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PUBLIC BANKS AND BANKING COMPETITION

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ABSTRACT: How margins of private banks are affected by public banks' conduct is a relevant question for both competition policy and credit market development in emerging economies. In this article, this question is addressed using an exogenous variation on the conduct of public banks between 2008 and 2015 when a pro-state government implemented a broad counter-cyclical policy in Brazil on major credit lines financed by the National Development Bank (BNDES). Given this event, we estimate the best reply function of private banks in a mixed oligopolistic market structure where private and public firms differ in their objective function. Using a detailed data set from a large BNDES credit line, in a dynamic panel data, results point to a significant but low reaction of private financial institutions. In the long run, a private bank's margin is reduced by 0.03 p.p for 1 p.p lower final interest rate set by state-owned institutions. In this sense, the reduction in margins observed between 2008-2014 is more associated with a lower subsidized funding cost.

KEYWORDS: Banking; margins; competition; mixed oligopoly.

JEL CODES: L13; D22; C23; G21

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BANCOS PÚBLICOS E COMPETIÇÃO BANCÁRIA

RESUMO: Como as margens de bancos privados são afetadas pela conduta de bancos públicos é uma questão relevante tanto para a política de defesa da concorrência quanto para o desenvolvimento de mercados de crédito em economias emergentes. Neste artigo, esta questão é abordada usando uma variação exógena na conduta de bancos estatais entre 2008 e 2015, quando um governo mais intervencionista implementou uma ampla política anticíclica em grandes linhas de crédito ofertadas pelo Banco Nacional de Desenvolvimento Econômico e Social (BNDES). A partir deste evento, é estimada uma função de melhor resposta para bancos privados derivada em um modelo de competição oligopolística mista, onde firmas públicas e privadas diferem em suas funções objetivo. Usando uma base de dados de operações de crédito realizadas pelo BNDES a partir de intermediários financeiros, resultados para modelos dinâmicos em painel apontam para uma baixa reação de instituições privadas à conduta das estatais. No longo prazo, foi estimada uma redução nas margens dos bancos privados de 0.03 p.p para uma redução 1 p.p nas taxas definidas por bancos públicos. Neste sentido, a redução observada nas margens que ocorreu entre 2008 e 2014 está possivelmente associada a um custo para o financiamento dos intermediários financeiros mais baixo.

PALAVRAS-CHAVE: Sistema bancário; margens; competição; oligopólio misto.

INTRODUCTION

Although concentration and high final interest rates for consumers and firms are not sufficient conditions for a low rivalry between financial institutions, they both attract public attention and motivate reforms, thus enhancing competition in the banking industry. Brazil has a concentrated market structure: four banks – two private and two state-owned – hold more than 75% of loan credit operations in the country (BCB, 2017). Besides, banking profitability is high compared with other emerging markets and it is inelastic to the economic cycle (BRAZIL'S…, 2018). Finally, there is a public view according to which the final interest rates set by the banks do not seem to react to the lower base interest rate set by the Central Bank and the presence of two big state-owned institutions does not mean different credit supply conditions under what would be with private banks. Given this scenario, the role of state-owned banks in the credit market is at the center of the competition policy debate in Brazil.

In stagnation since 2015, the country has had one of the lowest investment rates among emerging markets (THE WORLD BANK, 2018). Thus, policies designed to get a more competitive credit market are a focal point of supply-side reforms that have been proposed in the last years (Agenda BC+). As we know, a poorly developed capital market restricts economic development (RAJAN; ZINGALES, 1998). In addition, market failures in banking affect social optimal credit supply, placing a social burden on firms and consumers (ARISS, 2010; AGORAKI; DELIS; PASIOURAS, 2011; BECK; DEMIRGUC-KUNT, 2006; CARBÓ-VALVERDE; RODRÍGUEZ-FERNÁNDEZ; UDELL, 2006). In this sense, a pro view for public banks has been pointed out for potential attenuation of credit supply restrictions through direct or indirect funding (GREENWALD; STIGLITZ, 1993; HERMANN, 2011; STIGLITZ, 1994). The question of whether this is occurring or not remains open, with different answers in the literature. On one side, state-owned banks are associated with poor performance when compared with private ones. This line emphasizes factors such as corruption and elite capture in underdevelopment countries with weak institutions and high political instability (GAO *et al.*, 2019; HAWKINS; MIHALJEK, 2001; LA PORTA; LOPEZ-DE-SILANES; SHLEIFER, 2002; SAPIENZA, 2004). However, there is evidence supporting an active role for public banks at least as a counter-cyclical instrument in financial crises (BEHR; FOOS; NORDEN, 2015; BREI; SCHCLAREK, 2013; COLEMAN; FELER, 2015; CULL; PERIA; VERRIER, 2017; MICCO; PANIZZA, 2006).

In addition, state-owned banks' influence on banking competition is also a broad topic in industrial economics. This came from the idea that regulation policy could use public firms to induce changes in market outcomes in a specific industry. Given that public firms have a different maximization function than private ones, in an oligopolistic

market structure, the government could act as an enhancer for competition, expanding consumer surplus and restricting market power. For this market structure, strategic interaction between public banks and private ones has been modeled as a mixed oligopoly (BARROS; MODESTO, 1999; BEATO; MAS-COLELL, 1984; BREI; SCHCLAREK, 2013; CREMER; MARCHANS; THISSE, 1989; FRAJA; DELBONO, 1989; OGURA, 2018). In this line, given a private institution's best reply function, state-owned banks could change quantity and prices on credit market equilibrium with a different objective function.

In applied literature, for Switzerland, Bichsel (2006) did not find any evidence that interest rates set by private banks are influenced by state-owned rates. For Brazil, Coelho, Mello and Rezende (2013) studied isolated local markets and did not find evidence that state-owned banks' entry influences rivals' conduct. Finally, Sanches, Silva Jr. and Srisuma (2018) showed negative effects on the numbers of bank branches in isolated markets, considering scenarios of privatization or closure of a public bank.

In general, credible evidence for public banks' conduct causality on final interest rates set by private institutions is scarce given the difficulty to find an exogenous variation in the market structure on banking. This article used an exogenous conduct variation created by the biggest state-owned bank (Banco do Brasil – BB) on a significant credit line (BNDES Automático) for small and medium firms. This institution was used as a counter-cyclical instrument after the 2008 crisis, via broad credit lines for firms and consumers. BB was the main player on the credit lines made available by BNDES until 2014. However, in line with austerity policy – that began that year and was amplified later – and conservative fiscal conduct by the government after 2015, BB has reduced its activities as a BNDES's player and in some lines – BNDES Automático – the market share has dropped to almost zero.

