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BANKING, COMPETITION AND INTEREST RATE POLICY: EVIDENCE FROM THE BRAZILIAN DEVELOPMENT BANK

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BANKING, COMPETITION AND INTEREST RATE POLICY: EVIDENCE FROM THE BRAZILIAN DEVELOPMENT BANK

Trabalho apresentado como requisito parcial para a obtenção do título de Doutor em Ciências Econômicas pelo Programa de Pós Graduação em Economia da Universidade Federal do Rio de Janeiro.

Supervisor: Eduardo Pontual Ribeiro

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2020

FOLHA DE APROVAÇÃO

KAMAIAJI DE SOUZA CASTOR

BANKING, COMPETITION AND INTEREST RATE POLICY: EVIDENCES FROM THE BRAZILIAN DEVELOPMENT BANK

Tese de Doutorado apresentada ao Programa de Pós-Graduação em Economia (PPGE), Instituto de Economia, Universidade Federal do Rio de Janeiro, como requisito parcial à obtenção do título de Doutor em Ciências Econômicas. Aprovada pela seguinte banca examinadora:

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A minha mãe, Maria, e a minha irmã, Maíra.

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"Estou falando de bancos, balanços, essas coisas que vocês nem dão bola" (Ignácio Rangel, segundo Maria da Conceição Tavares em Entrevista à Revista Ciência Hoje, Ed. Mar-Abril 1986.)

RESUMO

Os três ensaios desta tese consideram a formação de preço de bancos em um mercado de crédito representativo financiado pelo Banco Nacional de Desenvolvimento Econômico e Social (BNDES) para pequenas e médias firmas. São estimados os efeitos nas margens bancárias de fatores como taxa de juros de curto prazo estabelecida pelo Banco Central, *funding cost* do BNDES, conduta de bancos públicos e políticas de taxas de juros subsidiadas para empréstimos à indústria.

O primeiro ensaio estima a dinâmica das margens dos intermediários financeiros do BNDES em função de mudanças no *funding cost* em uma estrutura de mercado concentrada. Um problema central é a dificuldade de isolar o efeito cíclico de demanda causado pela taxa básica de juros determinada pelo Banco Central e o efeito causado por esta taxa nos custos de *funding* para as operações de empréstimos dos bancos. Para contornar este problema, usa-se o desenho institucional no Brasil onde uma parte significativa do mercado de crédito para aquisição de bens de capital e expansão de planta possuía um *funding cost* subsidiado e não relacionado na prática à taxa básica de juros definida pelo Banco Central. A partir de uma detalhada base de dados das operações indiretas do BNDES, é estimado um modelo dinâmico em painel para se isolar os efeitos de mudanças nos custos de funding e de choques na demanda por investimento. Resultados apontam que os spreads bancários são pró-cíclicos em relação à atividade econômica. Além disso, como esperado em um modelo oligopolístico para o mercado de crédito, as margens reagem de maneira significativa e positiva a mudanças na taxa de *funding* do BNDES. Por fim, há evidências de que uma maior concentração está associada a spreads mais elevados neste mercado.

O segundo ensaio estima como as margens de bancos privados são afetadas pela conduta de bancos públicos. Para tanto, considera-se uma mudança exógena na conduta de bancos públicos entre 2008 e 2015 quando um governo mais intervencionista implementou uma ampla política anti-cíclica em grandes linhas de crédito do BNDES financiadas pelo Tesouro. Neste cenário, identifica-se a função melhor resposta de bancos privados em um modelo de oligopólio misto no qual unidades privadas e públicas diferem pela função objetivo. Resultados de um modelo de painel dinâmico apontam para uma baixa mas significativa reação de bancos privados. No longo prazo, as margens destas instituições reduzem em 0.03 p.p para uma taxa de bancos públicos inferior em 1 p.p. Neste sentido, há evidências de que a redução observada nas margens dos bancos privados entre 2008 e 2015 foi em grande parte resultado de uma taxa subsidiada mais baixa praticada pelo BNDES.

O último ensaio descreve como as margens dos intermediários financeiros reagiram às mudanças na política de taxas de juros definida para o BNDES em 2017. A partir

de 2018, uma nova taxa (TLP), alinhada com o custo de captação de longo prazo do Tesouro, foi apresentada como uma forma de eliminar o subsídio criado pela TJLP que vigorava desde 1994. A eliminação deste subsídio criou uma oportunidade para analisar o comportamento da conduta de bancos em relação a políticas de subsídio de crédito em sentido amplo. Os dados para a principal linha de crédito do BNDES apontam que o *Price-Cost-Margin* dos intermediários teve um incremento significativo com a TLP. Em linha com o primeiro ensaio, também é estimado um modelo em painel dinâmico derivado de um oligopólio em quantidade no mercado de crédito, condicionado ao custo de *funding*, à taxa básica da economia e a choques de demanda setoriais. Para este caso, é encontrado um aumento de 0.7 p.p nas margens após a mudança na política. Finalmente, restrito ao período da TLP, o mesmo modelo é estimado e encontra-se um negativo coeficiente de reação das margens ao custo de *funding* assim como havia sido obtido para o coeficiente da taxa básica no modelo restrito ao período da TJLP. Este resultado está em linha com uma tradicional estrutura a termo em que a taxa de longo prazo reage positivamente a mudanças da taxa básica definida pelo Banco Central. Este é um novo resultado para o efeito de crédito subsidiado na dinâmica das margens bancárias condizente com margens financeiras contrabalanceando a política monetária em um cenário em que o custo de *funding* é totalmente dependente da taxa básica.

Palavras-chaves: Competição Bancária, Taxas de Juros, Crédito, Subsídio

ABSTRACT

The three essays of this thesis consider the banking price formation in a representative credit market for small and medium firms financed by the Brazilian National Development Bank (BNDES). It's estimated the effect in the BNDES's financial intermediaries banking margins from a set of observable variables such as short term rates set by monetary authority, funding costs, public banks conduct and interest rate policies designed to subsidised loans for the industry.

The first essay estimates the margins dynamics of the financial intermediaries. Specifically, it's considered how bank loans markup varies to changes on funding cost in a concentrated credit market structure. As pointed in literature, it is difficult to disentangle the demand cyclical effect of base interest rates set by the Central Bank and cost shocks, as the base interest rate acts also as a funding cost for bank loans. The unique institutional arrangement in Brazil offers a opportunity to face this estimation problem given that a significant part of the credit market for capital goods acquisitions had a exogenous and subsidized funding cost that was not related to the base interest rate until 2017. Given a detailed loan data from BNDES, it's estimated a standard dynamic bank panel model of loan spreads to isolate the effects of changes on funding costs and investments demand shocks. Results indicate that loan bank spreads are pro-cyclical with overall economic activity. In addition, the effect of funding cost shocks on banking spreads is significant and positive, as expected in a concentrated market for bank loans. Model estimated also suggests that higher concentration is associated with larger credit spreads.

The second essay estimates how margins of private banks are affected by public banks conduct. It's considered an exogenous change on public banks conduct between 2008 and 2015 when a pro state government set a broad counter cyclical policy in Brazil in major credit lines financed by Treasury through BNDES. Using this major firm's conduct variation, it's estimated the best reply function of private banks in a mixed oligopolistic market structure where private and public firms differs on their objective function. Dynamic panel data results estimate a significant but low reaction of private financial institutions. On the the long run, private bank's margin reduces in 0.03 p.p for a 1 p.p lower final interest rate set by state owned institutions. In this sense, the reduction on the financial margins observed between 2008-2014 was more associated with a lower subsidized funding cost set by the National Development Bank.

The third essay describes how the margin of financial intermediaries reacted to changes on the interest rate policy set by BNDES after 2017. Since 2018, a new funding cost (TLP), aligned with the base rate, has ended the subsidy expressed by the traditional long term interest rate (TJLP). In this sense, the change from a lower rate to a more close

to market funding costs provided a interesting opportunity for analysis of banking pricing behavior. Data on a major credit line from this institution pointed for a significant increase on average price-cost-margins of financial intermediaries after 2018. It's also considered a dynamic panel data derived from a simple oligopolistic credit market to estimate an increase on final banking margins of 0.7 p.p, condition on the funding cost, the base rate and intra-sector demand shocks. Finally, under TLP, a negative reaction coefficient for the funding cost was obtained, a similar results for the period under TJLP (2002-2017). This found is in line with a basic term structure where the long term rate positive reacts to the short term rate set by the Central Bank. This is a new found on the effect of credit subsidy on the dynamics of banking margins in line with financial margin offsetting the monetary policy in scenarios where the funding cost is totally dependent of the base rate.

Key-words: Banking, Interest Rate, Price Cost Margin, Credit Subsidy

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1 INTRODUCTION

Banking competition has a broad range of motivations. For macroeconomics, the economic cycle is a function of price formation of this industry; for microeconomics, competition policy has a particular attention on consumer welfare impact in a concentrated and low rivalry market structure; for development, an efficient credit market is a necessary condition. This thesis presents three essays on banking competition, focusing on a very important credit market for investment in a emerging economy: the indirect loans and credit transactions for small and medium firms financed by the Brazilian Development Bank (BNDES).

In this institutional design, financial intermediaries (banks) pay a funding rate to BNDES. These rates vary by the type of good financed and the loan taker size and sector, but not by bank. Banks are free to set their own loan rates but bear the risk of default. At the same time, the funding is not offered to banks to prepare loans and the banks act only as financial intermediaries for the BNDES credit products. This design is used by other development banks which try to reach smaller and medium firms without the cost of setting branches and with a subsidized funding cost. Besides, according to the World Bank (2018), 51% of this kind of institutions around the world have loan products priced at a mix of market and subsidized interest rates.

In general, literature for banking in Brazil illustrates several ways for measuring competition. In this sense, many studies[1] tried to isolate the effects on banks conduct from factors such as market concentration, market contestability, presence of private or public rivals on local markets, the funding cost, macro variables, bank specifics characteristics and others.

This thesis innovates in considering a specific credit market for small and medium firms where the funding cost was set exogenously to the banks and it was formally different than the base rate until 2017 when a new market rate was introduced. Using this institutional design and policy change, it's estimated the effects of the funding cost and the influence of public banks and credit subsidy on bank's conduct. Particularly, this represents a opportunity for analysis on price formation in a representative credit market in a major economy where a strategic environment exists with public and private banks.

Results are presented in three essays. The first one estimates BNDES's financial intermediaries margins dynamics. Specifically, how bank loans markup vary to changes on funding cost in a concentrated credit market structure. As pointed in the

[1] See References along this thesis.

literature, it is difficult to disentangle the demand cyclical effect of base interest rates set by the Central Bank and cost shocks, as the base interest rate acts also as a funding cost for bank loans. This problem is faced using this unique institutional arrangement in Brazil where a significant part of the credit market for capital goods acquisitions had a exogenous and subsidized funding cost that was not related to the base interest rate until 2017. Given a detailed loan data from BNDES, it's estimated a standard dynamic bank panel model of loan spreads to isolate the effects of changes on funding costs and investments demand shocks. Results indicate pro-cyclical loan bank spreads in respect to overall economic activity. In addition, the effect of funding cost shocks on banking spreads are significant and positive, as expected in a concentrated market for bank loans. The estimated model also suggests that higher concentration is associated with larger credit spreads.

The second essay estimates how margins of private banks are affected by public banks conduct. It is a relevant question for both competition policy and for the development of the credit market on emerging economies. An strand of the literature points for market failures effect on consumer surplus caused by the presence of state owned institutions whose inefficiency helps to sustain private firms' price above the equilibrium levels in a low rivalry market structure. Another view tries to point a role to public institutions in enhancing competition on private markets as long it's assumed a different objective function for state owned firms. An exogenous change on conduct of public banks between 2008 and 2015 is assumed when a pro state government implemented a broad counter cyclical policy in Brazil on major credit lines financed by Treasury through BNDES. Given this variation, it's estimated the best reply function of non private banks in a mixed oligopolistic market structure where private and public firms differs on their objective function. Dynamic panel data results estimate a significant but low reaction of private financial institutions. On the the long run, private bank's margin reduces in 0.03 p.p for 1 p.p lower final interest rate set by state owned institutions. In this sense, the margins reduction observed between 2008-2014 was more associated with a lower subsidized funding cost than a more aggressive conduct by public institutions.

