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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.
JEL CODES: L10;L13;L33

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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 those with French civil law tradition, this figure is higher. 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 benefit 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, as a matter of fact significant, and an increased performance of the banking sector can have important spillover effects on other sectors. Using local Brazilian data, this is exactly the empirical question we address in this paper: 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 state-level public banks, they still held 42.7% of the banking sector assets nationally in

[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.

2001 (Panizza et al (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 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 is 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, 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. 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 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.

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[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.

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 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 equilibrium. Profits depend, among other things, on two observable variables, number of firms and market size, and one non-observable, competition regime (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 accounted for, this variation in the number of firms can be attributed to a difference 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.

An important 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, even if one trusts accounting data on profits, it is all but impossible to have profits disaggregated at the local level. Second, cost and price data at the local level are almost never available. 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: one only needs to assume free-entry and that fixed costs do vary systematically among cities.

In contrast to BR, 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 public 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.

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 (possibly) adverse effects on nationalization of companies.

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. Several identification hypotheses are necessary to interpret the estimated difference as the causal effect of public ownership. Identification comes from selecting two samples of cities in a convenient way, applying the BR framework to these two samples, and then

"homogenizing" the two groups. 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). Brazilian cities can be quite poor, and income per capita varies wildly across cities. Since banking 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.

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*). 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.

Differences across markets with public banks and markets without public banks are depicted in table 2. Measured by total income, private duopoly markets are almost twice of the size of private monopoly markets (98% increase). In contrast, markets with one public bank and one private bank are less than double the size of public monopoly markets (83% increase). When one compares public duopolies to public monopolies the increase in size is even less pronounced (60%).

Table 1:
Mean of main town's variables by number of banks

N banks	N obs	Adult population	Income per capita	Total income
0	2056	4219	116	423685
1	1334	6920	163	924943
2	559	10558	192	1767496
3	306	14356	210	2718658
4	224	18481	236	3999117
5	162	27351	250	6166622
>5	321	74706	311	24500000
Total	4962	12243	165	2756952

Source: Banco Central do Brasil (number of banks) and 2000 Census (adult population and income per capita). 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 multiplication of adult population and income per capita divided by 1000 for each town. The average was calculated after the multiplication made for each town.

Table 2:
Mean of the main towns' variables by market configuration

N private banks	N public banks	N obs	Adult Population	Income per capita	Total Income
0	0	2056	4219	116	423685
1	0	644	5013	175	808018
0	1	690	8700	151	1034072
2	0	41	7848	209	1598962
1	1	277	10228	204	1891879
0	2	241	11398	175	1653206
3	0	4	11920	281	3373125
0	3	73	17789	181	2638237
2	1	126	11810	226	2634477
1	2	103	15132	208	2853217
0	4	8	32414	99	3160939
3	1	17	14897	268	4061537
1	3	61	20715	235	4322034
2	2	138	17128	241	3897279
Number of banks >4		483	58823	291	18300000
Whole sample		4962	12243	165	2756952

Source: Banco Central do Brasil (number of banks) and 2000 Census (adult population and total income). Number of banks is the amount of different banks in each town. Total income is the multiplication of adult population and monthly income per capita divided by 1000 for each town and is measured in R$ of 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 $\pi(S, N_{pub}, N_{pri}, C, \varepsilon)$ be gross profits (before subtracting fixed costs) for a local market. Profits are function of three observable and two unobservable variables. 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. An important unobservable variable is conduct (*C*), i.e., the level of competitiveness in the market, holding the market fixed. Conduct is defined such that an increase in *C* means

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

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

All other unobserved effects are captured in ε, which include for example all demand factors and cost shifters. 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:

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

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.

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.[7] 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

[7] 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 Panizza et al. (2004) for a survey on the theoretical reasons why a public bank would not maximize profits.

$$\pi\left(S_{11}, N_{pub}=1, N_{priv}=1, C, \varepsilon\right)=FC_N$$
$$\pi\left(S_{20}, N_{pub}=0, N_{priv}=2, C, \varepsilon\right)=FC_N \quad (3)$$

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 $j \geq 1$.

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}. ε contains, for example, demand and cost shifters and, if, for example, public banks are present in markets in which the demand for banking services is particularly high (or markets less 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 and, if anything, private banks shy away from less profitable market, those in which banking demand, after controlling for size, is low, or far away markets that tend to be more costly to service. Therefore, if N_{pub} are systematically related to ε the bias created would be towards finding that public banks are pro-competitive.