That brings the question of whether the exogenous change in BB conduct after 2008 and before 2015 affected the final interest rate set by private institutions on the market equilibrium or if it was perceived by rivals as just a non-permanent policy whose aim was just to expand loan operations at a subsidized rate for consumers and firms.

In this scenario, I estimate the impact of public banks on interest rates set by private banks using this change in conduct in a model of mixed oligopolistic competition. Considering dynamic panel data, results point to a significant but low influence of public banks on private rivals' conduct. These results are presented in detail in section 6. Before, I give a general view of the institutional design of the Brazilian credit market financed by BNDES, the emergence of a public policy to use a state-owned bank in a broad manner between 2008 and 2014, and its end with the new fiscal conservative government. Then, I present a simple model of strategic interaction between public and private banks to rationalize the events that occurred in the market. Finally, based on an

identified assumption of an exogenous change in state-owned banks' conduct, I estimate a private bank's best reply function. The main results and some cautionary recommendations for competition policy on banking are presented in the conclusion.

1. INSTITUTIONAL SETTING

Brazil has many state-owned financial institutions. Banco do Brasil (BB), for example, is a bank with 54% of the shares owned the Federal Government. It is the largest bank in the country in terms of branches and total assets, having credit for the industry as one of its main activities. Caixa Econômica Federal (CEF), another federal bank, is a leader in the savings market and in real estate credit operations. BB and CEF are the two main public banks in the country with a wide range of activities (commercial, investments, savings).

In addition, given a poorly developed capital market, each state has specific agencies for development (*agências de fomento*). They act mainly as intermediaries to receive funding from the National Development Bank (BNDES) in specific investment projects related to infrastructure, public transportation, and innovation. Some regions have significant (in terms of market share in some credit lines) financial institutions controlled by local governments. This is the case with the Regional Development Bank of Extreme South (BRDE) and Northeast Bank (BNB).

Finally, also controlled by the federal government, BNDES was one of the largest development banks in the world, with assets reaching nearly 400 million USD in early 2010 (BNDES, 2011), even bigger than the World Bank at that time. It accounted for 20% of total investment funding in the Brazilian economy and more than 50% of machine and equipment sector outlays[1].

BNDES funding comes from a labor tax severance payment fund, complemented, eventually by Brazilian Treasury funding (BNDES, 2022a). Capital goods must meet local content requirements and are priced and offered independently by financial intermediaries. Banks pay a fixed funding rate to BNDES. These rates vary by the type of good financed and the loan taker size and sector, but not by the bank. Banks are free to set their loan rates but bear the risk of default. At the same time, the funding is not offered to banks to prepare loans. The banks act only as financial intermediaries for the BNDES credit products. Funding for credit is provided on a stand-by basis and it appears on the bank balance sheet only after the loan contract is signed. All bank loans using

[1] The information in this section is available at the BNDES (2022a), Ribeiro (2017), and Ribeiro and Negri (2009).

BNDES funding must follow BNDES guidelines. To a large extent, the funding from BNDES is not fungible with other funding lines and cannot be used to leverage loans in the own bank credit products.

Until 2018, the rate for BNDES credit operations was subsidized concerning market funding rates. As we can see in Figure 2, there is a significant difference between the interest rate set by BNDES (TJLP) and the base rate set by Central Bank that benchmarks inter-bank loans and public debt interests.

The BNDES funding cost to capital goods loans through financial intermediaries, TJLP, was set by the government in a committee led by the Finance Ministry and the Development Ministry until the end of 2017[2]. Its goals were to provide low and stable interest rates for domestic capital goods sector development.

After the 2008 crisis, all these state-owned institutions were used as a counter-cyclical instrument. This was publicly announced, and the government acted directly to expand credit operations and prevent a bigger downturn in credit markets as private institutions were turning more precautionary after the massive insolvency crisis in developed markets. BNDES was the main player in this respect with broad subsidized credit lines. Also, BB and CEF played a significant role in using BNDES funding and other federal government financial support[3]. In summary, this broad credit expansion was made possible through huge funding from the National Treasury and it was maintained until 2015. In a political turnover, this policy came officially to an end in 2017 in line with a more fiscally conservative government. Since 2018, except for a transition period, there is no difference between the funding cost fluctuation from BNDES and the base rate, i.e, there is no subsidized rate; besides, state-owned institutions have begun to pay the loans taken from the Treasury since 2008.

2. MODEL

Market structure is based on strategic interaction between public banks and private ones in a simple version of a mixed oligopoly (BARROS; MODESTO, 1999; BREI; SCHCLAREK, 2013; FRAJA; DELBONO, 1989; OGURA, 2018). We have a market with public institutions (np) and private ones (p) competing in prices (r) on a major BNDES credit line. Private institutions seek to maximize a standard profit function. State-owned

[2] TJLP existed until the end of 2017. In line with pro-market reforms, the government designed a new rate for BNDES, TLP, more aligned with the basic interest rate to end subsidized credit operations (BRASIL, 2017).

[3] For a detailed overview of this period see Ferraz and Coutinho (2019), Ferraz, Além and Madeira (2013), Barbosa (2011), Ipea (2011).

banks are subjected to a parameter set by the government (θ): the public institution maximizes a linear combination of margins and revenues[4].

As we explained in the last section, the credit line funding by BNDES is a separate component of the bank's assets. Given this, it is possible to write the profit function considering only the loan operation on this credit market.

Specifically, for private banks:

$$\pi_p = [r_p - \overline{r}]d_p - F_p \qquad \textbf{(1)}$$

In (1), r_p is the final rate, $\overline{r}$ is the funding cost that banks must pay to BNDES and $F_{p,}$ a fixed cost component. For public ones, given θ,

$$\pi_{np} = [r_{np} - \overline{r}]d_{np} + \theta r_{np} d_{np} - F_{np} \qquad \textbf{(2)}$$

In the last stage, $n-1$ private bank and 1 public choose prices simultaneously, given a demand d_i a la Dixit (1979):

$$d_i = a_i - \beta_i r_i + \beta \sum_{j \neq i} r_j \qquad \textbf{(3)}$$

Note that we are considering the same cross-elasticity between banks. Using the first-order condition for a public bank, we can get its best reply function:

$$r_{np} = \frac{a_{np}}{2\beta_{np}} + \frac{\beta}{2\beta_{np}} \sum_j r_j + \frac{1}{2(1+\theta)} \overline{r} \qquad \textbf{(4)}$$

And for the private bank:

$$r_p = \frac{a_p}{2\beta_p} + \frac{\beta}{2\beta_p} \sum_j r_j + \frac{1}{2} \overline{r} \qquad \textbf{(5)}$$

Note that θ is not an argument for the best reply function for private banks.