The third essay describes how the margins of financial intermediaries have reacted to changes on the interest rate policy set by BNDES since 2017. In 2018, a new funding cost (TLP), aligned with the base rate, eliminated the subsidy posed by the traditional long term interest rate (TJLP). In this sense, the end of a below market funding cost provides a opportunity for analysis of banking pricing behavior. Data on a major BNDES credit line pointed for a significant increase on average price-cost-margins of financial intermediaries after 2018. It's also considered a dynamic panel data derived from a simple imperfect credit market to estimating an increase on final banking margins of 0.7 p.p, condition on the funding cost, the base rate and intra-sector demand shocks. Finally, under TLP, it was obtained a negative reaction coefficient for the funding cost

just as it was the case for the period under TJLP (2002-2017). This result is in line with a traditional term structure from a New Keynesian model where the long term rate positive reacts to the short term rate set by the Central bank. This is a new found on the effect of credit subsidy on the dynamics of banking margins in line with previous results for financial margin offsetting the monetary policy in scenarios where the funding cost is totally dependent of the base rate.

2 BANKING COMPETITION AND PRO-CYCLICAL BANK LOAN SPREADS

ABSTRACT

How bank loans markup varies to changes on monetary policy in a concentrated credit market structure is a fundamental question for the economy business cycle. However, it is a estimation challenge to disentangle the demand cyclical effect of base interest rates set by the Central Bank and cost shocks, as the base interest rate acts also as a funding cost for bank loans. Using a unique institutional arrangement in Brazil where a significant part of the credit market for capital goods acquisitions had a exogenous and subsidized funding cost that was not related to the base interest rate, this article analyses financial markups dynamics in a significant credit market for small and medium firms. Given a detailed loan data from the National Development Bank (BNDES), it's estimated a standard dynamic bank panel model of loan spreads to isolate the effects of changes on funding costs and investments demand shocks. Results indicate that loan bank spreads are pro-cyclical with overall economic activity. In addition, the effect of funding cost shocks on banking spreads are significant and positive, as expected in a concentrated market for bank loans. The estimated model also suggests that higher concentration is associated with larger credit spreads.

Keywords: banking, spreads, interest rate.

2.1 INTRODUCTION

Bank spreads in Brazil are impressive high by international standards, reaching more than 30% in 2018, according to World Bank[1]. At the same time, it is a concentrated banking sector with the four largest banks holding more than 75% of total credit operations[2]. In additional, profitability is stable over the cycle[3] and there is a public view these final interest rates set by the banks do not seem to react to reductions on the base interest rate set by the Central Bank.

As in any other industry, price formation on banking depends on the market structure and firms conduct. But specific to financial activities, price-cost margin (PCM) of these institutions is also a direct function of fluctuations in interest rates set by monetary authorities. This is a key factor underlying the cyclical component of economic activity. It's a topic highlighted in the macroeconomic literature, in part, as a byproduct of the analysis of markups in capital markets (under imperfect competition) and the respective shift prompted by changes in aggregate demand (J.J ROTEMBERG; SALONER, 1986; J. ROTEMBERG; WOODFORD, 1992). Further, the nature of financial intermediation may amplify fluctuations in the economy through an "accelerator mechanism" precisely because markups in the sector are anticyclical (BERNANKE; GERTLER, 1989). In this sense, a recessionary shock to the economy (for example, a positive variation in the base interest rate) would be exacerbated by an increase in financial markups, further discouraging the demand for credit. In general, for Brazil, part of the related literature is based on results that the national banking market structure is concentrated on deposit, asset and credit segments and measures of competition relies between cartel and perfect competition (CARDOSO; AZEVEDO; K. BARBOSA, 2016; MODENESI et al., 2017). Finally, as spreads on the Brazilian banking industry is extremely high, there is some macro literature on the determinants of the net interest margin. For example, Gouveia, Ribeiro and Modenesi (2016) found a constant mark-up, condition on expected inflation and base interest rates. In this sense, banking spreads move in the same direction as the funding rate. On the same context, Almeida and Divino (2015) found positive effect from real GDP and market concentrations on spreads.

Similarly, there is a literature on the industrial organization, particularly for banks. For example, Spiegel and Stahl (2015) provided a model with entry that suggests pro-cyclical price-cost margins. Others studies sought to evaluate effects of market concentration on spreads: for Europe, see Corvoisier and Gropp (2002); for Mexico, see Maudos and Solis (2009); for the US, Aliaga-Diaz and Olivero (2010) and for Turkey, see Turgutlu (2010).

[1] DataBase From World Bank
[2] BBC, Jun. 2018
[3] The Economist, Aug. 2018

Besides, analyses on the behavior of PCM in the banking industry are driven by a broad range of motivations. From a macro perspective, the effects of monetary policy are a function of price formation in the industry while effectiveness of competition policy and regulations on credit markets depends on the response of such margins.

A central issue in understanding the dynamics of bank credit spreads is that the same variable used to measure theses spreads, namely, the base interest rate in the economy, is both a measure of funding cost for banks and an business cycle indicator under an inflation targeting monetary policy regime. Bank spreads are traditionally measured as the loan interest rate minus the bank funding cost. In general, the base interest rate is used as proxy for funding cost as it is a benchmark rate for both the interbank loan rate and the deposit rate (as investors could use their deposits to invest in government bonds). While this measurement generates more comparable analysis across countries, it brings the central difficulty of mixing actual costs and demand shocks (as base interest rates signal monetary policy grip and expectations on business activity). Alternative spread measurements (such as the one estimated by the Brazilian Central Bank) focus on accounting bank spreads and arbitrary allocation of administrative and default rates on credit lines.

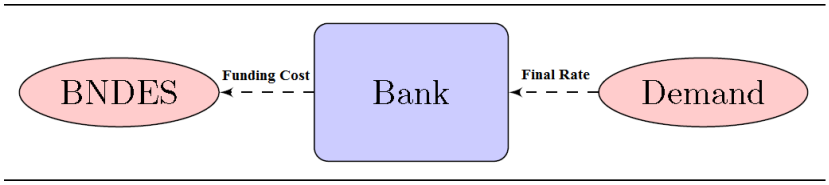
We explore a unique institutional setting in Brazil where a significant credit line had a funding cost set exogenously from lending banks – that are free to set their bank spreads on those credit lines. To a great extent, that credit line funding cost was also set independently from the base interest rate, allowing us to estimate the potentially different effects of a higher funding cost and a tightening of monetary policy (and an expected contraction of the economy).

In this credit line, funding for the loans were provided by the National Development bank (BNDES). The bank, which had accounted for 20% of investment funding in Brazil (FERRAZ; ALÉM; R.F. MADEIRA, 2013), operates using a direct and a indirect form. Through the latter, the bank grants resources to financial intermediaries (actual banks), which, for their part, compete for customers interested in obtaining credit to finance machinery and equipment and/or expand firm capacity. This results in the following: a significant portion of the banking activity (loans to fund capital goods) was funded directly by the Brazilian State at a rate set historically below the basic interest rate (at least until 2018, as we will see). It is important to underscore that both rates were up to that point determined exogenously by the monetary authority.

When granting a loan, the bank charges, in addition to the BNDES cost, its own rate. Note that under this model the bank is the price taker from BNDES: for a given demand, a given resource volume is transferred to the intermediary at a given cost, as illustrated on Figure 1.

On the credit side, the evidence indicates that the BNDES credit line market

FIGURE 1 – BNDES Indirect Operation



is less concentrated and involves greater rivalry than other markets. In addition, bank rates react more to changes by their competitors and there is greater concern with lost customers (higher deviation rates) than occurs traditionally in the other banking markets (E.P. RIBEIRO, 2017).

The role played by BNDES in this respect and data availability on value, final cost and spreads by operation and by bank from 2002 through November 2017 provides an opportunity to evaluate the behavior of bank spreads in relation to the funding cost in the country's principal credit market for capital goods and investment projects.

This article shows that the behavior of the rates charged by banks is substantially robust, when examined in a dynamic panel model (BLUNDELL; BOND, 1998). A drop or rise in the rate charged by BNDES is followed by a shift in the bank's spread in the same direction. By contrast, recessionary shocks to the economy (higher basic interest rates) are associated to lower spreads, even when BNDES rates (funding cost) remain constant. Similarly, in the case of expansive shocks (lower basic interest rates), bank spreads increase, suggesting a pro-cyclical mechanism.

The results summarized above will be presented as follows. First, a model of bank activities adjustment to basic interest rate and funding cost shocks is developed, including testable propositions. We then lay out an adequate methodology for the tests. In the subsequent sections, data are described and the results discussed. We end with some concluding remarks.

2.2 INSTITUTIONAL SETTING

BNDES was one of the largest development banks in the world, with assets reaching nearly 400 million USD in the early 2010 (BNDES Annual Reports), even larger than the WorldBank 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.[4]

BNDES funding comes from a labor tax severance payment fund, complemented, eventually by Brazilian Treasury funding (see the BNDES website). It provides support for investment project through three main different channels: acquiring equity positions in large and publicly traded firms, through BNDESPar; financing large invest-

[4] The information in this section is available at the BNDES website and E.P. Ribeiro and De Negri (2009)

ment projects, of at least USD10million, in the so called direct operations (handled by the bank staff and directors themselves); and providing funding for financial institutions (banks) to provide loans for the acquisition of machinery and equipment (including trucks and buses). These latter loans are about half of all non-equity credit in the early 2010.

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 bank. Banks are free to set their own 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. The funding for the credit is provided in a stand-by basis and it appears in the bank balance sheet only after the loan contract is signed. All bank loans using 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 were subsidized with respect to market funding rates. As we can see in Figure 2, there is a significant difference between the interest rate from BNDES (TJLP as we will see) and the economy base rate that benchmarks interbank loans and public debt interest (copom). Comparing final interest rates, the yearly average rate in the period for BNDES loans in our sample is about 14%, while market vehicle acquisition rates in 2011 were about 25%. The sheer difference between rates (under an average inflation rate of 6%) does not suggest that the own bank credit lines and BNDES funded credit lines operated by intermediares are actually in the same relevant market or would be considered substitutes. In addition, rationing into BNDES loans comes from the alleged stricter paperwork and types of goods financed (shortlisted by BNDES due to its minimum local content).

Surprisingly, given its below market interest rates, default rates on BNDES funded banks loans are very low, about a third of the national credit default rate[5]. This suggests firms using such credit are not riskier than regular credit takers.

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[6]. Its goals were to provide low and stable interest rates for domestic capital goods sector development. Its dynamics were explicitly decoupled from the economy base interest rate. The base interest rate is set by the Central Bank of Brazil, under *de facto* independence, following an inflation targeting monetary policy regime, in effect since 1999. This provides a unique opportunity to

[5] BNDES, Aug. 2018

[6] See Chapter 4 for a historical perspective on the Interest Policy for BNDES.

explore the dynamics of bank spreads over the business cycle as the funding cost was explicitly different from the base interest rate in a large credit market.

2.3 MODEL

We motivate the empirical relationship between basic interest rates and funding rates on loan spreads using a standard imperfect competition model for loans from Freixas and Rochet (2008) and VanHoose (2017). The market is made up of N banks. Each bank is an institution engaged in intermediation activities, i.e. fund-raising (D) and lending (L). Here, the financial intermediary i has the following operational cost function:

$$C(D_i, L_i) = \gamma_d D_i + \gamma_l L_i \tag{2.1}$$

And a profit function form given by:

$$\pi_i = r_{li} L_i + r M_i - r_{di} D_i - C(D_i, L_i) \tag{2.2}$$

Where L_i is the credit loaned at a rate of r_{li}. M_i is the bank's net position in the interbank market, paid at an exogenous rate (set by the Brazilian Central Bank) r. D_i is the total funds raised by the bank, at a rate r_{di}. The bank's liquid position can be rewritten as: $M_i = (1-\alpha)D_i - L_i$ where α is the portion of funds raised withheld by the Central Bank as compulsorily deposits. Rewriting the profit function in terms of loan spreads $(r_l^i - r)$ and funding cost $(r(1-\alpha) - r_d^i)$:

$$\pi_i = (r_{li} - r)L_i + (r(1-\alpha) - r_{di})D_i - C(D_i, L_i) \tag{2.3}$$

Assuming Cournot competition, the demand for loans is a function of the bank's own loans L_i and the rest of the banks $r_l(L_i + \sum_{j \neq i} L_j)$ and the rate that each bank must offer (r_d) for raising funds is a function of the total volume of available resources in the market: $r_d(D_i + \sum_{j \neq i} D_j)$. A quantity competition competition is a reasonable hypothesis for certain credit lines (those without any customization for a certain firm) designed by BNDES but offered by different financial agents to industry.