To estimate S_{jj} and $S_{i+1\,j-1}$, we impose structure on relation (1):

$$\pi_{ij}^{gross} = S_{ij} \times \left(\alpha_1 + \sum_{m=1}^{i} D_m \alpha_m + \beta \times j \right) - C + \varepsilon \quad (4)$$

D_m are dummies for the number of banks in the market, i.e.:

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

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. C is conduct; since it is non-observable, we bundle all unobservable factors into $\xi = \varepsilon + C$.

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

$$\pi_{ij}^{net} = S_{ij} \times \left(\alpha_1 + \sum_{m=1}^{i} D_m \alpha_m + \beta \times j \right) - \sum_{m=1}^{i} D_m \gamma_m + \xi \qquad (5)$$

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.

Finally, the variable N_{pub} is the number of public banks in a town. The parameter β measures the possible competition effect that a public bank can have, once it decides to enter in a market. We will be interested in comparing this effect with the private bank competition effect (the α_s).

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.[8] 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.[9]

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:

[8] 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.
[9] See Panizza et al. (2004).

$$\pi_1^{net} \geq \pi_2^{net} \geq \pi_3^{net} \geq \cdots \tag{6}$$

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

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

where $\Phi(\bullet)$ is the normal cumulative distribution and $\pi_{N_{pri}}^{net} = \overline{\pi}_{N_{pri}} + \xi$.

The probability of observing a monopoly equals:

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

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

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

The parameters in (5) are estimated by maximum likelihood. 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

	Estimate	t-statistic
α_1	19.7	24.8
α_2	-13.1	-16.3
α_3	-1.3	-5.3
α_4	-0.9	-2.2
α_5	-0.4	-1.3
γ_1	1.7	29.8
γ_2	0.5	6.7
γ_3	0.7	3.9
γ_4	0.4	1.3
γ_5	0.3	1.1
β	-0.5	-9.6

Source: Banco Central do Brasil e 2000 Census.
Ordered probit estimates of the model (5), robust *t-statistics*

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.[10]

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 competition effect of public banks, is negative, and highly significant. Comparing the value of this coefficient to the values of the private banks competition effects (the α's), one sees that the effect of entry by a

[10] BR estimate that once the market has from three to five competitors, entry has little effect on conduct.

public bank on profits is weaker than the effect of the first three private entrants (α_2 , α_3 and α_4), but stronger than the effect of the fifth private entrants (α_5).[11]

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:

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

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

$$\hat{s}_{ij} = \frac{S_{ij}}{i+j} = \frac{\sum_{m=1}^{i} \hat{\gamma}_m}{\left(\sum_{m=1}^{i} \hat{\alpha}_m + \hat{\beta} \times j\right)} \Big/ (i+j)$$

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.[12] Table 4 has the estimated (average) minimum scale per bank for different market structures.

[11] This is true because we assumed linearity of the effect of the public bank entry.

[12] 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 scale of the first empirical model*

s_{10}			
0.08			
s_{20}	s_{11}		
0.16	0.06		
s_{30}	s_{12}	s_{21}	
0.18	0.05	0.12	
s_{40}	s_{13}	s_{22}	s_{31}
0.17	0.05	0.10	0.11

* s_{ij} - minimum efficient scale with i private and j public banks

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} (0.16) 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:

$$\pi_{ij}^{net} = S_{ij} \times \left(\alpha_1 + \sum_{m=1}^{i} D_m \alpha_m + \beta \times j \right) - \sum_{m=1}^{i} D_m \gamma_m + \lambda_1 Southeast + \lambda_2 South + \lambda_3 North + \lambda_4 Centerwest + \xi \quad (8)$$

Northeastern towns are the omitted category. Table 5 present the results of estimated thresholds for market size (by region).[13]

Table 5: Minimum efficient scales by region

	Northeast	Southeast	South	North	Centerwest
s_{10}	0.11	0.05	0.08	0.17	0.08
s_{20}	0.23	0.14	0.17	0.32	0.18
s_{30}	0.25	0.17	0.20	0.32	0.21
s_{40}	0.26	0.19	0.21	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}	0.21	0.14	0.16	0.27	0.17
s_{22}	0.18	0.13	0.15	0.23	0.16
s_{31}	0.23	0.16	0.18	0.28	0.19

* s_{ij} - minimum efficient scale with i private and j public banks

[13] For the sake of brevity, only thresholds are included in robustness checks for the rest of this section.