We can get a view of the influence of θ on market equilibrium in Figure 1. In E_0 we have the classical outcome for equilibrium on a differentiated market with all firms with the same profit function. However, the government could use public banks to reduce the equilibrium rate by setting a $\theta > 0$. In practice, this means an incentive for the public bank to expand its loan operations more than it would do with a typical profit function. As we can see, E_1 means a lower final interest rate for consumers.

[4] Over the period from 2008 until 2014, anecdotal evidence suggest that public banks had disbursement targets. This is line with an objective function as it is considered in this model.

Finally, we can rewrite the best reply function in the more conventional way, where I_{np} is equal to one when i is a public bank and zero otherwise:

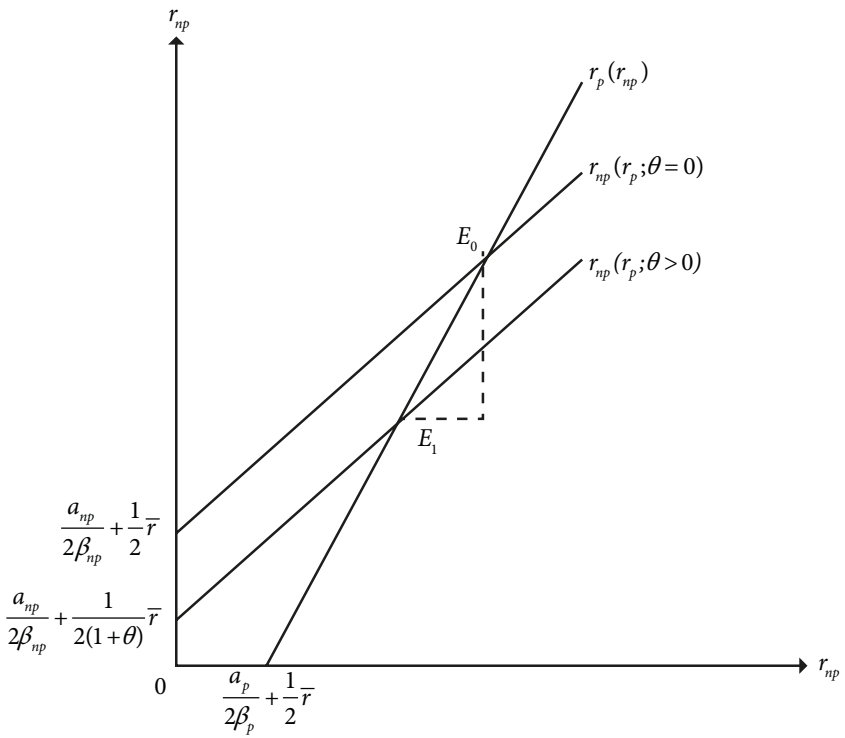
$$r_i - \frac{1}{2}\overline{r} = \frac{a_i}{2\beta_i} + \frac{\beta}{2\beta_i}\sum_{j \neq i} r_j - I_{np}\frac{\theta}{2}\overline{r} \;\forall i \qquad \textbf{(6)}$$

Given an exogenous change on θ we can identify the best reply function of non-private banks on this market.

As we have pointed out before, BB was one of the main intermediaries of BNDES in a specific credit line for machinery acquisition and plant expansion (BNDES Automático).

In this sense, we use an exogenous change set by the federal government on the conduct of non-private banks – mainly on BB – between 2008 and 2014 with a broader permissive policy on loan operations in line with an anti-cyclical macroeconomic policy. In terms of our model, that means a change in the intercept of the non-private bank best reply function (a greater θ). Using this variation, we can estimate the response of private banks. Specifically, the inclination of rp(r_{np}) given by the dashed triangle in Figure 1.

Figure 1 – Nash Equilibrium



Source: Author's own elaboration.

3. EMPIRICAL MODEL

We motivate the empirical relationship using equation (5). Also, we consider a two-step procedure, where the optimal loan rates are adjusted over time under quadratic adjustment costs as in the labor demand and investment literature (BOND; REENEN, 2007), yielding a dynamic model of loan spreads. The same dynamic specification is seen in Almarzoqi and Naceur (2015), Maudos and Solís (2009), Turgutlu (2010). This is also consistent with margins persistence over time. Finally, as we are considering small and medium firms, the relevant market for BNDES credit lines is defined as the region from the bank[5]. We index the market by *s*. In summary, for private banks we have:

$$r_{i,s,t} - \frac{1}{2}\overline{r}_t = \delta_p (r_{i,s,t-1} - \frac{1}{2}\overline{r}_{t-1}) + \phi_{i,s} + \beta_{p,0} \sum_{j \neq i} r_{j,s,t} + \beta_{p,i} \sum_{j \neq i} r_{j\,s,t-1} + \alpha_p X_{t,s} + \in^{p}_{i,s,t} \qquad (7)$$

On the left-hand side, we have the adjusted (average) spread for bank i in the regional market s in t given by $r_{i,s,t} - \frac{1}{2}\overline{r}_t$. On the right side, we add a lag of the dependent variable to consider the adjustment of the loan rates over time. Our main goal is to identify the coefficients that capture the effect of a change on loan rates set by state banks. However, $\sum_{j \neq i} r_{j,s,t}$, the sum of rivals (private and state-owned) loan rates on the same markets in t, is endogenous since $r_{j,s,t}$ is a function of $r_{i,s,t}$ as we can see on the model in the last section. At the same time, part of $\sum_{j \neq i} r_{j,s,t}$ depends specifically on the best reply function of non-private banks. Our strategy is to capture an exogenous change of $\sum_{j \neq i} r_{j,s,t}$ set by the federal government when the conduct (θ) of public banks changed between 2008 and 2014. Our exogenous assumption for this intervention enables us to use this period of treatment as a valid instrument. We argue that it seems more a broad macroeconomic policy to prevent a bigger downturn after 2008 and a state-oriented policy to public banks to subsidized credit from 2008q4 until 2014q4. As DT is a dummy variable for this period, it is regarded as independent of the idiosyncratic error term on Equation 8: $E[\in^{p}_{i,s,t} | D_t] = 0$. As illustrated in Figure 1, θ entry directly on the best reply function of non-private banks and the market rate equilibrium is a decreasing function of this parameter in a differentiated Bertrand competition. In this sense, as expected, between 2008 and 2014, θ is greater than before and after this period. Our main assumption is that between 2008q4 and 2014q4 the policy implemented changed this parameter causing an exogenous variation on the best reply function of non-private banks.