Banks select (D_i, L_i) to maximize profits below conditional on the response of each competitor (D^*_{-i}, L^*_{-i}):

$$\pi_i = [r_l(L_i + \sum_{j \neq i} L_j) - r]L_i + [r - r_d(D_i + \sum_{j \neq i} D_j)]D_i - C(D_i, L_i) \tag{2.4}$$

Considering only bank i, in the symmetric equilibrium case, the first order conditions can be rewritten to yield the well known market mark-up rule, or loan spread

over loan rate expression, where the bank i market share is $s_i^* = \frac{1}{n}$ and the market elasticity for loans is $\epsilon_l = -\frac{\partial L_i^*}{\partial r_l}\frac{r_l}{L_i^*}$:

$$\frac{r_l^* - (r + \gamma_l)}{r_l^*} = \frac{s_i^l}{\epsilon_l(r_l^*)} \tag{2.5}$$

$$\frac{r(1-\alpha) - (r_d^* + \gamma_d)}{r_d^*} = \frac{s_i^d}{\epsilon_d(r_d^*)} \tag{2.6}$$

We focus on the relationship between the base interest rate r and the loan interest rate r_l^*. As Freixas and Rochet (2008) show, given a well defined elasticity, in the extreme case of perfect competition ($s_i^l \to 0$), the banks pass through only the increase in r. On the other extreme given by cartel equilibrium or monopoly ($s_i^l = 1$), the cost pass through is greater than one.

We enrich the model including loans from a funding source that requires a funding cost that differ from deposits (see also VanHoose (2017)). This external organization[7] provides lending funds at a different rate $\bar{r}$. These funds are targeted as they cannot be used for other lending. Lending activities are divided in two: L_i and $L_l^{'}$, where the later are the external institution funded loans. The funding rate in the second market, $\bar{r}$, is determined by the organization. We also assume, following the institutional design of BNDES indirect loans for capital goods, resources are only transferred to the bank balance sheet once a loan is signed, i.e., there is no 'inventory' of funds for the lending bank to manage.

The profit function in this case is:

$$\begin{aligned}\pi_i =& [r_l(L_i + \sum_{j \neq i} L_j) - r]L_i + [r - r_d(D_i + \sum_{j \neq i} D_j)]D_i + [r_l^{'}(L_i^{'} + \sum_{j \neq i} L_j^{'}) - \bar{r}]L_i^{'} \\ & - C(D_i, L_i, L_i^{'})\end{aligned} \tag{2.7}$$

In the loan market funded by the organization, bank spreads follow the usual:

$$\frac{r_l^{*\prime} - (\bar{r} + \gamma_{l'})}{r_{l'}^*} = \frac{1}{N\epsilon_d(r_{l'}^*)} \tag{2.8}$$

In a comparative static analysis, under perfect competition and a finite demand elasticity, $|\epsilon_l| < \infty$, a positive shock in $\bar{r}$ will not alter the spread $(r_{l'}^* - \bar{r})$. Under imperfect competition, bank spread increase with an increase in the funding cost and this increase is greater further the market is from perfect competition.

[7] The term external organization is used to make clear that this institution does not provide direct loans to customers and thus do not compete directly with banks. The strict and high loan thresholds enforced by BNDES suggest this assumption.

An important question for banks involves the possibility of interdependence of asset and liability decisions. According to VanHoose (2017), this point is examined by dividing bank assets into loans and bonds, and bank liabilities into deposit funds (D) and non-deposit funds (N). The bank's profit function is thus altered as follows:

$$\pi_i = (r_l^i - r)L_i + (r_l - \bar{r})L_i' + (r(1-\alpha) - r_d^i)D_i + r_s S^i - r_N N_i - C(D_i, L_i, S_i, N_i) \quad (2.9)$$

r_s is the interest on public bonds, exogenous to bank. r_N is a function (analogous to D) of $N_i + \sum_{j \neq i} N_j$. L_i the volume of loans on the credit market without BNDES and r is the fund-raising cost given by the base interest rate; L_i' is the volume of indirect BNDES funding lines and $\bar{r}$ is the cost of fund-raising given by the TJLP.

The bank's objective is to make a selection $(L_i, L_i', D_i, S_i, N_i)$ so to maximize profit. We assume that in the bond market, the bank has no market power. In the remaining markets, it encounters a negatively sloped demand curve.

From the first-order conditions and using a demand elasticity adjusted for market share, we obtain:

$$\begin{aligned} r_L^* &= [\frac{\epsilon_L}{(\epsilon_L - 1)}](r + \gamma_L) \\ r_{L'}^* &= [\frac{\epsilon_{L'}}{(\epsilon_{L'} - 1)}](\bar{r} + \gamma_{L'}) \\ r_D^* &= [\frac{\epsilon_D}{(\epsilon_D - 1)}](r(1-\alpha) + \gamma_D) \\ r_N^* &= [\frac{\epsilon_N}{(\epsilon_N - 1)}](r + \gamma_N) \\ r_s &= \gamma_S \end{aligned} \quad (2.10)$$

Therefore, the economy's base rate (r) does not determine the equilibrium level of the rate charged by the financial intermediaries of BNDES, which is determined rather by $\bar{r}$, the market elasticity and corresponding marginal cost. If we rewrite the first-order condition in market L' (BNDES funding lines) in terms of spreads ($r_{L'} - \bar{r}$), we get:

$$\begin{aligned} r_{L'}^* - \bar{r} &= \beta_1 \bar{r} + \beta_2 \gamma_{L'} \\ \beta_1 &= [\frac{1}{1 - \epsilon_{L'}}] \\ \beta_2 &= [\frac{\epsilon_{L'}}{\epsilon_{L'} - 1}] \end{aligned} \quad (2.11)$$

The term $\beta_2 \gamma_{L'}$ reflects the operational costs to provide these loans. We can assume that these are constant per loan amount[8].

[8] The anecdotal evidence would appear to suggest that costs in connection with loan processing do not vary significantly over time.

Under this separability in the profit function of external loans and own loans, the base interest rate does not affect the loan spreads, condition on external loan costs, unless they represent demand shifts that alter the demand for loans itself. And this exactly what is expected for monetary policy in an inflation targeting regime. For example, consider a recessionary shock (increase in the basic rate r). In this case, given a stable inflationary expectations, interest rates will rise. If the demand for aggregate investment is a decreasing function of the (real) interest rate then the demand for credit in the economy will fall (BERNANKE; GERTLER, 1986), including the demand for BNDES credit, even if its interest rate does not change. Other questions regarding business expectations may also play an important role here: if an increase in the base rate signals to market agents a deterioration in economic activity, the perspectives for future receipts, for a given investment, will also worsen, reducing the agent's expected profit margins. In the BNDES credit market, this trend is reflected by a leftward shift in the demand curve.

2.4 EMPIRICAL STRATEGY

Empirical approach is based on Equation 2.11. We expand the model to include shifts in the demand for loans to control for changes in the demand elasticity. We consider also 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, yielding a dynamic model of loan spreads (BOND; REENEN, 2007). The same dynamic specification is seen in Almarzoqui and Naceu (2015), Maudos and Solis (2009), and Turgutlu (2010). Bank i spread on period t, denoted by $r^*_{i,t} - \bar{r}_t$, is the difference between the final loan interest rate and the funding cost (interest charged by BNDES to banks that contract BNDES funded loans). The model is:

$$\begin{aligned} r^*_{i,t} - \bar{r}_t =& \beta(r^*_{i,t-1} - \bar{r}_{t-1}) + \beta_1 r_t + \beta_2 r_{t-1} + \gamma_1 \bar{r_t} + \gamma_2 \bar{r}_{t-1} + \\ &+ X'_t\theta + \delta_i + \epsilon_{i,t} \end{aligned} \tag{2.12}$$

The matrix $X_{i,t} = [HHi_t; BK_t]$ is a set of control market variables. HHi_t is the market's Hirshman Herfindahl Index. A higher HHi increases the pass-though from costs to spread. BK_t is an indicator of capital goods production[9]. The idea here is to control for potential sector demand shocks. Both indicators can be considered endogenous (or only pre-determined) as there is a well known endogeneity between markups and concentration and, at the same time, the capital goods activity level may depend on the price of loans that finance their sale. $r^*_{i,t}$ is the final rate charged, at t, by intermediary i to the borrower of the external organization's funding line. $\bar{r}_t$ is the cost of borrowing funds

[9] Series 21863: Production indicators (2012=100) – Capital goods. Avaialble on the Brazilian Central Bank's Time Series Management System.

from the external organization. $r_t$is the economy's base interest rate. Set by a external committee, $\bar{r}_t$ is exogenous with respect to individual bank shocks. r_t is exogenous, as the Brazilian Central Bank does not consider the performance of an individual bank's idiosyncratic credit. Therefore, $\bar{r}_t$ e r_t are exogenous as they are determined by a monetary authority that does not consider banking units individually. Thus:

$$E[\epsilon_{i,t}|\bar{r}_t, r_t] = 0 \quad \forall i, t \tag{2.13}$$

The difference $r^*_{i,t} - \bar{r}_t$ is the bank i spread at t. Specifically, it consists of a weighted average of the spreads charged by all of the operations carried out at t. Consider that at t the bank executed n loan operations based on a given funding line of the external organization:

$$r^*_{i,t} - \bar{r}_t = \sum_{j=1}^{n} \frac{LoanValue_{j,t} Spread_{j,t}}{TotalValue_t} \tag{2.14}$$

Coefficients β_1 e β_2 represent the response of the bank spread to a shock on the base rate at t and t-1, respectively. Negative values indicate that a general recessionary shock (increase in r) in the economy, controlled by the market structure, by the cyclical variable represented by the BK production and by direct funding cost (TJLP), is accompanied by lower spreads. This would be consistent with the previous model.

From the standpoint of the external organization, γ_1 and γ_2 reflect the sensitivity of the spreads to changes in the rates charged to banks at t and $t-1$, respectively. Specifically, given the linear model, the cost pass-through to prices is $\gamma_1 + 1$ in the short term and $\frac{\gamma_1+\gamma_2}{1-\beta_1-\beta_2}$ in the long term. Because we are considering market equilibrium, the goal is to test whether $\frac{\gamma_1+\gamma_2}{1-\beta_1-\beta_2} > 0$, i.e. whether the transfer of intermediaries is greater than a given shock to the respective funding cost.

Finally, indicators with invariant effects over time and idiosyncratic to intermediaries are represented by δ_i. Here, we control for certain characteristics of banks, e.g., private and state enterprises. More importantly, a fixed effect may accommodate heterogeneous spreads among banks.

In summary, the main goal is estimate the sensitivity of bank spreads to variations in the rate charged by the external organization and to monetary policy shocks on the base interest rate.

To obtain consistent estimates for the model above, we employ a dynamic GMM estimator of Blundell and Bond (1998), with lagged spreads and HHI and BK taken as contemporaneously correlated with the time varying error term. Lagged values of all variables are used as instruments. This is suggested by Evans, Froeb and Werden

(1993) and it is also standard in the dynamic panel data literature. See Appendix for a detailed discussion.

2.5 DATA

In the previous model, BNDES operates as an external organization whose primary goal is funding capital goods investments through financial intermediaries and directly channeling larger financial injections to infrastructure companies and projects. In terms of the composition of its portfolio, the separation between direct and indirect operations is approximately 50% for each modality[10], as mentioned before.

Information on indirect BNDES operations is provided through its Download Center, which contains data on the value, interest rates, spreads and final cost to borrowers under each contract executed between intermediaries and customers. Based on these data, we calculated bank level spreads using 2.14; as well as the market share of each institution in each period and the market HHi at each t. Indirect operations encompass the main funding lines (BNDES Finame, BNDES Finame Agrícola, BNDES Finame Leasing and BNDES Automático). The first three ones one account for a significantly share and, for this reason, is the subject of the present analysis. In fact, it represented 84% of all operations pegged to the TJLP in the period.

BNDES Finame is "Funding through authorized financial institution intermediaries for the production and acquisition of new domestically manufactured machinery, equipment, and computer and automation goods, as approved by BNDES"[11]

Only loans which the funding cost was pegged to the TJLP were considered. The TJLP is represented in the model by $\bar{r}_t$, rate of the external organization. We use monthly data from 2002 to 2017, aggregated to quarterly data, given the frequency of base interest changes. Over most of the data period, the Central Bank of Brazil met to decide on base interest rates in six weeks intervals, longer than a month.

Information on the basic interest rate (COPOM Series) and the capital goods production index (Series 21863: Production Indicators (2012=100) – Capital goods) was obtained from the Brazilian Central Bank available on its Time Series Management System.

2.6 RESULTS

Table 1 provides some descriptive statistics for the set variables considered. Note that the sum of the average spreads (Margin) and the TJLP, which is an approximation for average final price assessed to the borrower, is 12.58%, very near 14.38%, the

[10] BNDES - Estatisticas de Desempenho Link, Aug. 2018

[11] BNDES Finame - Link, Aug. 2018

average basic interest rate. This means that, on average, the final cost to the Finame line borrower closely approximates, at least in level terms, the basic interest rate. Nevertheless, the TJLP dynamics are quite different from the basic interest rate. Figure 2 also reveals that the TJLP varies less than the basic interest rate. In fact, between 2010 and 2015 the variations were small, remaining separate and independent of changes in the SELIC rate. The correlation between TJLP and the base interest rate (Copom) is small, at about 0.16, as expected, given their institutional setting.

