, after controlling for income and income distribution, different region in the country do no have different price-cost margins (all κs are not different from zero). Nevertheless, there is a clear ranking of fixed cost of operation: the North in the most expensive region to launch a banking operation (λ_3 = 1.22), followed by the Northeast (the omitted category), then the Centerwest (λ_4 = - 0.52), the South (λ_2 = - 0.70) and the Southeast (λ_1 = - 1.12). This matches perfectly the belief in the industry and the intuition on where fixed costs should be high. The North in the farthest region economically, and the least developed. The Northeast follows. The Centerwest is the center region, midway in terms both geographically and economically. The South has the best social indicators but economic activity is much more dynamic in the Southeast, the main economic region of the country. Table 6 shows the associated thresholds for the minimum scales.

Table 6: Minimum efficient scales by region

	Northeast	Southeast	South	North	Centerwest
s_{10}	0.11	0.05	0.08	0.17	0.08
s_{20}	0.24	0.14	0.18	0.31	0.19
s_{30}	0.27	0.17	0.21	0.32	0.21
s_{40}	0.29	0.20	0.23	0.33	0.23
s_{11}	0.07	0.04	0.05	0.10	0.06
s_{12}	0.06	0.04	0.05	0.08	0.05
s_{13}	0.05	0.04	0.04	0.07	0.05
s_{21}	0.17	0.10	0.12	0.22	0.13
s_{22}	0.13	0.08	0.10	0.17	0.10
s_{31}	0.17	0.09	0.12	0.21	0.13

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

Results in table 5 are also interesting because they indicate that the efficient scale can change significantly from one region to another. The poorest regions (northeast and north) have minimum efficient scales larger than the richest regions (southeast and south). This means, for example, that in a private duopoly a client from southeast is equivalent to 1.6 clients from northeast.

Robustness 2: Different Definitions of Market Size

In this subsection we re-estimate model (5) for different market size definitions. The first change is marginal: market size is now defined as the total income of those who earn more than three minimum wages. The third definition of market size follows the spirit of BR. Market size is modeled as function of several variables. More specifically:

$$S_k = \begin{pmatrix} \text{Population} + \omega_1 \text{Commuters from out of Town} + \\ \omega_2 \text{Commuters to out of Town} + \\ + \omega_3 \text{Positive Growth} + \omega_4 \text{Negative Growth} \end{pmatrix} \times \text{Income Per Capita} \qquad (10)$$

Commuters from out of town is the number of people that, although no living the city, work there. Commuters from out of town is the number of city residents that work somewhere else. Positive growth is a dummy that assumes 1 if the town's population increased from 1990 to 2000, and negative growth is the reverse. The idea is simple. Given a certain population, the market size (for entry decision) should be larger the more people commute from out of town, the less people commute to out of town, the faster the population is growing or the slower the population is declining. The estimated model is Now:

$$\pi_{ij}^k = \begin{pmatrix} \text{Population} + \omega_1 \text{Commuters from out of Town} + \\ \omega_2 \text{Commuters to out of Town} + \\ + \omega_3 \text{Positive Growth} + \omega_4 \text{Negative Growth} \end{pmatrix} \times \text{Income Per Capita}$$
$$\times \left(\alpha_1 + \sum_{m=1}^{N_{pri}^k} D_m^k \alpha_m + \beta \times N_{pub}^k + \eta X_k \right) - \sum_{m=1}^{i} \tilde{D}_m^k \gamma_m + \varepsilon_k \qquad (11)$$

Market size parameters ω are estimated along with all parameters. Table 7 shows the estimated coefficients for the alternative market size definitions.