[5] For a discussion if the relevant market for financial services is national, state or local, see Cade (2019). Our results are not sensible to this definition. We choose region and sate mainly to highlight some market structure differences between these regions with strong local development banks as South and others with basically no significant development banks as São Paulo.

Also, in equation (7), we add a matrix X to account for an observable demand shock proxied by the Industrial Production Index (PIM) and one lag for region s in t.

For the first stage, the following model is considered for each I on the set of private banks:

$$\sum_{j\neq i} r_{j,s,t} = c+\omega DT_t + X_t + \eta_{i,s,t} \quad \textbf{(8)}$$

Given the assumption that these instruments (DT_t and X_t) are exogenous on the structural model, the fitted values estimated by the equation (8) represent only the variation on $\sum_{j\neq i} r_{j,s,t}$ that was caused by the public banks conduct variation. Back to the equation (7), with this approach it's possible to identify the effect of public bank conduct on spreads set by private banks given by the long run multiplier $\frac{\beta_{p,0}+\beta_{p,1}}{1-\delta_p}$. Consider $\frac{\beta_{p,0}+\beta_{p,1}}{1-\delta_p}>0$, for example. In this case, it would mean that a negative shock on final interest rates set by public banks reduces private margins equilibrium – on the long run– as it can be seen in Figure 1.

Although we could potentially use a fixed or random effect instrumental variable estimator for panel data, the presence of a lagged dependent variable makes standard estimators inconsistent because there is, by construction, a correlation between unobserved effects and the lagged dependent variable. In this case, we have $E[\in^p_{i,s,t} | X_{i,st}] \neq 0$. Therefore, to circumvent the problem posed by the lagged margin, we use a GMM estimator for dynamic panel data (ARELLANO; BOND, 1991; ARELLANO; BOVER, 1995) with standard error estimated by Windmeijer (2005) adjustment to correct for small sample bias.

4. DATA

BNDES operates with primary responsibility for funding capital goods investments through financial intermediaries and directly channeling larger financial injections to infrastructure companies and projects. In terms of its portfolio composition, the separation between direct and indirect operations is approximately 50% for each modality (BNDES, 2022a) as was mentioned before. Credit lines on the indirect operation segment are associated with a (subsidized) funding cost set by the Government called TJLP.

Information on TJLP and indirect BNDES operations is provided through its Download Center, which contains data on the date, location, value, interest rates, spreads, and final cost to borrowers under each contract executed between intermediaries and customers. There are two main funding lines (BNDES Finame and BNDES Automático) that represent 84% of all operations pegged to the funding cost set by the Government, represented in the model by $\overline{r_t}$, the rate set exogenously to all banks in the period

between 2002-2017. BNDES Automático is a "funding through authorized financial institution intermediaries for investment in acquisition, expansion, and recuperation of fixed assets, RD projects in Industry, Commerce, Services, Agricultural, Forest Production, and Fishing" (BNDES, 2022b); BNDES Finame is a "funding through authorized financial institution intermediaries, for production and acquisition of new computer and automation machinery, equipment and goods, made in national manufacture and certified by BNDES" (BNDES, 2022c). Here, the information is considered for the period between January 2002 until December 2017.

It's important to note that between 2008q4 and 2013q4, the margins of all credit operation in BNDES Finame and for all financial intermediaries were set at 3% and 1.7% for large and non-large companies. In this sense, there is no price decision for the banks (RIBEIRO, 2018). Given this we are only considering here the main credit line that was not directly affected by this policy, BNDES Automático.

Based on the detail loan data for BNDES Automático, we calculated the market share of each bank in each period (month) and in each regional market considering indirect operations pegged to the funding cost set by the Government (TJLP). For a market structure proxy, the Herfindahl-Hirschman index (HHi) was obtained by the sum of the square of the market share for each bank in each regional market.

Using the data base, we also calculated the monthly bank-level spreads given by a weighted average of all credit operation for each bank in each region and in each month with weights given by the value of the loan. To consider a control for economic cycle for each region, we used the regional industrial production index (PIM) which was mainly affected by the downturn of 2008 and the stagnation beginning at the end of 2014. Information is available on IBGE Time Series Data Base.

Finally, we aggregate the monthly spread data to quarterly data, in order to control for quarterly seasonality in the production index time series in the models estimated.

5. RESULTS

There is a large regional concentration of credit operations with the South states (Rio Grande do Sul, Santa Catarina and Paraná) with 37% and São Paulo with 20% of all credit operation on BNDES Automático along the period considered (2002q1-2017q4). Table 1 provides some descriptive statistics for the monthly variables considering the pooling data for the two main regional markets (South and São Paulo) that accounts for more than 50% of the credit line. Over the period (2002-2017), note that the sum of the average spread and the (funding cost) TJLP, the approximate average final price assessed to the borrower, is 12.9%. This high final interest rate, even with subsidized

funding cost, brings attention to competition between banks in the Brazilian credit market. The subsidy can be seen on Figure 1 with TJLP below the base rate set by the Central Bank all over the period. After the 2008q3 crisis and until the end of 2013, the TJLP remained at its historical minimum, illustrating one of the instruments used by the government to contain the effects on domestic investment.

Figures 5 and 6 shows the spreads for the Top 4 financial institutions in each region considered. The spreads of Banco do Brasil and its rivals do not have a clear relationship. Although, in fact, in the intervention period, the average rates are lower for all banks, it is not possible to visualize a direct relationship between the spreads of a state-owned bank and the spreads of a private bank.