TABLE 1 – Descriptive Statistics - BNDES Finame, 2002-2017

	Margin	Copom	TJLP	Total Credit	Market Share	HHi	BK
Mean	4.84	14.38	7.74	20.00	0.03	0.14	4.37
Std Dev	1.32	4.51	1.96	1.18	0.07	0.08	0.24
Min	1.30	4.51	1.96	1.18	0.07	0.08	0.24
Max	12.96	26.50	12.00	21.65	0.66	0.95	4.84
N	2078	2079	2079	2078	2078	2078	2079

First column is Bank's margin in loan operation on FINAME. Copom is the base rate set by Central Bank.
TJLP is the funding cost from BNDES. HHi is the Herfindahl-Hirschman Index.
BK is a monthly index of Capital Good production (Series 21863, Central Bank of Brazil)

As an first estimation, the correlations between bank loan spreads and the TJLP and the COPOM (base interest rate), controlling for bank fixed effects, can be seen in Figure 3 and 4. Results indicate a positive relationship between the funding cost (TJLP) and margins, suggesting a positive pass-through on bank loan spreads. Also, a positive association between base interest rate (copom) and margins.

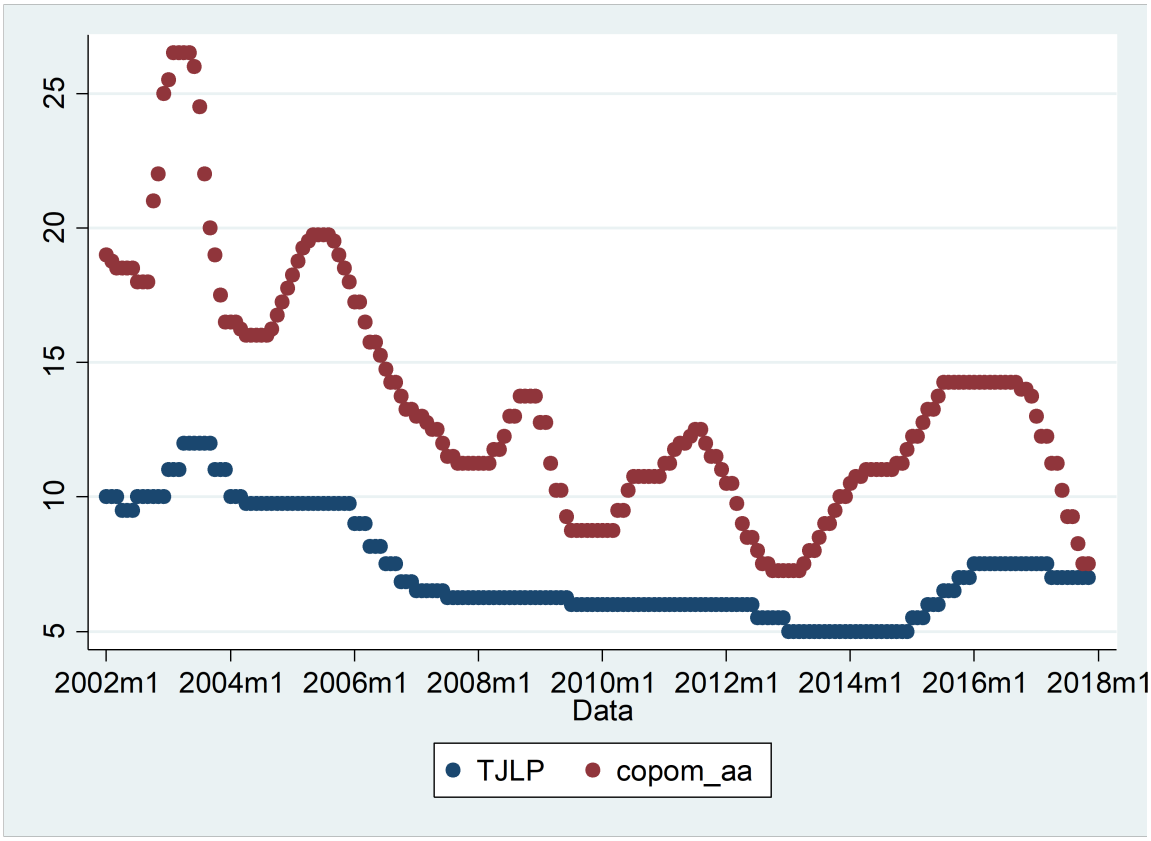
Table 2 presents the results of the main empirical estimates for the question of whether changes in the base interest rate or the TJLP itself alter the spreads of financial intermediaries. Estimates are presented under a variety of estimation methods, from least squares and fixed effects that require strict exogeneity of the explanatory variables, to the System GMM with one step and two step estimates, that allow for endogenous explanatory variables and more flexible error structures for robustness sake.

There is evidence for relatively persistent spreads as expected in adjustment cost models as the coefficients of the autoregression terms are positive and significant in all models considered.

The base interest rate ($copom$) concentrates its effects on the spreads at t. Considering the most flexible model - System GMM Two-step[12]-, note that the $copom$ coefficients are negative and significant. The long term effect is about -.2, This means that a positive shock of 1 p.p. on the base interest rate reduces the spreads over the long term by 0.2 p.p., controlling for the factors described. That suggests an elasticity of

[12] The 2 step estimator (SYS 2 GMM) do not impose any restriction on the error variance matrix. See Appendix.

FIGURE 2 – TJLP and Copom (base rate), 2002-2017



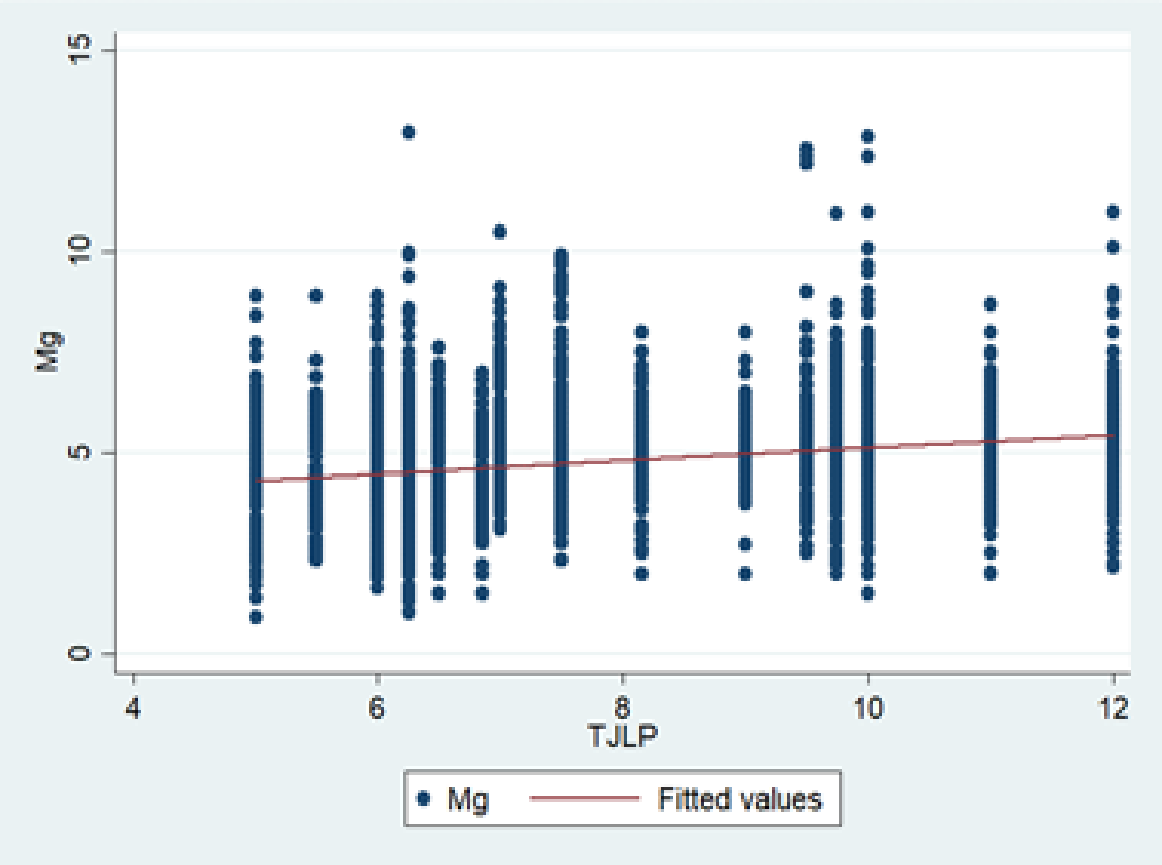
-.7, given the average spread of 4% p.a. and the average base rate of 14% p.a., as seen in Table 1.

Therefore, a recessionary shock to the economy has the effect of reducing the spreads, suggesting a mechanism as described in the models laid out in the previous section. Note that an increase in the basic interest rate must negatively affect the general demand for credit in the economy, including the demand for BNDES credit, even with a constant TJLP. In this case, lower spreads in response to a recessionary shock are suggestive of a pro-cyclical dynamics.

If the underlying Finame funding line rate (TJLP) is subject to an increase at t, on average, the spreads charged by the intermediaries for the loans granted at t are expected to increase. Here, the final cost to the borrower is impacted more than simply by an increase in the "BNDES cost" (TJLP), but by an increase in the spreads themselves. Based on model GMM-Sys in 2 stages, an increase of 1 percentage point (p.p.) in the TJLP results in an increase, in the short term, of 0.262 p.p and, in the long term, of 0.30 p.p in the spreads obtained by intermediaries. This would indicate that the transfer to the final price is greater than the respective variation in cost.

In relation to the market structure variable, the HHi coefficient is positive and significant under all models. In this case, as expected, a more concentrated market

FIGURE 3 – OLS Fixed Effect: Spread x TJLP

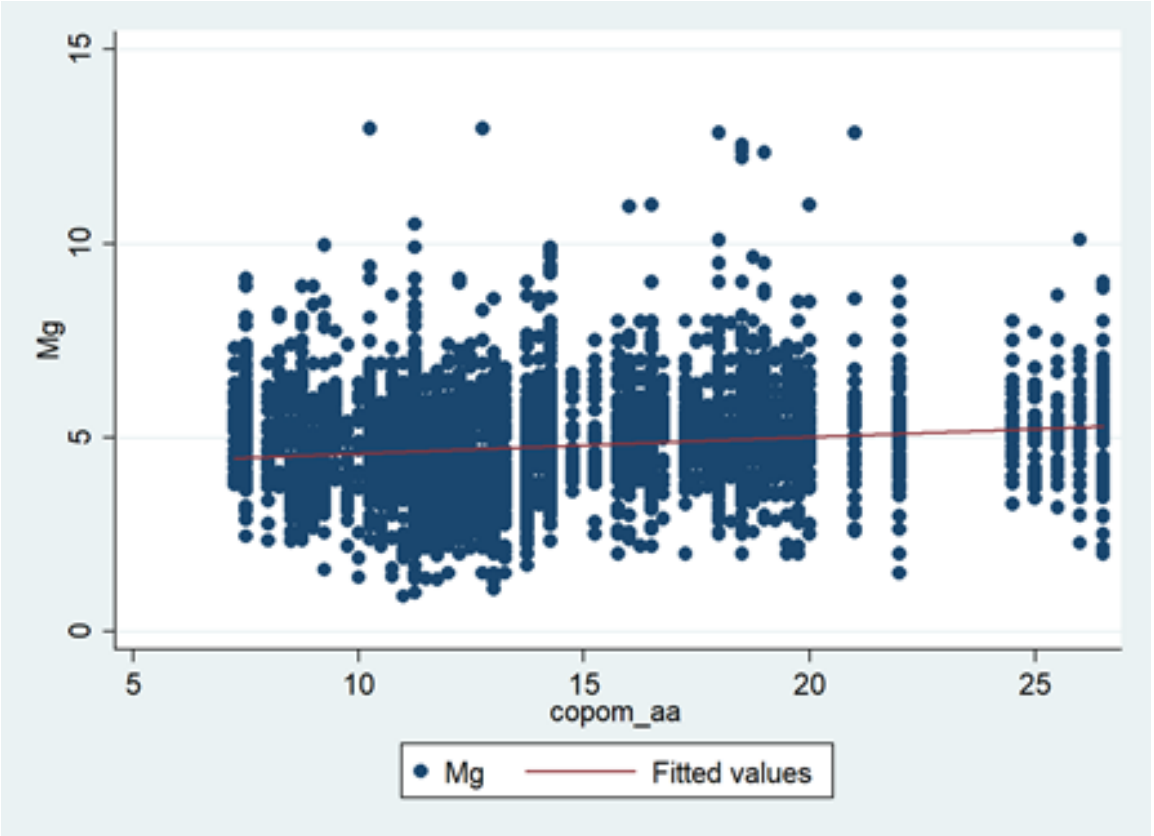


Note: OLS with Fixed Effect, Spread (Mg) as dependent variable. Coef.= .0187 (sd = .008).

tends to present higher spreads. Finally, positive shocks on the production of capital goods (BK) have a negative effect on bank intermediary spreads in the short term and the long term. Here, it's important to note that the negative coefficient of base interest rate can be interpreted as a pro-cyclical pattern as it refers to the economy business cycle, not just to the specific capital goods market, that is controlled by the capital goods index.