Table 7: Different Definitions of Market Size

	3 minimum wages†	BR modeling of scale‡
α_1	21.97 (0.74)***	20.66 (0.98)***
α_2	-10.64 (0.37)***	-11.28 (0.71)***
α_3	-1.25 (0.23)***	-1.32 (0.33)***
α_4	-0.80 (0.35)**	-0.80 (0.43)***
α_5	-0.29 (0.25)	-0.41 (0.31)
γ_1	1.26 (0.04)***	2.19 (0.09)***
γ_2	0.74 (0.06)***	0.20 (0.09)**
γ_3	0.76 (0.20)***	0.70 (0.26)***
γ_4	0.48 (0.32)	0.48 (0.41)
γ_5	0.38 (0.23)	0.30 (0.28)
β	-0.31 (0.06)***	-0.36 (0.06)***
Income	0.15 (0.06)***	0.29 (0.06)***
Gini	-10.66 (0.81)***	-6.90 (0.95)***
Commuters out of town		-0.0005 (0.00025)
Commuters in town from outside		0.0005 (0.00088)
Positive populational growth		0.02 (0.01)**
Negative populational growth		0.03 (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 of model (11). 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.

Again, the estimates in both columns of table 7 are very similar to those in table 4, which means that the results are robust to two different definitions of market size.[25] In column (2), one can see that, except for the estimated coefficient associated with the negative growth dummy, all other the estimates market size parameters have the expected sign (although the ones on the commuters are not precisely estimated.). Table 8 show the associated minimum scale thresholds, which are again very similar to those in table 4.

Table 8: Minimum efficient scale, modeling market size*

Panel A: Minimum efficient scale, 3 minimum wages			
s_{10}			
0.08			
s_{20}	s_{11}		
0.18	0.06		
s_{30}	s_{12}	s_{21}	
0.21	0.06	0.13	
s_{40}	s_{13}	s_{22}	s_{31}
0.23	0.05	0.10	0.12
Panel B: Minimum efficient scale, BR scale			
s_{10}			
0.13			
s_{20}	s_{11}		
0.20	0.07		
s_{30}	s_{12}	s_{21}	
0.22	0.06	0.14	
s_{40}	s_{13}	s_{22}	s_{31}
0.23	0.06	0.11	0.14

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

Although remarkably robust, results in tables 5 to 8 are conditional on accepting the hypothesis that public bank presence is exogenous. Towns where the market structure is a public monopoly, or a duopoly with one public and one private bank, are (slightly)

[25] As mentioned in footnote 12, the results in column (1) are not sensitive to other different definitions of market size (such as income of those who earn more than 2, 4 and 5 minimum wages), Results are available upon request.

poorer than those with a private monopoly and duopoly. This fact has two implications[26]. On the one hand, it suggests that public banks have goals different than profit maximization, which helps interpreting results table 4 as evidence of different competitive effects by private and public banks. On the other hand, markets where public banks are present may be smaller for precisely this reason. The procedure implemented in the next sub-section attempts to account for systematic differences in towns according to the presence of public banks.

III.B Splitting the sample

In this sub-section we present estimates of the differential effect of public banks that do not require us to assume that public banks' entry is exogenous. Instead, the effect is measured by comparing estimates from different samples. In one sample, we will use the whole sample of towns while in the second sample we will use the towns that have only private banks. To increase comparability, both samples are restricted to cities with no more than two banks since there are at most two private banks in cities with only private banks. Ownership, once used to select the samples, is ignored when estimating the parameter of the profit function. Let N^k be the number of banks (both private and public) in market *k*, and let D_m^k be defined as before. The profit function is now:

$$\pi_{ij}^k = S_k \times \left(\alpha_1 + \sum_{m=1}^{N^k} D_m^k \alpha_m + \eta X_k \right) - \sum_{m=1}^{N^k} D_m^k \gamma_m + \varepsilon_k \qquad (12)$$

Note that this specification is a little different from (5): the number of public banks does not enter as an exogenous variable. The strategy now is to select difference sub-samples of cities, and infer the effect of public banks by the differences in estimated parameters across different these different sub-samples.

[26] The income per capita average in towns with public monopoly is of R$151 while in towns with private monopoly it is R$175, an average difference of 15.9%. For duopolies the figures are: an average of R$204 for towns with one public and one private bank, and an average of R$209 for private duopolies, this mean a smaller average difference of 2.5%.