Note that the market concentration and Hhi has a peak of 70% and 0.52 respectively, as shown on Table 1. This occurred in 2012 when BB was responsible for more than 2/3 of all operations in this credit line (BNDES Automático) along the year. To see the evolution for the Top 4 Banks in each regional market, Figure 4 and 5 plot the market share series. Note that, in both regions, the growth of 2017's market share was remarkable in the period under intervention by the government after 2008's crisis. In SP, the main rivals of the state bank are the private banks: Itau, Santander and Bradesco. In this case, the growth of the BB market share is associated with a drop in the participation of these private banks.

On the other hand, in the South region, there is a significant presence of other state-owned banks, such as BRDE and BADESUL. Thus, in this market, BB's main rivals, in addition to the private bank Itau, are the state-owned banks BRDE and BADESUL

We can get a view of the differences in the market structure before and after the period of intervention by the federal government through the expansion of public banks in Tables 2- 7. DT is defined as a dummy variable for the period of 2008q3-2013q4. Out of DT, the average margin was 6.36. In this period, it reduced to 5.12. Also, public banks had a greater average margin than private ones. When the policy was implemented, the margin of public banks dropped from 6.36 to 5.12. In the same period, private bank's margins dropped from 6.0 to 5.0. The funding cost (TJLP) came from 8.6 to 5.7.

Table 1 – Descriptive Statistics: BNDES Automático, 2002-2017

	Spread	TJLP	Market Share	Hhi	Industrial Production Index (PIM)
Mean	5.65	7.25	0.08	0.23	5.11
Standard Deviation	2.14	1.94	0.11	0.08	0.55
Min	1.46	5	0	0.13	4.32
Max	19	12	0.70	0.52	5.79
N	1624	1624	1624	1624	1624

Note: First column is Bank's margin in loan operation on BNDES Automático. TJLP is the funding cost from BNDES. Hhi is the Herfindahl-Hirschman Index.

Source: Author's elaboration based on BNDES (2019).

Table 2 – Margins: state banks in and out of period (DT)

DT	Mean	Standard Deviation	N
0	6.36	2.18	283
1	5.12	1.23	236

Note: DT is defined as a dummy variable for the period of 2008Q3-2013Q4.

Source: Author's elaboration based on BNDES (2019).

Table 3 – Margins: private banks in and out of period (DT)

DT	Mean	Standard Deviation	N
0	6.0	2.46	586
1	5.0	1.83	519

Note: DT is defined as a dummy variable for the period of 2008Q3-2013Q4.

Source: Author's elaboration based on BNDES (2019).

Table 4 – TJLP: in and out of period (DT)

DT	Mean	Standard Deviation	N
0	8.6	1.78	869
1	5.7	0.48	755

Note: DT is defined as a dummy variable for the period of 2008Q3-2013Q4.

Source: Author's elaboration based on BNDES (2019).

Specifically, for BB, the average market share tripled between 2008 and 2014, as we can see in Table 5. Therefore, it is not a surprise that Hhi increased on the market. In Figures 3 and 4, BB's market share grew in a significant way between 2008 and 2014, peaking in 2012. In both regions considered, BB became the leader. Note, however, that South has shared this position before 2008 with BRDE, another state-owned institution. Our main variation came from São Paulo where before and after the period 2008-2014, BB shared this position with private banks – Itau, Bradesco, and Santander.

As we stated before, the main question of this article is that whether the change in public banks' conduct causes the change on private banks' final rate observed over this period, conditioned to the funding cost. For the estimation, we have an unbalanced panel data of 87 banks along the period from Q1-2002 until Q4-2017.

We estimate the response from private banks to an exogenous variation that occurred after 2008 crisis as a broad countercyclical policy implemented by the Government. As pointed out on the last section, we capture the effect of this exogenous change on the market equilibrium using the period of the policy shock as an instrument for the endogenous dependent variable on Equation 7 given by $\sum_{j \neq i} r_{j,s,t}$ and its lag. The response of this policy change on private spreads is captured by the coefficients $\beta_{p,0}$ and $\beta_{p,1}$ on Equation 7, considering the predicted values of $\sum_{j \neq i} r_{j,s,t}$ on the first stage estimate using

the Equation 8. Back to Equation 7, the long run response of private banks spread to a change in 1 p.p on the spreads of public banks is given by $\frac{\beta_{p,0}+\beta_{p,1}}{1-\delta_p}$.

In this sense, our baseline approach was to use the period of intervention (DT, dummy variable for 2008q3-2013q4) as an instrument to the non-private component of $\sum_{j\neq i} r_{j,s,t}$ in our model of the last section. In the case of the Fixed Effect of estimator, as a check for the quality of our instruments (IV), we considered the first stage regression for the FE-IV Model to test that endogenous regressors are unidentified (SANDERSON; WINDMEIJER, 2016). As we can see, we reject the null given an F statistics of 7.91 for the sample period between 2002 to 2017 in Table 8 and 25.64 for the restricted one in Table 9. Considering this model, for the private banks margin we have a drop of 0.11 p.p on the short run and an increase of 0.16 [(0.11-0.14)/(1-0.81)] in the long run for an increase in 1 p.p on rivals rate. It's important to note that this result is biased, given OLS and fixed effect instrumental variable estimators both suffer from bias on standard errors of the estimate parameters.

Table 5 – Market share: Banco do Brasil in and out of period (DT)

DT	Mean	Standard Deviation	N
0	0.13	0.06	71
1	0.30	0.15	56

Note: DT is defined as a dummy variable for the period of 2008Q3-2013Q4.

Source: Author's elaboration based on BNDES (2019).

Table 6 – Margin: Banco do Brasil in and out of period (DT)

DT	Mean	Standard Deviation	N
0	6.98	3.03	71
1	4.99	1.58	56

Note: DT is defined as a dummy variable for the period of 2008Q3-2013Q4.

Source: Author's elaboration based on BNDES (2019).

Table 7 – HHi: in and out of period (DT)

DT	Mean	Standard Deviation	N
0	0.23	0.08	869
1	0.25	0.06	755

Note: DT is defined as a dummy variable for the period of 2008Q3-2013Q4.

Source: Author's elaboration based on BNDES (2019).