For robustness check, Table 3 considers only a part of the sample (up to 2010). Beginning in 2011, BNDES issued a new capital goods FINAME credit line with fixed final interest rates that competed with TJLP funded loans. The results are clearly robust to the period under analysis, with small changes in coefficient estimates, across models.

FIGURE 4 – OLS Fixed Effect: Spread x Copom (base rate)



Note: OLS with Fixed Effect, Spread (Mg) as dependent variable. Coef.= .0463 (sd = .0035).

TABLE 2 – BNDES Finame: Models, 2002-2017

Variable	OLS	FE	SYS 1 GMM	SYS 2 GMM
$Margin_{t-1}$	0.601***	0.472***	0.468***	0.218***
$Margin_{t-2}$	0.258***	0.169***	0.115**	0.202***
$Copom_t$	-0.055***	-0.059***	-0.050***	-0.052***
$Copom_{t-1}$	-0.012	-0.039**	-0.037**	-0.052***
$TJLP_t$	0.298***	0.337***	0.278***	0.262***
$TJLP_{t-1}$	-0.180***	-0.140***	-0.097*	-0.038
HHi	0.767**	1.160***	1.052**	1.282**
BK_t	-0.947***	-1.041***	-0.925***	-1.079***
BK_{t-1}	0.468	0.271	0.143	0.07
State	-0.018			
Constant	2.786***	4.852***	5.155***	6.811***
N	1560	1560	1560	1560
R^2	0.68	0.488		
Hansen df			299	299
Hansen			77.698	67.799
AR(1) pvalue			0.000	0.001
AR(2) pvalue			0.395	0.018
F	195.658	156.179	60.012	28.923

Note: *p<.1; **p<.05;***p<.01
The 2 step estimator (SYS 2 GMM) does not impose any restriction on the error variance matrix.
SYS 1 GMM imposes homoskedastic assumption.
BK (capital good production index) and HHi are treated as endogenous variables in the model.
State is a dummy variable for state owned banks.
AR(k) test for autocorrelation of residuals.
Hansen null hypothesis is validity of over identification of the restrictions. In all GMM models, this was not rejected.

TABLE 3 – BNDES Finame: Models, 2002-2010

Variable	OLS	FE	SYS 1 GMM	SYS 2 GMM
$Margin_{t-1}$	0.521***	0.371***	0.366***	0.355***
$Margin_{t-2}$	0.304***	0.162***	-0.017	-0.06
$Copom_t$	-0.008***	-0.007***	-0.006***	-0.007***
$Copom_{t-1}$	-0.001	-0.002	-0.002**	-0.002*
$TJLP_t$	-0.025**	-0.027**	-0.030**	-0.027**
$TJLP_{t-1}$	0.032***	0.026***	0.017	0.015
HHi	0.353**	0.669***	0.888**	0.841**
BK_t	-0.138***	-0.145***	-0.135***	-0.142***
BK_{t-1}	0.107**	0.092**	0.055	0.058
State	-0.003			
Constant	-0.022	-0.220		
N	1075	1075	986	986
R^2	0.700	0.490		
Hansen df			94	94
Hansen			50.403	50.403
AR(1) pvalue			0.001	0.000
AR(2) pvalue			0.877	0.999
F	172.774	106.818	55.264	52.605

Note: *p<.1; **p<.05;***p<.01
The 2 step estimator (SYS 2 GMM) does not impose any restriction on the error variance matrix.
SYS 1 GMM imposes homoskedastic assumption.
BK (capital good production index) and HHi are treated as endogenous variables in the model.
State is a dummy variable for state owned banks.
AR(k) test for autocorrelation of residuals.
Hansen null hypothesis is validity of over identification of the restrictions. In all GMM models, this was not rejected.

2.7 CONCLUSION

This article analyzed the behavior of the BNDES financial intermediaries - banks - for his main funding line, FINAME. Using a dynamic panel model, we found that an increase in the rate charged by BNDES was accompanied by a shift in the spread on the same direction. This result is predicted precisely by a Cournot model in which spreads are contingent only on demand elasticities and the number of competitors. For purposes of application to a banking case, the results indicated that the bank spread is an increasing function of the funding cost.

In summary, results suggest that the financial intermediation of BNDES funding lines exacerbates shocks to the institution's interest rate policies. A transfer to the final loan rate greater than the change in funding cost corroborates a pattern of competition that strays far afield of perfect competition and much closer to an oligopoly based on quantity competition (volume of loans).

In addition, robust results were obtained for recessionary shocks to the economy (higher basic interest rates), which are associated to lower spreads, even when BNDES rates (funding cost) remain constant. By comparison, for expansive shocks (lower basic interest rates), bank spreads increase, suggesting a pro-cyclical dynamics.

This article introduces results from a detailed data set for loan operations using the Brazilian institutional setting as a laboratory for the study of price transfers stemming from banking activities. Here, BNDES acts as an external organization whose funding cost for intermediaries is determined exogenously, uniformly for all banks. In general, previous works (ALMARZOQUI; NACEU, 2015; MAUDOS; SOLIS, 2009; TURGUTLU, 2010) have focused on shocks to the basic interest rate in the economy, which, in practice, acts as an indirect measure of funding costs. Besides, these studies centered on testing hypotheses regarding the behavior of spreads in cases of a shock to monetary policy without objectively consider the competitive dimension. By controlling for this and using a direct cost measure (TJLP), this article was able to identify the response of financial intermediaries margins to changes in funding cost and demand shocks with robust results to different estimation methods.

3 PUBLIC BANKS AND BANKING COMPETITION

ABSTRACT

How private banks margins are affected by conduct of public banks is a relevant question for both competition policy and for credit market development in emerging economies. Using an exogenous change on public banks conduct between 2008 and 2015, when a pro state government implemented a broad counter cyclical policy in Brazil in a major credit line financed by the National Development Bank, it's estimated the best reply function of non private banks in a mixed oligopolistic market structure where private and public firms differs on their objective function. In a dynamic panel data, results point for a significant but low reaction of private financial institutions. On the the long run, private bank's margin reduces in 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 than a conduct change by state owned banks.

Keywords: banking, margins, competition, mixed oligopoly.

3.1 INTRODUCTION

Although market concentration and high final interest rates are not sufficient condition for low rivalry between financial institutions, they both attract public attention and motivate reforms enhancing competition on banking industry. Brazil has a concentrated market structure: four banks – two private and two state owned – hold more than 75% of credit operations on the country[1]. Besides, it is not clear if the presence of two state owned institutions implies different credit supply conditions under what would be with just private banks. Given this scenario, the role of state owned banks on credit market is at center of competition policy debate in Brazil.

In a stagnation since 2015, the country has one of the lowest investment rate in emerging markets.[2] Thus, policies designed to get a more a competitive credit market is a focal point on supply side reforms that has been proposed on last years (Agenda BC+).[3]

As it's known, a poorly developed capital market restricts economic development (RAJAN; ZINGALES, 1998). In addition, market failures on banking affect social optimal credit supply and pose social burden for firms and consumers (BECK; DEMIRGUÇ-KUNT, 2006; VALVERDE-CARBO; RODRIGUEZ-FERNANDEZ; UDELL, 2006; ARISS, 2010; AGORAKI; DELIS; PASIOURAS, 2011). In this sense, a pro view for public banks points for potential attenuation on credit supply restrictions through direct or indirect funding (GREENWALD; J. STIGLITZ, 1993; J.E STIGLITZ, 1994; HERMANN, 2011). If this is in fact occurs is a open question with mixed results on literature. For one side, state owned banks are associated with poor performance when compared with private ones. This line emphasizes factors as corruptions and elite capture in under development countries with weak institutions and high political instability (HAWKINS; MIHALJEK, 2001; LA PORTA; SILANES; SHEIFER, 2002; SAPIENZA, 2004; HAOYU; YANG, 2019). However, there is evidence supporting an active role for public banks at least as a counter-cyclical tool in financial crisis (MICCO; PANIZZA, 2006; BREI; SCHCLAREK, 2013; CULL; PERIA; VERRIER, 2017; COLEMAN; FELER, 2015; BEHR; FOOS; NORDEN, 2015).

In addition, state owned bank's influence in banking competition is also a broad topic in industrial economics. This came from the idea that regulation policy could use public firms for inducing changes on market outcome in a specific industry. Given that public firm has a different maximization function than private ones, in a oligopolistic market structure, government could act as an enhancer for competition and expand consumer surplus restricting market power. For this market structure, strategic

[1] BCB- Relatório Estabilidade Bancária - Link, Jun. 2018
[2] World Bank - Investment Index by Country Link
[3] Agenda BC+ Link

interaction between public banks and private ones has been modeled as a mixed oligopoly (BEATO; MAS-COLELL, 1984; CREMER; MARCHAND, 2013; DE FRAJA, 1989; BARROS; MODESTO, 1999; BREI; SCHCLAREK, 2013; OGURA, 2018). In this line, given a best reply function for private institutions, state owned banks could change quantity and prices on credit market equilibrium with a different objective function.

In applied literature, for Switzerland, Bichsel (2006) found no evidences that interest rates set by private banks is influenced by state owned rates. For Brazil, Coelho, Mello and Rezende (2013) studied isolated local markets and did not find evidence that entry of state owned banks influenced rivals conduct. Finally, Sanches, Junior and Srisuma (2018) showed negative effects on the numbers of bank branches on isolated markets, considering scenarios of privatization or closure of a public bank.

In general, credible evidences for the impact of public banks on final interest rate set by private institutions is limited given the difficulty to find exogenous variation on market structure in banking. In this article, I used a exogenous market share variation created by the biggest state owned bank (Banco do Brasil, BB) in a significant credit line (BNDES Automático) for small and medium firms. This is a representative case because the role played by BB on Brazilian economy highlights the nature of public banks in the literature. This institution was used as a counter cyclical instrument after the 2008 crisis through broad credit lines for firms and consumers. Also, BB was the main player on the credit lines made available by the National Development Bank (BNDES) until 2014. However, in line with austerity policy – that began on this year and it was amplified later - and conservative fiscal conduct by the government after 2015, BB reduced his activities as a BNDES's player and in some lines – BNDES Automático - the market share fell to almost zero.

This brings the question if the exogenous change on 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 policy oriented to expand loan operations of his own with no effect on their conduct.

In this scenario, it's estimated the impact of public banks on interest rates set by private banks using this conduct change in a model of mixed oligopolistic competition. Considering a dynamic panel data, results point for a significant but low influence of public banks on private rivals conduct. Also, results point for evidences that state-owned tends to lend with longer average maturity. These results are presented in details on section 3.6. Before, it's described the institutional design in Brazilian credit market supported by BNDES, the emergence of a public policy oriented to use state owned bank in a broad way between 2008 and 2014 and its end with the new fiscal conservative government. Then, it's derived a simple model of strategic interaction between public and private banks to rationalize the events which occurred on the market. Finally, based

on an identify assumption of a exogenous change on state owned banks conduct, it's estimated the best reply function of non private banks. After results discussion, in the conclusion, it's pointed some cautionary recommendations to banking competition policy.

3.2 INSTITUTIONAL SETTING

Brazil has many state owned financial institutions. Banco do Brasil (BB), for example, is a bank whose 54% of the shares are property of the Federal Government. It's the largest bank in the country in terms of branches and total assets. Credit for industry is one of the main activities of this institution. Caixa Econômica Federal (CEF), other federal bank, is a leader on saving market and real estate credit operations. BB and CEF are the two main public banks on the country with a wide rage of activities (commercial, investments, real estate and savings).

In additional, given a poorly developed capital market, each state has specific agencies for development (*Agencias de Fomento*). They act mainly as intermediaries to receive funding from the National Development Bank (BNDES) in investments related to infra-structure, 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 of 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 the early 2010 (BNDES Annual Reports), even bigger than the WorldBank 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.[4]

All these state owned institutions were used as a counter cyclical instrument after 2008 crisis. This was public announced and the government acted directly to expand credit operations and prevent a bigger downturn on credit markets as private institutions was becoming more precautionary after the massive insolvency crisis in developed markets. BNDES was a main player in this respect with broad subsidized credit lines. BB and CEF also were used by Federal Governments through BNDES or others state financial support (FERRAZ; COUTINHO, 2019; FERRAZ; ALÉM; R.F. MADEIRA, 2013; N. BARBOSA, 2011; IPEA, 2011). In summary, this broad credit expansion was made possible through huge funding from Treasury and it was maintained until 2015.