The sample is split in three different groups, according to their market structure. Group 1 is composed of cities where there is either a private monopoly or a private duopoly; group 2 is composed of cities where there is either a public monopoly or a public duopoly; finally, group 3, which is the closest to the ideal experiment described above, is composed of cities in which there is a public monopoly or a private-public duopoly. The idea is quite simple. Suppose we randomly decided what cities would belong to each group. Difference in their behavior would then be interpretable as differences in the competitive drive.

Table 9 shows the estimates of the parameters of (12) for the three different groups.

Table 9: Spliting the sample

	(1)†	(2)‡	(3)§
α_1	24.77	32.85	31.97
	(3.08)***	(2.59)***	(2.44)***
α_2	-10.43	-13.10	-12.07
	(1.09)***	(0.95)***	(0.97)***
γ_1	1.53	2.22	2.24
	(0.06)***	(0.07)***	(0.07)***
γ_2	1.16	0.34	0.49
	(0.13)***	(0.09)***	(0.10)***
Income	3.62	-0.21	0.76
	(0.43)***	(0.26)	(0.23)***
Gini	-27.26	-12.15	-13.15
	(4.94)***	(3.91)***	(3.73)***

Ordered probit estimates of the model (5), robust standard deviations in parentheses

† = only private monopolies and dupolies in the sample

‡ = only public monopolies and dupolies in the sample

§ = only public monopolies and private-public dupolies in the sample

*** = significant at the 1% level

** = significant at the 5% level

* = significant at the 10% level

Source: Banco Central do Brasil and 2000 Census.

There is one noticeable thing in the estimates. First, αs and γs continue to have the expected signs and magnitudes, and their pattern is quite similar across sub-groups, which suggests that looking at estimated parameters is uninformative. Public banks could have a significantly lower impact on competition and yet have a large impact on the profits of other *public* banks. Thresholds for the minimum scales, reported in table 10, are more informative.

Table 10: Minimum efficient scale for duopolies, spliting the sample*

Panel A: Only private monopolies and duopolies††		
	Sample means†	Fixed values‡
s_1	0.10	0.08
s_2	0.32	0.14
s_2/s_1	3.04	1.82
Panel B: Only public monopolies and duopolies†††		
	Sample means†	Fixed values‡
s_1	0.09	0.08
s_2	0.10	0.10
s_2/s_1	1.18	1.15
Panel C: Public monopolies and priva-public duopolies††††		
	Sample means†	Fixed values‡
s_1	0.09	0.08
s_2	0.10	0.09
s_2/s_1	1.16	1.09

* s_i - minimum efficient scale with i banks.

† = Minimum scales evaluated at the average income per capita and Gini index for the group of cities in question.

‡ = Minimum scales evaluated at the overall average income per capita and Gini index.

†† = Minimum scales computed with estimates in table 9, column (1)

††† = Minimum scales computed with estimates in table 9, column (2)

†††† = Minimum scales computed with estimates in table 9, column (3)

The difference among sub-samples is absolutely clear now. Start at panel A, and consider the first set of number (under the title Sample means). When the world is composed of only private banks, the relationship between market size and number of competitors is as expected: private duopolies are, on average, more than three times the size of private monopolies, This number imply two things: private banks are guided by the decision rule (3), and the second competitor has a strong effect on conduct. Consider

now panel B: when only public bank cities are considered the pattern hardly arises: public duopolies are only 18% larger than public banks, which implies that either public banks do not follow (3), or that their competitive effect is very limited. More interestingly, consider panel C. Private-Public bank duopolies are only 16% larger than public bank monopolies. The interpretation, in contrast to panel A, is the following. When faced with the prospect of competing with a public bank, a private bank waits until the market is 16% than the average size of the public monopoly. When the prospect is facing with a private competitor, the entrant waits until the market is more than three times the size. This corroborates the previous results that suggested that private banks are more pro-competitive than public banks.

Robustness 1: Homogenizing the Samples

One major concern about results in table 9-10 is than allocation of public and private banks is not random, as we would like it to be. Therefore, the sub-samples of towns with only private banks could be systematically different in dimensions pertinent to bank profits. In this sub-section we check whether the results are robust to homogenizing the sample.