In this sense, in Table 8, we also show the GMM Two-Step estimator as our benchmark given the problems posed by the lagged dependent variable and the endogeneity of $\sum_{j\neq i} r_{j,s,t}$. The two-step estimator is less restricted for the error variance structure than

the one-step estimator on the third column. As in the case of FE-IV, GMM also points to the significant but low impact of public banks on the final margins of private banks (our dependent variable as stated in the last section), but with a different sign on the long run. Specifically, as we can see in Table 8, for a 1 p.p drop on the final interest rate by the rivals, the two-step estimator gives a drop of 0.01 p.p on margins of private banks in the short run; in the long run, we have a coefficient of 0.03 [0.01/(1-0.62)].

A sensitivity analysis was conducted with a different instrument set specification in the GMM estimation. In Table 8 and Table 9, results were estimated under a restriction to three periods for lags in the instrument set. In Table 10, it's considered a restriction to 5 periods. Note that the estimate of the lagged dependent variable's coefficient is quite sensitive to the choice of lag length, but the coefficients for the rival's rate ($\sum_{j \neq i} r_{j,s,t}$) and the Industrial Production Rate show small variation when compared with the results from the Table 8.

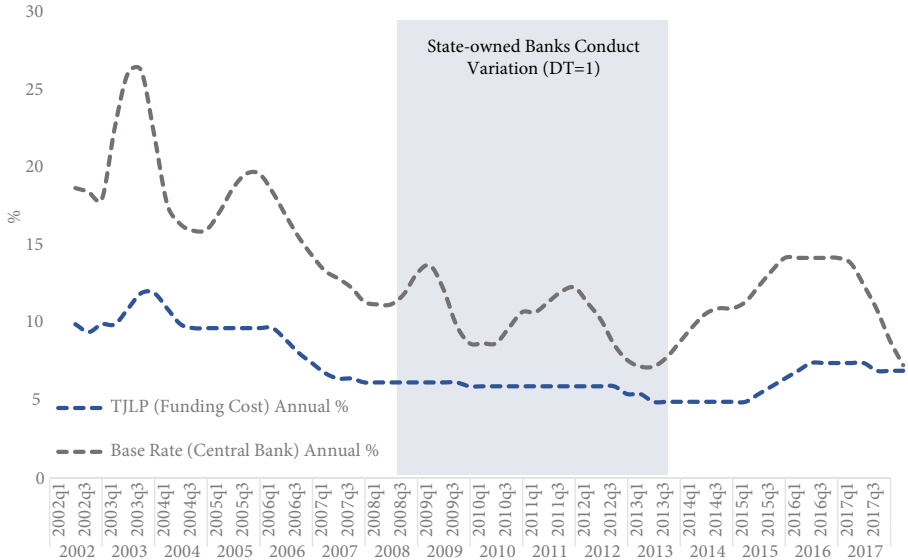
Following Roodman (2006), if the difference GMM-Diff estimated is close to or below the fixed effect estimate, this suggest that the former estimate is downward biased because of weak instruments and a system GMM estimator should be preferred instead. For the GMM-Diagnostics, we use two tests for instruments validity: Sargan-Hansen test of over-identifying restrictions (H0: instruments validity) and an autocorrelation/serial test for the error term in which the failure to reject the null hypothesis for the second order correlation means that the original error term is uncorrelated and the moment conditions are correctly specified (there is by construction a first order correlation on the error term).

The industrial production (PIM) coefficient in all models for the short and long run indicates a counter cycle margin that is in line with the previous find on other BNDES credit lines (CASTOR; RIBEIRO, 2018). Finally, note that the dummy variable for the abrupt change on BB margins after 2016q4 was not significant in any model as it was seen by the market as adjustment portfolio management set by the new government.

In summary, although we cannot discard the influence of public banks' conduct on rivals' responses, we found a low inclination of the best reply function of the private institutions. Besides, it is important to note that the drop in margins verified between 2008-2014 was mainly associated with the reduction of the funding cost (TJLP). The positive association between margins and cost funding is a result of an oligopolistic market and it was found in other credit lines (CASTOR; RIBEIRO, 2018; TURGUTLU, 2010).

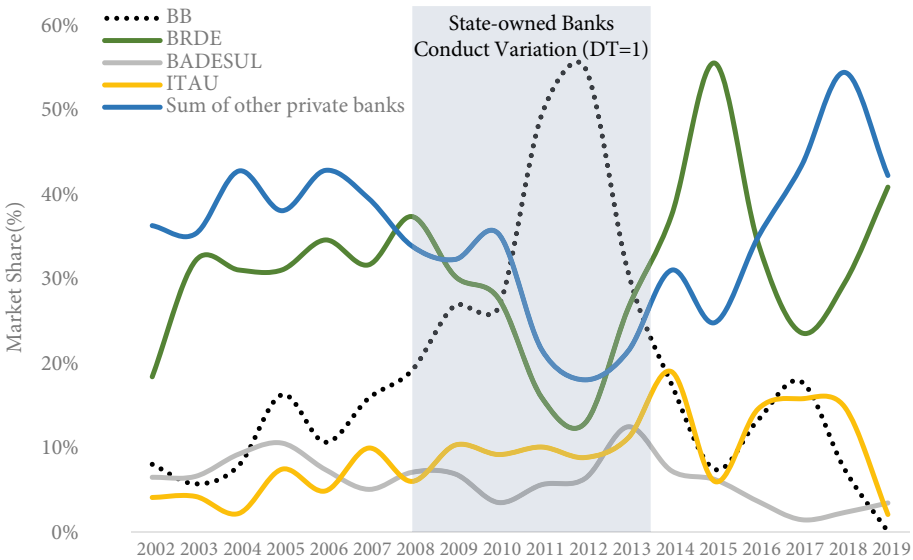
As a robustness check, we consider the sample only between 2008-2017. In this case, we have a more distinction between periods. From 2008 to 2014, a pro-state-owned bank role in the credit market becomes clear. The period from 2002 until 2007 is not clear as the other ones in terms of conduct by the public banks. In fact, in terms of the evolution of market share, they are stable in the two markets considered, as we can see in Figure 4-7. In any case, in general, the results in Table 9 are the same as before.

Figure 2 – TJLP (funding cost) and base rate, 2002-2017



Source: Author's elaboration based on time series for TJLP and the Base Rate available on Ipea (2019).