[4] The information in this section is available at the BNDES website, E. Ribeiro (2017) and E.P. Ribeiro and De Negri (2009).

In a political turnover, this policy came officially to a end in 2017 in line with a more fiscal conservative government. Since 2018, except for a transition period, there is no difference between funding cost from BNDES and the borrowing long term cost for Treasury[5], ie, *a priori* there is no subsidized rate; besides, state owned institutions began to pay the loans took from the Treasury since 2008.

Here, it's summarized a much more complex process with political economy turnovers that happened in Brazil since 2014. However, main objective is highlight a huge change of public banks conduct after the 2008-2014 period. This creates a opportunity for analysis on the influence of public banks in market conduct in a strategic structure with major private banks. For small and medium firms, at the geographical level of the states, these credit lines made available by BNDES represent a significant credit market for the industry, given the role played by the National Development Bank in the country.

3.3 MODEL

Strategic interaction it's modeled between public banks and private ones in a simple version of a mixed oligopoly (DE FRAJA, 1989; BARROS; MODESTO, 1999; BREI; SCHCLAREK, 2013; OGURA, 2018). We have a market with public institutions (np) and private ones (p) competing in prices (r) on a major credit line financed by BNDES. Private institution seeks to maximize a standard profit function. And state owned is subjected to a parameter set by the government (θ): the public institution maximize a linear combination of margins and revenues.

As it was explained in the last Chapter, the credit lines financed by BNDES are a separated component of the bank's asset. Given this, the profit function can be rewritten considering only the loan transactions on this market.

Specifically, for private banks:

$$\pi_p = [r_p - \bar{r}]d_p - F_p \tag{3.1}$$

r_p is the final rate, $\bar{r}$ is the funding cost that banks must pay to BNDES and F_p a fixed cost component.

For public ones: given a θ,

$$\pi_{np} = [r_{np} - \bar{r}]d_{np} + \theta r_{np} d_{np} - F_{np} \quad \forall i, t \tag{3.2}$$

[5] See Chapter 4 for more details of this policy change.

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

$$d_i = \alpha_i - \beta_i r_i + \beta \sum_{j \neq i} r_j \tag{3.3}$$

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

$$r_{np} = \frac{\alpha_{np}}{2\beta_{np}} + \frac{\beta}{2\beta_{np}} \sum_j r_j + \frac{1}{2(1+\theta)} \bar{r} \tag{3.4}$$

And for the private bank:

$$r_p = \frac{\alpha_p}{2\beta_p} + \frac{\beta}{2\beta_p} \sum_j r_j + \frac{1}{2} \bar{r} \tag{3.5}$$

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

We can get a view for the influence of θ on market equilibrium in Figure 5. In E_0 we have the classical equilibrium outcome in a differentiated market with all firms with the same profit function. However, government could use public banks to reduce the equilibrium rate setting a $\theta > 0$. In practice, this means an incentive for public bank expand loans transactions more than it would do with a typical profit function. As it can be seen, E_1 means a lower final interest rate for consumers.

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

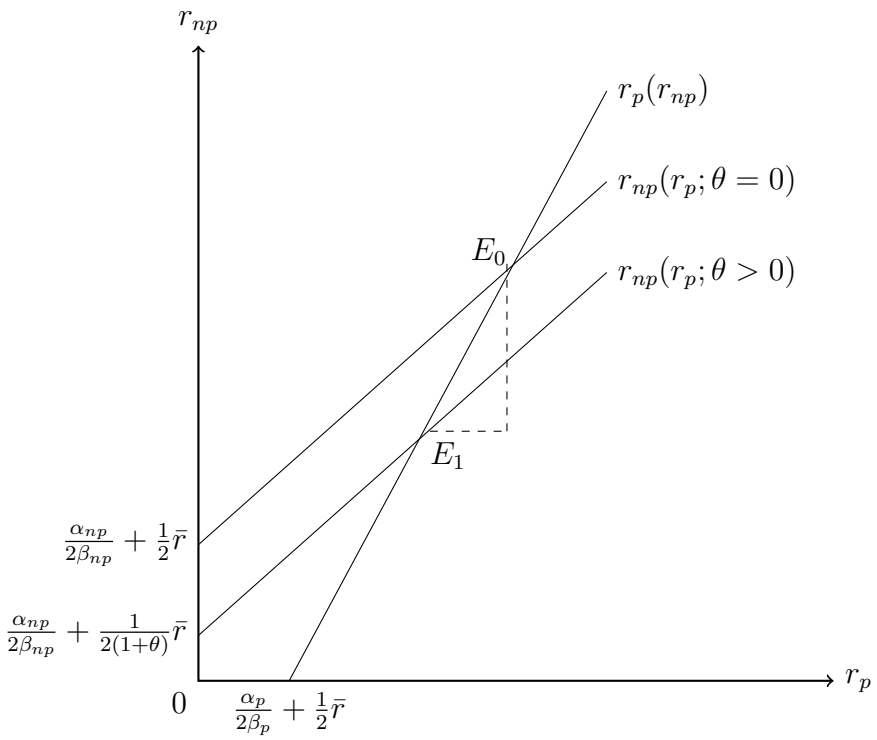
$$r_i - \frac{1}{2}\bar{r} = \frac{\alpha_i}{2\beta_i} + \frac{\beta}{2\beta_i} \sum_{j \neq i} r_j - I_{np} \frac{\theta}{2} \bar{r} \quad \forall i \tag{3.6}$$

Given an exogenous change on θ, it's possible to identify the best reply function of non private banks on this market.

As pointed 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, it's used an exogenous change set by the federal government on the conduct of non private banks - mainly on BB - between 2008 and 2014 through a more broad permissive policy on loan transactions in line with a anti cyclical macroeconomic policy. In terms of the model above, this implies a variation on the intercept of the best reply function of the non private banks (a greater θ) . Using this variation, it can be estimated the function response of private banks. Specifically, the inclination of $r_p(r_n p)$ given by the dashed triangle on Figure 5.

FIGURE 5 – Nash Equilibrium



3.4 EMPIRICAL STRATEGY

Empirical relationship is motivated by Equation 3.6. As in Chapter 2, it's also 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, yielding a dynamic model of loan spreads (BOND; REENEN, 2007). Finally, as we are considering small and medium firms, the relevant market for BNDES credit lines is local or state[6]. We index the market by s. In summary, for private banks we have:

$$r_{i,s,t}-\frac{1}{2}\bar{r}_t=\delta_p(r_{i,s,t-1}-\frac{1}{2}\bar{r}_{t-1})+\phi_{i,s}+\beta_{p,0}\sum_{j\neq i}r_{j,s,t}+\beta_{p,1}\sum_{j\neq i}r_{j,s,t-1}+\alpha_p X_{t,s}+\epsilon^p_{i,s,t} \quad (3.7)$$

Above, we have a specific bank-state effect given by $\phi_{i,s}$, a matrix X for control variables by state-time and a error term $\epsilon_{i,s,t}$. Note that $\sum_{j\neq i} r_{j,s,t}$ is actually endogenous since $r_{j,s,t}$ is a function of $r_{i,s,t}$ as it can be seen in the model on the last section. Part of $\sum_{j\neq i} r_{j,s,t}$ depends specifically of the best reply function of non private banks. Empirical strategy is capturing an exogenous change of $\sum_{j\neq i} r_{j,s,t}$ set by the federal government when changed the conduct (θ) of public banks between 2008 and 2014. Exogenous

[6] For a discussion if the relevant market for financial services is national, state or local, see CADE (2019). Results presented here are not sensible to this definition. We choose state mainly to highlight some market structure differences between regions with strong local development banks and others with basically no significant development bank

assumption for this intervention makes possible to use this period of treatment as a valid instrument. Argument is based on the policy design which was embedded on a more broad macroeconomic policy to prevent a bigger downturn after 2008 and on the use of public banks to subsidised credit after 2010 until 2014. We set PT as dummy variable for this period and we are considering $E[\epsilon_{i,s,t}|PT] = 0$.

Although we could potentially use fixed or random effect iv 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 $E[\epsilon_{i,s,t}|X_{i,s,t}] \neq 0$. Therefore, we use a GMM estimator for a dynamic panel data (ARELLANO; BOND, 1991; ARELLANO; BOVER, 1995) to circumvent the problem posed by the lagged margin (See Appendix).

As illustrated on Figure 5, θ entries 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, we expect, between 2008 and 2014, θ is greater than before and after this period. Our main identify assumption is that between 2008 and 2014 the policy oriented change this parameter causing a exogenous variation on the best reply function of non private banks.

In the model considered, given an exogenous change on public banks conduct between 2008 and 2014, β_0 captures the short-run effect of this policy on margins of the private banks. Consider $\frac{\beta_0+\beta_1}{1-\delta} > 0$, for example, it means that a negative shock on final interest rates set by public banks reduces private margins equilibrium, as we saw in Figure 5.

3.5 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 the composition of its portfolio, the separation between direct and indirect operations is approximately 50% for each modality, as mentioned before.[7]

Information on indirect BNDES operations is provided through its Download Center, which contains data on the value, interest rates, spreads and final cost to borrowers under each contract executed between intermediaries and customers. Based on these data, we calculated bank level spreads using; as well as the market share of each institution in each period. Indirect operations encompass the main funding lines (BNDES Finame and BNDES Automático). It represented 84% of all operations pegged to the TJLP in the period.

[7] Estatísticas de Desempenho BNDES, Jun.2018 Link

We focus attention where the change of public bank conduct, specially BB, was more evident: BNDES Automático. It is “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". [8]

Only loans which the funding cost was pegged to the TJLP were considered. The TJLP is represented in the model by $\bar{r}_t$, rate set independent to all banks. We use monthly data from 2002 to 2017, aggregated to quarterly data, given the frequency of base interest changes.

We also consider as a control for economic cycle industrial production index (PIM) which was mainly affected on the downturn of 2008 and on stagnation beginning on the end of 2014. Information is available on IBGE Time Series DataBase.

3.6 RESULTS

Table 4 provides some descriptive statistics for the set variables considered. Over the period (2002-2017), note that the sum of the average spreads (Margin) and the TJLP, the approximate average final price assessed to the borrower, is 12.9%. This high final interest rate, even with subsidised funding cost, brings attention to competition between banks on Brazilian credit market. Note that the market concentration has a peak on 70%. In 2012, BB was responsible for more than 2/3 of all operation in this credit line.

On Figure 6, we can see the difference on the loans maturity profile between public and private banks. This result is also presented on Grimaldi and R.F Madeira (2016) considering other credit lines of BNDES. Given this, model is also conditioned on maturity (*prazo*).

We can get a view about the differences in market structure before and after the period of intervention by federal government through expansion of public banks on Tables 5- 10. PT is defined as dummy variable for the period of 2008-2015. Out of PT the average margin was 6.36. On this period it reduced to 5.12. Also, public banks had a greater average margin than private ones. When the policy was implemented, margin of public banks fell from 6.36 to 5.12. In the same period, private bank’s margin dropped from 6.0 to 5.0. The funding cost (TJLP) came from 8.6 to 5.7.

Specifically for BB, the average market share triple between 2008 and 2014, as we can see on Table 8. Therefore, it’s not a surprise that HHi increased on the market. On Figure 7- 10, BB market share grew in a significant way between 2008 and 2014, peaking on 2012. On both regions considered, BB became the leader. Note, however,

[8] BDNES Automático, BNDES, Jun.2018 Link

TABLE 4 – Descriptive Statistics - BNDES Automático, 2002-2017

	Margin	TJLP	Market Share	HHi	Maturity	PIM
Mean	5.65	7.25	0.08	0.23	46	5.11
Standard Deviation	2.14	1.94	0.11	0.08	23.83	0.55
Min	1.46	5	0	0.13	0	4.32
Max	19	12	0.70	0.52	146	5.79
N	1624	1624	1624	1624	1624	1624

First column is Bank's margin in loan operation on BNDES Automatico.
TJLP is the funding cost from BNDES. HHi is the Herfindahl-Hirschman Index.
PIM is a monthly index of Industrial production (IBGE)

TABLE 5 – Margins - State Banks In and Out of Period (PT)

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

PT=1 between 2008 and 2014. The period with broad expansion of state owned banks.