The first question that comes to mind is what explains the presence of public and private banks in the sample. To partially answer this question, we run a Logit procedure to relate city characteristics to the presence of public banks. Table 11 shows the results.

Table 11: Logit regressions*

	Sample of monopolies†	**Sample of duopolies‡**
	Dependent Variable = 1, if monopolist is public	Dependent Variable = 1, if dupolist is public
	Coefficient	Coefficient
Product	-3.00E-06	-2.00E-06
	(1.00E-06)***	(2.00E-06)
Population	9.00E-05	6.00E-05
	(1.00E-06)***	(4.00E-06)
Gini Index	-0.97	-2.02
	(1.45)	(3.74)
Illiteracy rate	-0.03	0.001
	(0.04)	(0.03)
Northeast region dummy	1.48	1.35
	(0.27)***	(1.29)
% in Farm Product	1.13	0.91
	(0.47)**	(1.36)
Privatization	-2.42	-3.88
	(0.16)***	(1.03)***
Demographic density	2.00E-03	5.00E-05
	(2.00E-03)	(4.00E-04)
Distance	-0.01	0.06
	(4E-03)***	(0.04)
Constant	1.39	4.76
	(0.81)	(2.21)**
# of observations	1334	559

§ Robust standard deviations in paretheses
† = Sample composed of cities whose market structure is monopoly.
‡ = Sample composed of cities whose market structure is duopoly, private-private and public-public.
*** = significant at the 1% level
** = significant at the 5% level
* = significant at the 10% level
Source: Banco Central do Brasil and 2000 Census.

In the first column the sample is composed of monopolies, and the coefficient and the dependent variable is a dummy for public (as opposed to private) monopolies. Given that the market structure is a monopoly, the odds of it being a public monopoly increase if the city is located in the Northeast and if the city is located in a state whose state-owned public bank was privatized, with the importance of farm product in the city, with the size of the city, and decreases with product. The last two facts were already suggested in table 2. The importance of farm product is a peculiarity of Brazil: Banco do Brasil, for

political reasons, has a major (possibly larger than economics would justify) in farm financing.

Privatization is, not surprisingly, an important driving force. There are 13% private monopolies, 0.8% private duopolies, of a total sample of 4962 towns. Out of these, 76.6% are in the region south or southeast and 88% are in a state that had a state bank being privatized until the end of 2000[27]. For private duopolies the figures are more striking: from the 41 private duopolies of the sample, 39 (95%) are in the south or southeast region[28]. In November of 2000, Banco Santander bought the state-operated government owned bank BANESPA, one of the largest banks in Brazil, paying a very high premium, presumably to recruit a profitable client base of relatively wealthy public servants.[29] Indeed, all cities where BANESPA operated continued to be serviced by Santander in December 2001, roughly 13 months after privatization. This makes us confident that, Santander´s presence in a local market is indeed profit driven, not because it was too late for an exit strategy to be carried through.[30] For the 41 private duopolies in our sample, 16 were generated from BANESPA privatization. In October of 2000, the Itaú bank bought the state-operated government owned bank BANESTADO. This privatization gave us 14 private duopolies.

Finally, the presence of public banks in the Northeast region is explained by the political strategy of the federal government in the last years of the military regime.[31]

When duopolies are concerned, the presence of public banks seems much more random, only related to whether privatization took place in the state.

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[27] The others states that had private banks being privatized were: Rio de Janeiro in June of 1997, Minas Gerais in September of 1998 and Paraná in October of 2000. For Rio de Janeiro and Minas Gerais we considered that the position of 2000 is already a good measure of the exit decision of the institutions that bought the local banks. For the state of Paraná we did the same treatment as for the state of São Paulo. We looked for the number of agencies in each town for the privatized institution in December of 2001.

[28] We did not make the robustness check for a single state because we did not have any state with sufficient number of observations for private duopolies.

[29] The price paid for Banespa was R$7,050 millions, which were at that time more than three times larger than Banespa's equity. At that time, the number of Banespa's agencies was of 578. This large number of agencies was one of the main reasons for why the Santander paid such high price, since the purchase of Banespa was a cheap way to enter in the Brazilian market through branches in the richest state of the federation.