Results in table 5 show that estimates in table 4 are robust to controlling for regional effects: public banks again have a smaller competitive effect than the private ones. 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: Demand shifter

The second robustness check consists of the inclusion of demand control in the regression. The most natural way to do this is put income per capita in the variable profit of banks. So we estimated the following model:

$$\pi_{ij}^{net} = S_{ij} \times \left(\alpha_1 + \sum_{m=1}^{i} D_m \alpha_m + \beta \times j + \varphi income \right) - \sum_{m=1}^{i} D_m \gamma_m + \xi \qquad (9)$$

Table 6 presents the (average) minimum scales estimated.

Table 6: Minimum efficient scale for the model with demand control*

s_{10}			
0.08			
s_{20}	s_{11}		
0.18	0.06		
s_{30}	s_{12}	s_{21}	
0.22	0.05	0.13	
s_{40}	s_{13}	s_{22}	s_{31}
0.25	0.05	0.11	0.14

* s_{ij} - minimum efficient scale with i private and j public banks

The estimates of table 6 are very similar of table 4 which means that the results of table 4 are robust to the presence of income per capita in the variable profit to control for differences in the profitability between cities.

Although remarkably robust, results in tables 4, 5 and 6 are only suggestive. Towns where the market structure is a public monopoly, or a duopoly with one public and one private bank, are poorer than those with a private monopoly and duopoly. This fact has two implications[14]. 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 *i* be the number of banks (both private and public). The profit function is:

$$\pi_i^{net} = S_i \times \left(\alpha_1 + \sum_{m=1}^{i} D_m \alpha_m + \lambda income \right) - \sum_{m=1}^{i} D_m \gamma_m + \xi \qquad (11)$$

[14] 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%.

Note that this specification is a little different from (5): the number of public banks does not enter as an exogenous variable. Significantly different estimated parameters among different samples are suggestive that public and private banks affect conduct differently.

Tables 7 and 8 show the estimates of the parameters of (11). In Table 8 the whole sample is used. All parameters have the expected sign and are significantly different from zero. In particular, the competition effects (α_s) are all negative, as expected. Table 9 shows the estimates for the sample with only private banks. We can see that the effect of the entry of a second bank in a monopoly market (α_2) is negative, as expected, and significant. Fixed cost parameters are positive in both samples, as expected, so are the parameters of income. An interesting thing to note is that the income coefficient for towns that have only private bank is much larger than the income coefficient for the whole sample, which is evidence that demand factors are more important for private banks.

Table 7: Whole sample

	Estimate	t-statistic
α_1	20.6	26.9
α_2	-10.7	-14.7
γ_1	1.5	29.5
γ_2	0.7	11.7
Income	0.9	5.7

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (5), robust *t -statistics*

Table 8: Only private banks

	Estimate	t-statistic
α_1	8.5	8.3
α_2	-10.5	-9.9
γ_1	1.5	19.7
γ_2	1.1	10.6
Income	4.1	20.4

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (5), robust *t -statistics*

Based on estimates in tables 7 and 8 the threshold entry levels (the minimum efficient scale) were computed. Table 9 shows the results.

Table 9: minimum efficient scale for duopolies with demand controls*

	Whole sample	Only private banks
s_1	0.07	0.08
s_2	0.09	0.16
s_2/s_1	1.41	1.86

Source: Banco Central do Brasil and 2000 Census $*s_j$ - minimum efficient scale with j banks

In both samples, the second entrant has a significant effect: α_2 negative implying that minimum efficient scale increases with the entry of the second bank. Comparing the whole sample with the sample with only private banks we note several interesting differences. First, the minimum scale to support a private monopoly is slightly larger than the minimum scale to support a monopoly in general (0.08 versus 0.07). This difference, although small, again suggest that public banks maximize something other than profit.

The most important difference for our purposes concerns the different minimum efficient scales to support a duopoly or three banks in a local banking market. While for the whole sample, the minimum scale is 0.16 (0.07 + 0.09), the minimum efficient scale to support a private duopoly is 0.24 (0.08 + 0.16). These results again suggest that entry by private banks toughen competition more than entry by public banks.

In the following sub-sections we present several robustness checks. Particularly important for our purpose is the first sensitivity analysis, in which the two samples are homogenized. At this point we introduce a methodological extension to BR.

Robustness 1: homogenizing the samples

One major concern about results in table 8-10 is whether the sub-sample of towns with only private banks is not systematically different from the whole sample of towns. If this sub-sample was drawn randomly from the population then we would not have to be

concerned. However, we do not know this, and so we have to deal with possible non-random determination of towns with only private banks.

The first what that comes to mind is what explains a town with private monopoly or a private duopoly. The answer is surprisingly simple: privatization. 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[15]. 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[16]. 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.[17] 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.[18] 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.