TABLE 6 – Margins - Private Banks In and Out of Period (PT)

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

PT=1 between 2008 and 2014. The period with broad expansion of state owned banks.

that on South, it already shares 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 shares this position with private banks, as Itau, Bradesco and Santander.

As we stated before, the main question of this article is that if the change on public banks conduct cause the change on private banks final rate observed on the period, condition on the funding cost. We estimate the response from private banks to a exogenous variation on θ in the best reply function of non private banks (Equation 3.6). In this sense, our baseline approach was to use the period of intervention (PT, dummy variable for 2008-2014) as a instrument to the non private component of ${}_jr_j$ in our model.

Results are robust across models. On Table11, we use the GMM Two-Step estimator as our benchmark given the problems posed by the lagged dependent variable and the endogeneity of ${}_jr_j$. The two step estimator is less restricted for the error variance structure than the one step estimator on the third column. We present OLS and fixed effect iv for start points to compare our baseline approach although they both suffer from bias on standard errors of the estimate parameters.

TABLE 7 – TJLP - In and Out of Period (PT)

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

PT=1 between 2008 and 2014. The period with broad expansion of state owned banks.

TABLE 8 – Market Share - Banco do Brasil In and Out of Period (PT)

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

PT=1 between 2008 and 2014. The period with broad expansion of state owned banks.

TABLE 9 – Margin - Banco do Brasil In and Out of Period (PT)

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

PT=1 between 2008 and 2014. The period with broad expansion of state owned banks.

As a check for the quality of our instruments (IV), we consider the first stage regression for the FE-IV to test that endogenous regressors are unidentified (SANDERSON; WINDMEIJER, 2016). As we can see, we reject the null given a F statistics of 7.91 for the sample period [Table11] and 25.64 for the restricted one[Table12].

Our results point for significant but low impact of public banks on final margins of private banks (our dependent variable as stated on the last section). As we can see on Table 11, for a 1 p.p drop on final interest rate by the public banks, the two step estimator gives a drop of 0.01 p.p on margins of private banks on the short run; on the long run, we have a coefficient of 0.03. The exception is given by the FE_IV estimator. Considering this model, we have a drop of 0.11 p.p on the sort run and a increase of 0.16 on the long run. The maturity ("Prazo") variable is important to explain the dynamics of margins of private banks. Note that as longer tend to be the loan operation smaller tend to be the margin in any specification considered. The industrial production (PIM) coefficient in all models for the short and long run indicates a counter cycle margin which is line with previous find on other BNDES credit lines (CASTOR; E.P RIBEIRO, 2018). Finally, note that 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 an adjustment portfolio managment set by the new government.

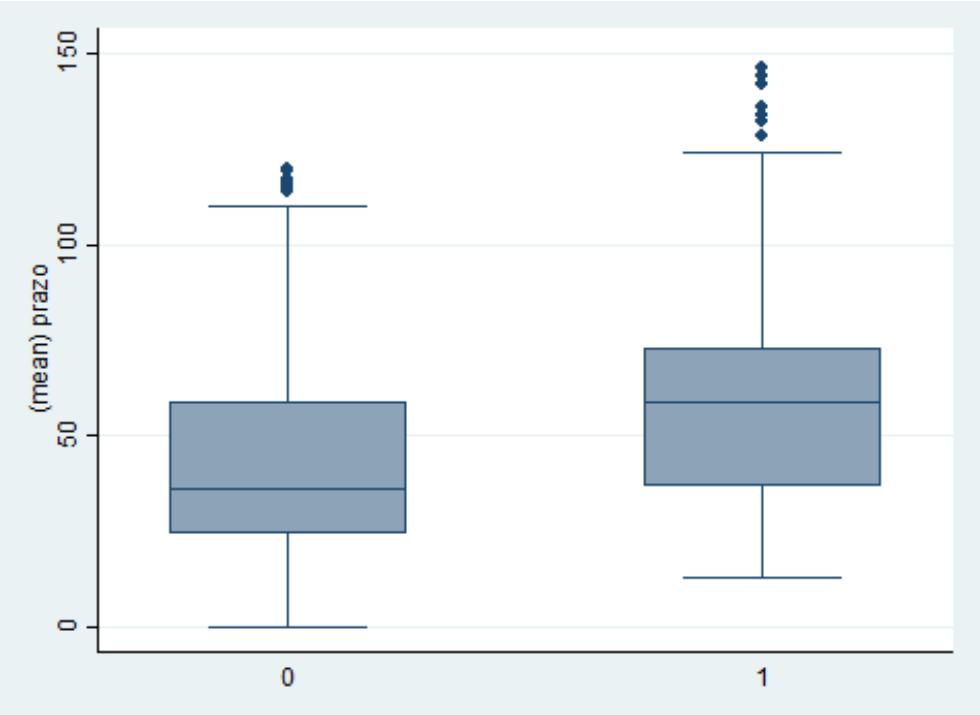
In summary, although we can not discard the influence of public banks conduct on rivals response we found a low inclination of the best reply function of the private

TABLE 10 – HHi - In and Out of Period (PT)

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

PT=1 between 2008 and 2014. The period with broad expansion of state owned banks.

FIGURE 6 – Loan Operation Maturity, BNDES Automático, 2002-2017



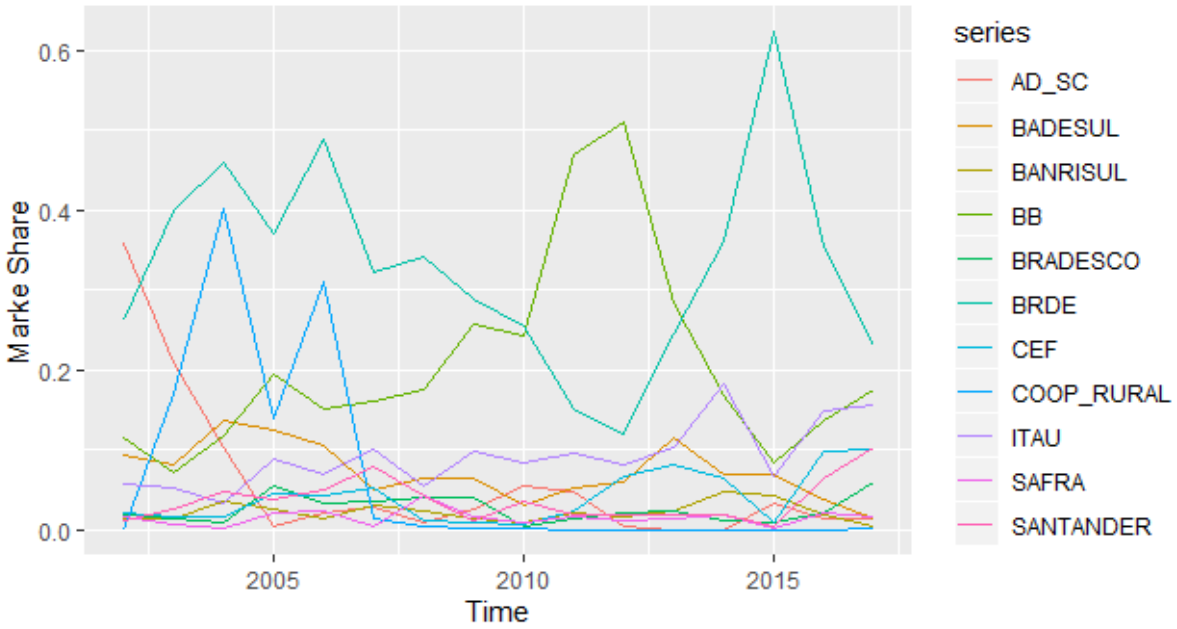
Note: Prazo is the maturity of the loan operation on the data considered (See Section Data).

institutions. Besides, it's important to note that the drop on margins 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 a oligopolistic market and it was found in other credit lines [(TURGUTLU, 2010; CASTOR; E.P RIBEIRO, 2018)].

As a robustness check, we consider the sample only between 2008-2017. In this case, we have a more distinction between periods. For 2008-2014, as we stated before, it's clear a pro state owned bank actuation on the credit market. The period from 2002 until 2007 is not clear for conduct of the public banks. In fact, in terms of the evolution of market share, they are stable in the two market considered, as we can see on Figure 7-10. In any case, the results on Table12 are the same as before.

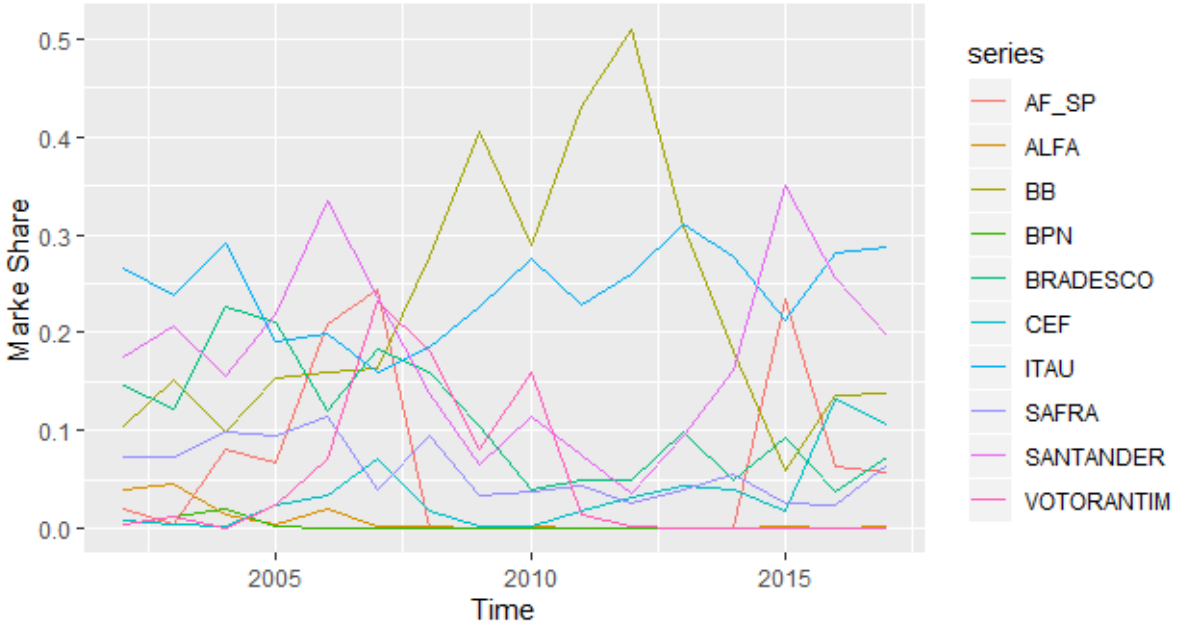
It's also considered a different model specification. Motivated by the price correlation literature, it's modeled banks competing in prices à la Bertrand just as in the case of Moita and Silva (2014). A major difficult for the credit market from BNDES is that the number of equations to be estimated in a VAR setting would pose several difficulties given the number of parameters from the system. Thus, I restrict the analysis

FIGURE 7 – Market Share on South Region, 2002-2017



Note: Banks with a mean market share over the period greater than 4%.For a more suitable visualization, we consider annual market share.

FIGURE 8 – Market Share on São Paulo, 2002-2017



Note: Banks with a mean market share over the period greater than 4%. For a more suitable visualization, we consider annual market share.