[30] In fact, three years after privatization Santander still serviced the same cities.

[31] Anticipating difficulties in more educated, more politicized urban places, the military, during the then inevitable transition to democracy, chose to favor rural, poorer places, where they could more easily establish a solid support base. Therefore the presence of Banco do Brasil in the Northeast cities.

Table 11 suggests that there may be significant differences in cities where public and private banks operate, especially for monopoly cities. Therefore it is important to try to homogenize the samples somehow. Table 11 itself provides also provide one simple way in which the sample can be homogenized. Since privatization was more important in the South and the Southeast (see analysis above), and Banco do Brasil is particularly strong in the Northeast, we first restrict the three sub-samples to cities that belong to the South and Southeast regions. Besides the aforementioned reasons, this has the further advantage of homogenizing the sample in other dimensions, since the Southeast and the South are the most homogeneous regions in the country. Table 12 presents the results.

Table 12: Minimum efficient scale for duopolies, south-southeast*

Panel A: Only private monopolies and duopolies		
	Sample means†	Fixed values‡
s_1	0.06	0.08
s_2	0.10	0.12
s_2/s_1	1.55	1.61
Panel B: Only public monopolies and duopolies		
	Sample means†	Fixed values‡
s_1	0.08	0.08
s_2	0.07	0.07
s_2/s_1	0.92	0.93
Panel C: Public monopolies and priva-public duopolies		
	Sample means†	Fixed values‡
s_1	0.08	0.08
s_2	0.08	0.08
s_2/s_1	1.02	1.03

* s_i - minimum efficient scale with i banks. Minimum scale computed with estimates from the same models as table 9, except that the sample is restricted to the south and south-east regions
† = Minimum scales evaluated at the average income per capita and Gini index for the group of cities in question.
‡ = Minimum scales evaluated at the overall average income per capita and Gini index.

Inspection of table 12 shows that results are, in relative terms, very similar to those in table 10, which suggests that heterogeneity across cities is not driving results in table 10. The sample, however, can be homogenized in a more systematic way. Crump, Hotz, Imbens and Mitnik (2007) propose a method to deal with heterogeneity of

treatment and control groups when estimating average treatment effects. We adapt their procedure to the BR framework.

The procedure consists of estimating the probability that an observation belongs to a group (the propensity score), commonly called the treatment group, as a function of observable explanatory variables. Then, the sample is "trimmed": some observations are excluded on the basis of having propensity scores that are too high or too low. The idea is that, by excluding extremes, the remaining data would have similar possibilities of being part of group (treatment) or another (control). In case we want to select among towns with only private bank those that, given observables, also had a fair chance of having a public bank, and vice versa (towns with public banks with characteristics more close to the towns that have only private bank). The ideal experiment would be to select a random town and compare the same town with and without the public bank in order to measure the "treatment" public bank presence. In this case, all towns would a 50% chance of having only private banks. Trimming the sample emulates this ideal experiment.

The procedure is as follows. In a first stage, we use the two logit models estimated to find predicted probabilities that a monopoly will be public, and a duopoly will contain only public banks. The sample is then "trimmed" by excluding the towns with the top t % and the bottom t % of propensity scores. We estimate model (10) excluding t = 5% and t =10%. The choice of t involves a trade-off. We would like trim the sample as much as possible. But we have only few observations of cities with only private banks. Tables 13 and 14 show the results of the 5% and 10% trimming procedures.