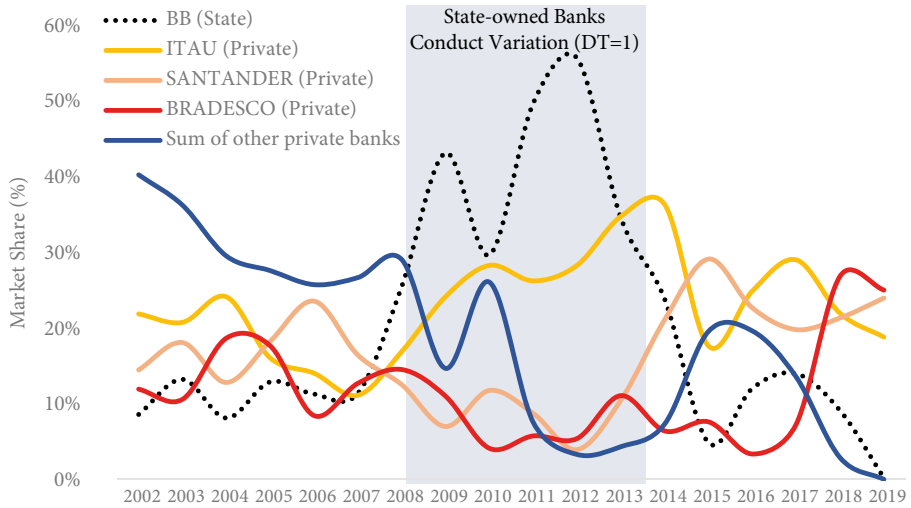
Figure 3: Market Share on South Region, 2002-2017



Note: For a more suitable visualization, we consider average annual market share for the Top 4: BB, BRDE, BADESUL and Itau. Blue Line is the market share sum of the others private banks.

Source: Author's elaboration based on BNDES (2019).

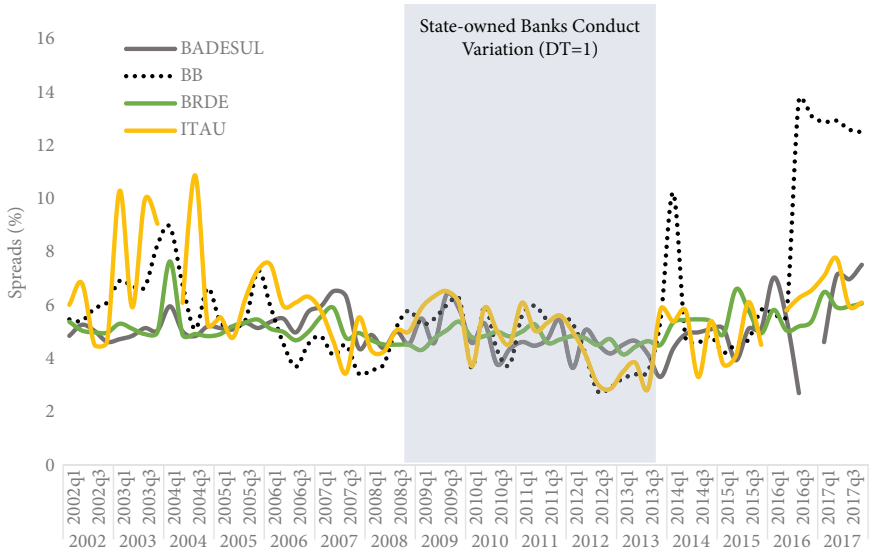
Figure 4 – Market share on São Paulo, 2002-2017



Note: For a more suitable visualization, we consider average annual market share for the Top 4: BB, ITAU, SANTANDER and BRADESCO. Blue Line is the market share sum of the others private banks.

Source: Author's elaboration based on BNDES (2019).

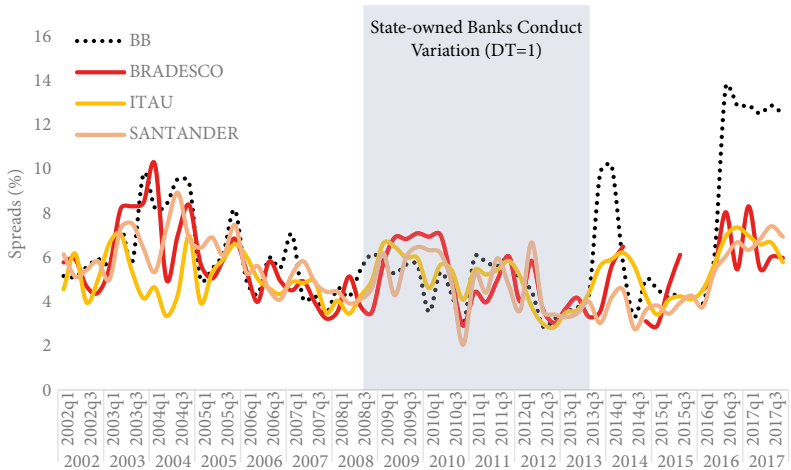
Figure 5 – Bank spreads on the South, 2002-2017



Note: "ES" after the bank's name stands for the local market considered. On the South market, on 2016q2, the average margin of BB was 5.6%. After this quarter, the average was 12.9%. This is in line with adjustment ("cleaning") on the portfolio made by the new government. We control for this variation using a dummy variable for this period.

Source: Author's elaboration based on BNDES (2019).

Figure 6 – Bank spreads margin on São Paulo, 2002-2017



Note: "SP" after the bank's name stands for the local market considered. On the São Paulo market, in 2015q4, BB did not make any loans on this credit line. This is in line with adjustment ("cleaning") on the portfolio made by the new government. We can see also a great positive variation after 2016q2 as occurred in the South region. We control for this variation using a dummy variable for this period.

Source: Author's elaboration based on BNDES (2019).

Table 8 – BNDES Automático: models, 2002-2017

Variable	OLS	FE-IV	SYS 1 GMM	SYS2 GMM
$Spread_{t-1}$	0.62***	0.81***	0.60***	0.62***
$\sum_{j \neq i} r_{j,s,t}$	0.01***	0.11**	0.01***	0.01**
$\sum_{j \neq i} r_{j,s,t-1}$	-0.00	-0.14**	-0.00	-0.00
$Production\ Index_{t}$	-4.42**	-13.17**	-4.58**	-4.49*
$Production\ Index_{t-1}$	4.26**	13.24**	4.16**	4.14*
Dummy 2016	-0.31	0.21	0.10	-0.17
Constant	7.26**	3.51***	2.87**	4.21***
N	809	686	686	686
T	64	60	60	60
R2	0.725			
Hansen-Sargan			33.53	33.53
AR(1) pvalue			0.001	0.001

(Cont.)