Thus, a simple way to attempt to homogenize the samples is to restrict the attention to the south and southeast region. Table 11 presents the results of thresholds computed based on estimates of model (11) using only cities from the south and southeast region.

[15] 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.

[16] 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.

[17] 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.

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

Table 10: minimum efficient scale for duopolies from south-southeast*

	Public-private duopoly	Private duopoly
s_1	0.080	0.07
s_2	0.083	0.12
s_2/s_1	1.05	1.88

Source: Banco Central do Brasil and 2000 Census *s_j - minimum efficient scale with j banks

Differences are still pronounced. Minimum scale to support entry still increases more pronouncedly in the sample composed of towns with private banks.

The sample can be homogenized in a more systematic way. Crump et. al. [2006] 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 is a way to mimic this ideal experiment.

The procedure is as follows. In a first stage, we estimate two logit models to find predicted probabilities that a town only has private banks, one for monopoly markets and one for duopoly markets. The dependent variable is a categorical variable taking the value one if the town has public bank presence, and zero otherwise. The towns' characteristics are the explanatory variables. We included as regressors variables that could explain the presence (or lack thereof) of public banks in a town. The proportion of rural product, for example, is included because public banks are supposed to fulfill a

development role and support agriculture. The gini coefficient is intended to capture the higher propensity that a public bank has to enter in a town with underdeveloped credit markets and high levels of inequality. The variables demographic density and distance are intended to capture a possible public bank objective to offer bank services in remote towns. Additionally, a dummy if the state-level public bank of the state in which the town is located was privatized until 2000 was included because privatization obviously helps explain the absence of public banks.

After estimating the models, propensity scores are computed and the sample is 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 11 and 12 present the estimates from the logits model for monopolies and duopolies.

Table 11: logit regression for monopoly

dependent variable=1 if the monopolist is a public bank		
	Coefficient	z-value
gdp	-0.000003	-2.1
population	0.00009	6.33
gini	-0.97	-0.67
illiteracy	-0.03	-0.68
northeast region	1.48	5.5
%rural product	1.13	2.43
privatization	-2.42	-15.04
demographic density	0.002	0.96
distance	-0.01	-2.56
constant	1.39	1.71
N obs	1334	

Table 12: logit regression for duoopoly

dependent variable=1 if the duopolist is a public bank		
	Coefficient	z-value
gdp	-0.000002	-1
population	0.00006	1.54
gini	-2.02	-0.54
illiteracy	0.001	0.03
northeast region	1.35	1.05
%rural product	0.9	0.66
privatization	-3.88	-3.77
demographic density	0.0005	0.13
distance	0.06	1.54
constant	4.76	2.15
N obs	559	

As expected, public banks tend to enter in towns with higher proportion of rural product and with smaller gdp (poorer towns). Again not surprisingly, a larger proportion of towns in the sample with only private banks belong to a state that had a local public bank being privatized.

Table 13 and 14 show estimates of the minimum scale to support a monopoly and duopoly in both samples (markets with 3 private banks disappear)[19] using the following model.

$$\pi_i^{net} = S_i \times \left(\alpha_1 + \sum_{m=1}^{i} D_m \alpha_m \right) - \sum_{m=1}^{i} D_m \gamma_m + \xi \qquad (12)$$

Table 13: Minimum scale, trimming the bottom and top 5%

	Only private banks	Towns with public banks
s_1	0.10	0.09
s_2	0.15	0.08
s_2/s_1	1.55	0.93

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (12), robust *t -statistics*

[19] In these estimations we used private monopoly as the base for the private duopolies and public monopoly as the base for public-private duopoly. We run the same model using private monopoly as the base for both samples and the results did not change.

Table 14: Minimum scale, trimming the bottom and top 10%

	Only private banks	Towns with public banks
s_1	0.10	0.09
s_2	0.15	0.08
s_2/s_1	1.54	0.91

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (12), robust *t -statistics*

Results are again very similar to those in table 10.

Robustness 2: homogenizing the samples with demand shifter

As in the previous case we will include income per capita in the variable profit in order to control demand factors at the town level. The profit function estimated in this case was the equation (11).

Table 15 and 16 show the (average) minimum scale estimated for this model.

Table 15: Minimum scale, trimming the bottom and top 5% with demand control

	Only private banks	Towns with public banks
s_1	0.08	0.09
s_2	0.14	0.08
s_2/s_1	1.70	0.93

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (11), robust *t -statistics*

Table 16: Minimum scale, trimming the bottom and top 10% with demand control

	Only private banks	Towns with public banks
s_1	0.09	0.09
s_2	0.15	0.08
s_2/s_1	1.72	0.91

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (11), robust *t -statistics*

Again the results suggest that private banks are more pro-competitive than public banks as the minimum thresholds are larger for private.