Table 13: Minimum efficient scale for duopolies, 5% sample trimming*

Panel A: Only private monopolies and duopolies††		
	Sample means†	Fixed values‡
s_1	0.10	0.08
s_2	0.21	0.12
s_2/s_1	2.03	1.54
**Panel B: Only public monopolies and duopolies††† **		
	Sample means†	Fixed values‡
s_1	0.09	0.08
s_2	0.08	0.08
s_2/s_1	0.91	1.00
**Panel C: Public monopolies and priva-public duopolies†††† **		
	Sample means†	Fixed values‡
s_1	0.09	0.09
s_2	0.09	0.09
s_2/s_1	1.00	1.00

* s_i - minimum efficient scale with i banks.
† = Minimum scales evaluated at the average income per capita and Gini index for the group of cities in question.
‡ = Minimum scales evaluated at the overall average income per capita and Gini index.
†† = Minimum scales computed with estimates in table 9, column (1) but with sample restricted those with predicted probabilities (scores) in the (0.05,0.95) interval, from table 12.
††† = Minimum scales computed with estimates in table 9, column (2) but with sample restricted those with predicted probabilities (scores) in the (0.05,0.95) interval, from table 12.
†††† = Minimum scales computed with estimates in table 9, column (3) but with sample restricted those with predicted probabilities (scores) in the (0.05,0.95) interval, from table 12.

Table 14: Minimum efficient scale for duopolies, 10% sample trimming*

Panel A: Only private monopolies and duopolies††		
	Sample means†	Fixed values‡
s_1	0.10	0.08
s_2	0.22	0.12
s_2/s_1	2.11	1.55
**Panel B: Only public monopolies and duopolies††† **		
	Sample means†	Fixed values‡
s_1	0.09	0.09
s_2	0.08	0.08
s_2/s_1	0.89	0.89
**Panel C: Public monopolies and priva-public duopolies†††† **		
	Sample means†	Fixed values‡
s_1	0.09	0.09
s_2	0.09	0.09
s_2/s_1	1.00	1.00

* s_i - minimum efficient scale with i banks.
† = Minimum scales evaluated at the average income per capita and Gini index for the group of cities in question.
‡ = Minimum scales evaluated at the overall average income per capita and Gini index.
†† = Minimum scales computed with estimates in table 9, column (1) but with sample restricted those with predicted probabilities (scores) in the (0.10,0.90) interval, from table 12.
††† = Minimum scales computed with estimates in table 9, column (2) but with sample restricted those with predicted probabilities (scores) in the (0.10,0.90) interval, from table 12.
†††† = Minimum scales computed with estimates in table 9, column (3) but with sample restricted those with predicted probabilities (scores) in the (0.10,0.90) interval, from table 12.

Once more, results are very similar to those previously presented.

IV. Conclusion

In this paper we measure the competitive effect of entry by public banks in local banking markets in Brazil by extending Bresnahan and Reiss's [1991] framework to measure the entry's effects. In our baseline estimations, where the public bank entry was considered exogenous, we find that, while markets whose structure is private bank duopoly are 100% larger than private monopolies, duopolies with one public and one private bank and private monopolies are no different with respect to market size. These results suggest that, while entry by private banks toughens competition, entry by public banks seem neutral to conduct. This result is robust to including regional differences, and demand controls.

In the second procedure, entry by public banks is no longer assumed to be exogenous. The ordered probit is estimated for two samples of cities: one of towns where only private institutions serve the market, and the whole sample (including the markets where public banks are present). The results corroborate the previous findings: private banks seem more pro-competitive than public banks. We also studied the entry process of public banks more closely in concentrated markets to understand what drives public bank presence *vis-à-vis* private bank entry. We find that some variables associated with the development view of public banks existence, like the proportion of rural production, help to explain why public banks enter in some cities that private banks are not willing to service. Using these results, the two samples were homogenized using a procedure proposed by Crump et. al. (2006), which excludes cities that are too dissimilar based on the probability of being part of one group (the propensity score). By combining BR`s method for measuring the effect of entry on competition with propensity score methods of homogenizing samples, we contribute methodologically to the empirical literature on entry effects. Results are in line with the previous procedure (exogenous public banks), and are themselves robust to another set of robustness checks.

The reason why private are more pro-competitive than public banks is still an open question. The theoretical predictions about the effects of public bank presence are ambiguous. On the one hand, consumer surplus maybe part of public banks' objective function, and this would induce them to toughen competition. On the other hand, public banks may run a higher operation cost, because of poor management, and/or because they serve higher cost clients for development reasons. Our results suggest that the second effect outweighs the first.

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