Table 8 – BNDES Automático: models, 2002-2017 (CONTINUATION)

Variable	OLS	FE-IV	SYS 1 GMM	SYS2 GMM
AR(2) pvalue			0.139	0.147
F-Statistics	195.658	156.179	136.86	48.01
First Stage F Test Sanderson-Windmeijer		7.91		

Note: *p<.1; **p<.05; ***p<.01. The two-step estimator (SYS 2 GMM) does not pose any restrictions on the error variance matrix. SYS 1 GMM imposes homoscedasticity. For the GMM estimation, for the instruments set, we restrict the maximum lags to three periods. AR(k) test for autocorrelation of residuals. Hansen's null hypothesis is the validity of over-identification of the restrictions. In all GMM models, this was not rejected. *Dum*2016 is a dummy variable for controlling the variation of margins after 2016q2 as we saw in the last section because of shrinking on BB activities on the credit market. In the Fixed Effect and GMM models, *DT* was used as an instrument.

Source: Author's own elaboration.

Table 9 – BNDES Automático: models, 2007-2017

Variable	OLS	FE-IV	SYS 1 GMM	SYS2 GMM
$Spread_{t-1}$	0.67***	0.76***	0.55***	0.52***
$\sum_{j \neq i} r_{j,s,t}$	0.01**	0.06*	0.01*	0.01*
$\sum_{j \neq i} r_{j,s,t-1}$	-0.01	-0.07**	-0.01	-0.01
$Production\ Index_{t}$	-2.25	-8.09*	-3.84**	-4.65*
$Production\ Index_{t-1}$	2.19	8.37	3.66**	4.71*
Dummy 2016	-0.24	0.80	0.85***	0.91**
Constant	4.41***	2.11***	4.91***	3.98
N	535	461	461	461
T	22	18	18	18
R2	0.673			
Hansen-Sargan			21.46	21.46
AR(1) pvalue			0.001	0.002
AR(2) pvalue			0.029	0.042
F-Statistics	195.658	156.179	166.20	48.01
First Stage F Test Sanderson-Windmeijert		25.64		

Note: *p<.1; **p<.05; ***p<.01. The two-step estimator (SYS 2 GMM) does not pose any restrictions on the error variance matrix. SYS 1 GMM imposes homoscedasticity. For the GMM estimation, for the instruments set, we restrict the maximum lags to three periods. AR(k) test for autocorrelation of residuals. Hansen's null hypothesis is the validity of over-identification of the restrictions. In all GMM models, this was not rejected. *Dum*2016 is a dummy variable for controlling the variation of margins after 2016q2 as we saw in the last section because of a shrinking on BB activities on the credit market. In the Fixed Effect and GMM models, *DT* was used as an instrument.

Source: Author's own elaboration.

Table 10 – BNDES Automático: models, sensitivity analysis, 2007-2017

Variable	SYS 1 GMM	SYS2 GMM
$Spread_{t-1}$	0.99***	0.98***
$\sum_{j \neq i} r_{j,s,t}$	0.01**	0.01*
$\sum_{j \neq i} r_{j,s,t-1}$	0.01	0.03
$Production\ Index_{t}$	-1.44**	-7.59**
$Production\ Index_{t-1}$	5.12**	1.20
Dummy 2016	1.05**	1.21**
Constant	1.71***	6.71
N	461	461
T	56	56
Hansen-Sargan	31.46	41.26
AR(1) pvalue	0.001	0.001
AR(2) pvalue	0.059	0.082
F-Statistics	258.20	79.01

Note: Sensitivity analysis was performed restricting the instruments set to include up to five lags.*p<.1; **p<.05; ***p<.01. The two-step estimator (SYS 2 GMM) does not pose any restrictions on the error variance matrix. SYS 1 GMM imposes homoscedasticity. For the GMM estimation, for the instruments set, we restrict the maximum lags to five periods. AR(k) test for autocorrelation of residuals. Hansen's null hypothesis is the validity of over-identification of the restrictions. In all GMM models, this was not rejected. *Dum*2016 is a dummy variable for controlling the variation of margins after 2016q2 as we saw in the last section because of a shrinking on BB activities on the credit market. In the Fixed Effect and GMM models, *DT* was used as an instrument.

Source: Author's elaboration.

CONCLUSION

The role played by public financial institutions is a broad topic on emerging economies, given a weak and non-developed capital market. In this scenario, few banks could exercise market power restricting the capital supply needed for higher investment rates and growth. In a more pro-intervention view, state-owned banks could potentially affect market equilibrium restricting inefficiencies generated by market failures. The point is how credible is the assumption of a significant reaction of private banks to changes on the conduct of policy motivated public ones.

This article estimates the response of private banks to changes in the conduct of state-owned banks in a differentiated oligopolistic market structure using an exogenous change set by the more pro-state government between 2008 and 2015 and the more conservative conduct posed after 2015. Given a broad policy that exogenously changes the role played by state-owned firms, we circumvent a major problem posed by

endogeneity issues when estimates best reply functions. Using a representative credit market (BNDES Automático), funding by BNDES, with detailed loan data, we applied a dynamic panel to test the predictions of our model of strategic interaction between public and private banks.

On average, conditional on the funding cost, private banks' margins drop 0.01 p.p in response to a reduction of 1 p.p on the final interest of public banks. In the long run, spreads reduce by 0.03 p.p. Although low, these estimates pose the possibility that state-owned institutions have a relevant role in banking competition, especially on a concentrated market structure. Our results are robust to change on sample period and the set controls used.

The open question is how efficient public banks are and what are the fiscal costs of a government policy that induces these institutions to act more aggressively on credit markets. In this sense, there may be a trade-off between this kind of policy with positive results on market competition and an unsustainable fiscal policy.

In general, this work is part of the debate related to the role played by the public banks in a turbulent period for the Brazilian economy. At the same time, discussion about this topic was absent on reforms (Agenda BC+, for example) proposed to get a more competitive credit market. In this case, policymakers tried to focus more on issues related to a more open financial market to fintech's, default registers, funding cost reduction through less capital taxation, and other supply-side proposals. On the other side, disregarding the relevance of public banks on competition seems exacerbated given the evidence available today.

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