Robustness 3: changing the scale variable to population

The last robustness check consists of changing the scale variable definition and use the more usual variable population as the scale. At the same time we included income per capita in the variable profits in order to control for demand factors that influence profit within the towns in the same spirit of robustness 2. We hope that a town with a large population but low income per capita would have a low profitability, since the demand for credit in this town would be too slow, decreasing bank's margin for a given level of market power.

Table 17 shows the results for the whole sample and for the sub-sample with towns with only private banks[20]. Tables 18 and 19 show the results using the same sample cut used in the robustness 1. In the table 18 the sample was trimmed by excluding the bottom and top 5%, while in the table 19 the top and bottom 10% of the sample was excluded[21].

Table 17: Minimum scale of population - whole sample

	Only private banks	Towns with public banks
s_1	0.030	0.028
s_2	0.047	0.032
s_2/s_1	1.56	1.16

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (11), robust *t-statistics*

Table 18: Minimum scale of population, trimming the bottom and top 5%

	Only private banks	Towns with public banks
s_1	0.031	0.036
s_2	0.044	0.029
s_2/s_1	1.39	0.79

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (11), robust *t-statistics*

[20] As in the previous case, private monopoly was used in the private duopoly estimations and public monopoly was used in the public-private duopoly estimation. Again, the qualitative results did not change when we used private monopoly in both sample.

[21] As in the previous case we divided population by 100,000. So, a monopoly threshold of 0.047 means a minimum population of 4,700 inhabitants.

Table 19: Minimum scale of population, trimming the bottom and top 10%

	Only private banks	Towns with public banks
s_1	0.032	0.037
s_2	0.044	0.029
s_2/s_1	1.36	0.78

Source: Banco Central do Brasil e 2000 Census. Ordered probit estimates of the model (11), robust *t-statistics*

Again, these three tables show the robustness of our results: the minimum efficient scale after a private bank entry is larger than the public bank entry as is larger the difference between monopoly and duopoly scales, i.e., the entry effect.

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.

References

Ahlin, Christian and Robert Townsend, "Using Repayment data to test across models of joint liability lending", Working paper available at http://www.src.uchicago.edu/users/robt/workingpaper/repaypuby.pdf, 2003.

Berry, Steven T. , "Estimation of a model of entry in the airline industry," Econometrica, 60(4):889–917, July 1992.

Berry, Steven T. and Elie Tamer, "Identification in models of oligopoly entry", in Advances in Economics and Econometrics: Theory and Applications, Ninth World Congress, vol. 2, R. Blundell, W. K. Newey and T. Persson, eds., Cambridge Univ. Press, 2007.

Bresnahan, Timothy and Peter Reiss, "Entry in Monopoly Markets", *The Review of Economic Studies*, Vol. 57, pp. 531-53, 1990.

Bresnahan, Timothy and Peter Reiss, “Entry and Competition in Concentrated Markets”, *The Journal of Political Economy*, Vol. 99, No. 5, pp. 977-1009, 1991.

Ciliberto, F. and Elie Tamer, “Market Structure and Multiple Equilibria in Airline Markets”, (pdf), March 2006.

Crump, Richard, Joseph Hotz, Guido Imbens and Oscar Mitnik, “Moving the Goalpost: Addressing Limited Overlap in Estimation of Average Treament Effects by Changing the Estimand”, IZA Discussion Paper No. 2347, 2007.

Gorton, Gary and Andrew Winton, “Financial Intermediation”, in Handbook of the Economics of Finance, eds. George Constantinides, Milton Harris and Rene Stulz, Amsterdam: North Holland, 2002.

Mazzeo, Michael J., “Product choice and oligopoly market structure,” RAND Journal of Economics, 33(2):221–242, 2002.

La Porta, Rafael, Florencio Lopez-de-Silanes and Andrew Shleifer, “Government ownership of banks,” *The Journal of Finance*, vol. 57,No. 1, pp. 265-301, 2002.

Panizza, Ugo, Eduardo Levy-Yeyati and A. Micco, “Should government be in the banking business? The role of public and development banks”, in Unlocking credit: the quest for deep and stable lending, The John Hopkins University Press, 2004.

Seim, Katja, “An empirical model of firm entry with endogenous product-type choices”,(pdf), April 2002.

Tamer, Elie. “Incomplete simultaneous discrete response models with multiple equilibria”, Review of Economic Studies, 70:147–165, 2003.

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