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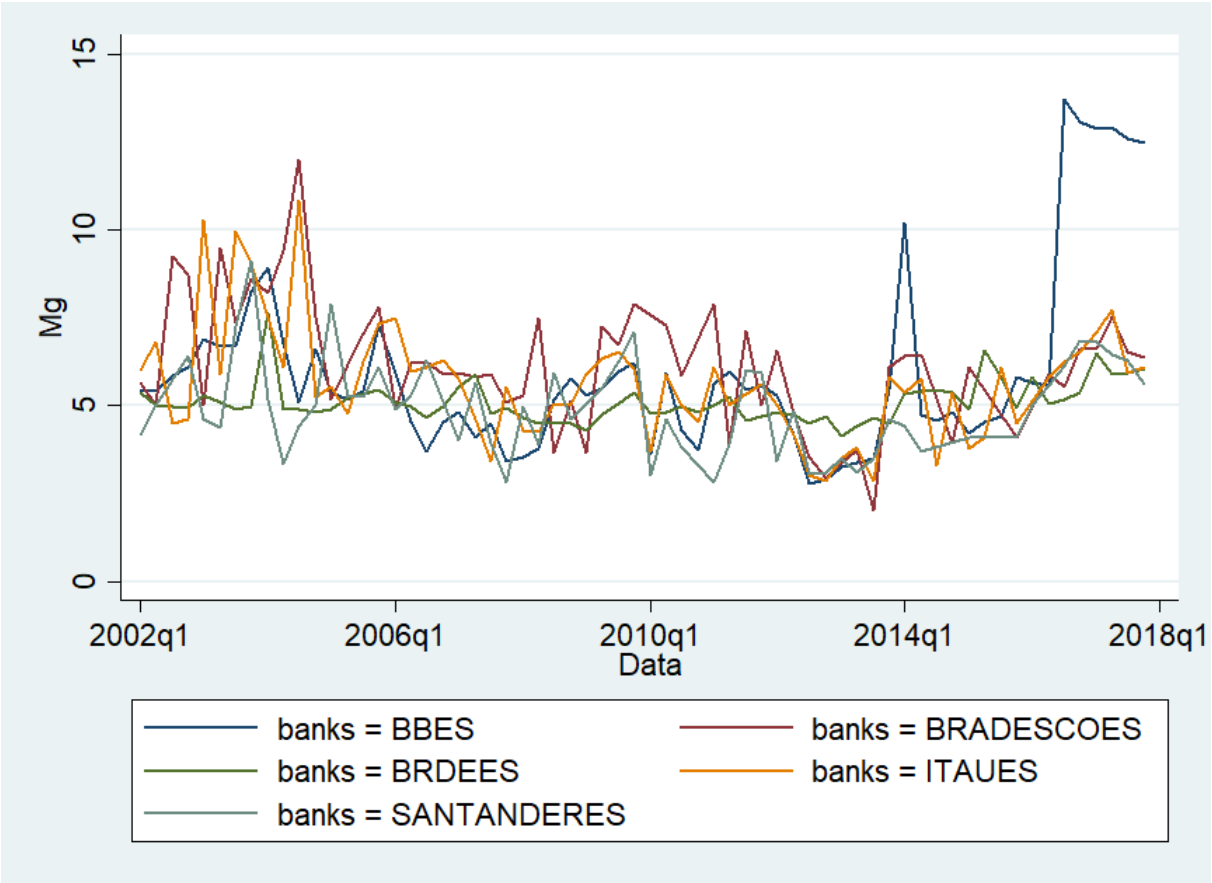
FIGURE 9 – Bank Margin on South, 2002-2017



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 line with adjustment ("cleaning") on the portfolio made by the new government. We control for this variation using a dummy variable for this period.

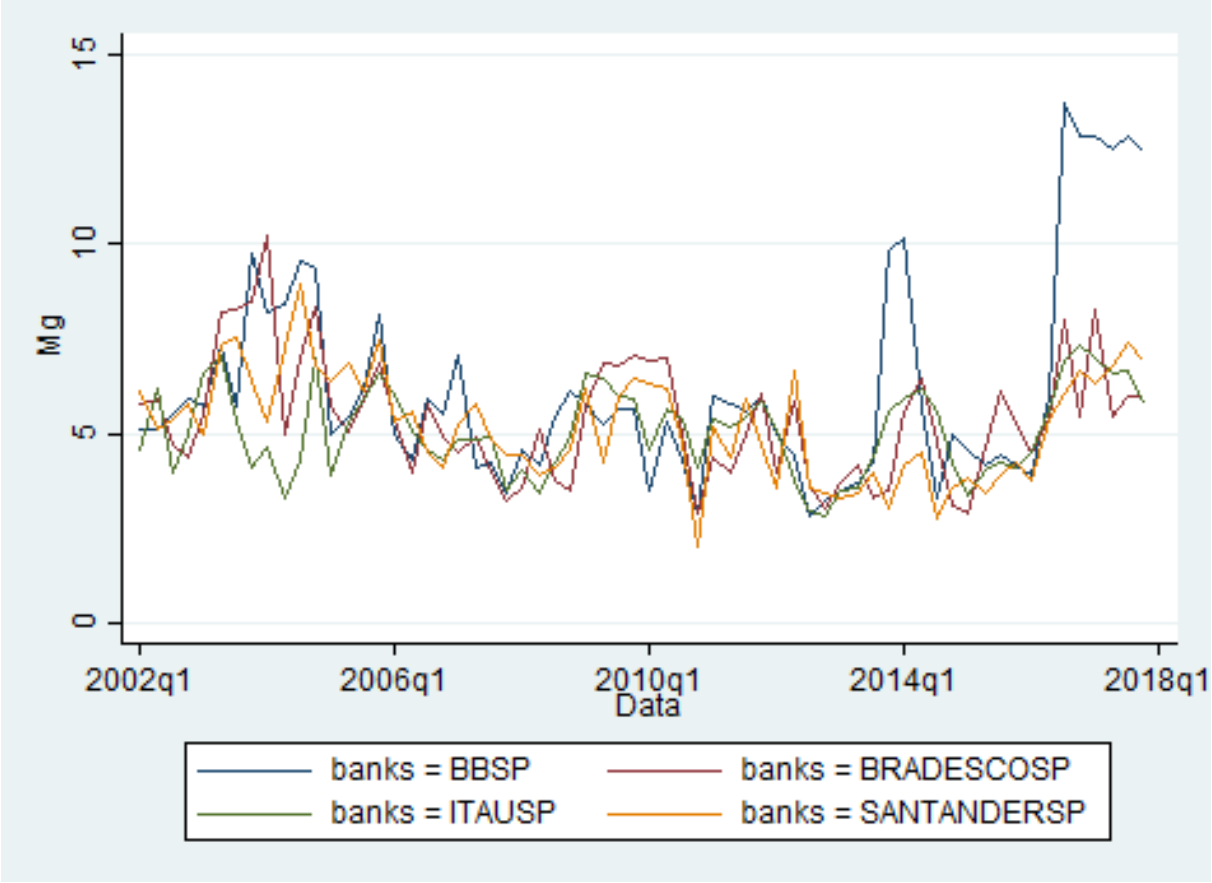
for the major state bank (Banco do Brasil) and three main private banks (Bradesco, Itaú e Santander). Specifically, for bank $i = BB, Bradesco, Itau, Santander$ on the state s in time t:

$$r_{i,s,t} - \bar{r}_{t-1} = \phi_{i,s} + \beta_1^i (r_{i,s,t-1} - \bar{r}_{t-1}) + \sum_{j \neq i} \beta_{j,i}^s (r_{j,s,t-1} - \bar{r}_{t-1}) + \beta_{TJLP} \bar{r}_t + \beta_s X_{t,s} + \eta_{i,s,t} \quad (3.8)$$

In this model, $\beta_{j,i}^s$ would capture the influence of the bank j margin on the margin of bank i on the market s. If $\beta_{j,i}^s \neq 0$ and $\beta_{i,j}^s \neq 0$, it's a case of imperfect competition à la Bertrand. If one of these coefficient is zero it would be the case for a price leadership market structure (MOITA; SILVA, 2014).

Results for Equation 3.8 are in line with a low reaction coefficient for private banks estimated on Tables 11 and 12. As pointed on Table, on average, Itau, Bradesco and Santander have a reaction coefficient estimated in a VAR below 0.03, the long run effect estimated on Table 11.

FIGURE 10 – Bank Margin on SP, 2002-2017



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

TABLE 11 – BNDES Automatico: Models, 2002-2017

Variable	OLS	FE-IV	SYS 1 GMM	SYS 2 GMM
Margin$_{t-1}$	0.62***	0.81***	0.60***	0.62***
Sumj$_t$	0.01***	0.11**	0.01***	0.01**
Sumj$_{t-1}$	-0.00	-0.14**	-0.00	-0.00
Prazo$_t$	-0.03***	-0.02***	-0.03**	-0.022*
PIM$_t$	-4.42**	-13.17**	-4.58**	-4.49*
PIM$_{t-1}$	4.26**	13.24**	4.16**	4.14*
Dum2016	-0.31	0.21	0.10	-0.17
Constant	5.24**	3.50***	5.77**	5.41***
N	809	686	686	686
R^2	0.725			
Hansen			30.93	30.93
AR(1) pvalue			0.001	0.001
AR(2) pvalue			0.139	0.147
F	195.658	156.179	136.86	48.01
Sanderson-Windmeijer		7.91		

Note: *p<.1; **p<.05;***p<.01
The 2 step estimator (SYS 2 GMM) does not impose any restriction on the error variance matrix.
SYS 1 GMM imposes homoskedastic assumption.
PIM is a industrial production index.
AR(k) test for autocorrelation of residuals.
Hansen null hypothesis is validity of over identification of the restrictions. In all GMM models, this was not rejected.
$Dum2016$ is a dummy variable for control the variation of margins after 2016q2 as we seen on the last section as a result of shrink on BB activities on credit market.
In Fixed Effect and GMM models, PT was used as instrument.

TABLE 12 – BNDES Automatico: Models, 2007-2017

Variable	OLS	FE-IV	SYS 1 GMM	SYS 2 GMM
Margin_{t-1}	0.67***	0.76***	0.55***	0.52***
Sumj_t	0.01**	0.06*	0.01*	0.01*
Sumj_{t-1}	-0.01	-0.07**	-0.01	-0.01
Prazo_t	-0.02***	-0.01**	-0.02*	-0.02
PIM_t	-2.25	-8.09*	-3.84**	-4.65*
PIM_{t-1}	2.19	8.37	3.66**	4.71*
Dum2016	-0.24	0.80	0.85***	0.91**
Constant	4.41***	2.11***	4.91***	3.98
N	535	461	461	461
R^2	0.673			
Hansen			23.46	23.46
AR(1) pvalue			0.001	0.002
AR(2) pvalue			0.029	0.042
F	195.658	156.179	166.20	48.01
Sanderson-Windmeijert		25.64		

Note: *p<.1; **p<.05;***p<.01
The 2 step estimator (SYS 2 GMM) does not impose any restriction on the error variance matrix.
SYS 1 GMM imposes homoskedastic assumption.
PIM is a industrial production index.
AR(k) test for autocorrelation of residuals.
Hansen null hypothesis is validity of over identification of the restrictions. In all GMM models, this was not rejected.
$Dum2016$ is a dummy variable for control the variation of margins after 2016q2 as we seen on the last section as a result of shrink on BB activities on credit market.
In Fixed Effect and GMM models, PT was used as instrument.

TABLE 13 – $\beta^s_{j,i}$ VAR estimation - BNDES Automático, 2002-2017

	Itau	Bradesco	Santander	BB
Itau	1	0.012*	0.013*	0.023*
Bradesco	0.021*	1	0.011	0.018*
Santander	0.019*	0.148*	1	0.023*
BB	0.021*	0.023*	0.029	1

Cells represents the reaction coefficient in the VAR equation specific to the bank in line table. Columns are the regressors.
***, **, * indicate that the parameter is statistically significant at a confidence level of 1%, 5% and 10%, respectively.

3.7 CONCLUSION

The role played by public financial institutions is a broad topic on emerging economies, given a poorly capital market. In this scenario, big banks could exercise market power restricting capital supply which is necessary for higher investment rate 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 conduct of policy motivated public ones.

This article estimates the response of private banks to changes on conduct of state owned banks in a differentiated oligopolistic market structure using a exogenous change set by the more pro state government between 2008 and 2015 and the later more conservative policy posed after 2015. Given the assumption of exogenous change on the role played by state owned firms, it's possible to circumvent a major problem posed by endogeneity issues when estimates best reply functions. Using a representative credit market (BNDES Automatico), financed by BNDES, with detailed loan data, it's estimated a dynamic panel data to test the predictions of the mixed oligpolistic model of strategic interaction between public and private banks. It's also considered a VAR setting to estimate reaction coefficient for a set of major banks over the sample period to verify the results from the first model.

On average, given a funding cost, margins of private banks drop 0.01 p.p in response to a reduction of 1 p.p on the final interest of public banks. On the long run, spreads reduces in 0.03 p.p. Although low, this estimates poses the possibility that state owned institutions have a relevant role on banking competition, specially on a concentrated market structure. Our results are robust to change on sample period and controls used. VAR model results are in line with low reaction coefficient below 0.03 p.p for all big banks considered.

Results also pointed for public institutions with higher margins than private ones, although the loans of the first have a longer maturity than the latter. The open questions are how efficient are public banks and what are the fiscal costs of a government policy which induces this institutions acting in a more aggressive way. In this sense, it's possible to exist a trade-off between this kind of policy with positive results on market competition and a responsible fiscal policy. At the same time, the analysis of benefits and costs of the alternative scenario with no state owned banks must be considered in a more complex scenario where market failures presented in weak capital markets are significant.

In general, this work tries to shed some light on the debate related to the role played by the public banks in a turbulent period for the Brazilian economy. At same time, discussions about this question was absent on reforms (Agenda BC+, for example)

proposed to get a more competitive credit markets. In this case, policy makers focused on topics related to a more open financial market to fin-techs, default registers, reduction of funding cost through less capital taxation and others supply side proposals. By other side, discard the relevance of public banks on competition seems exacerbated given the evidences that is available today.

4 INTEREST RATE POLICY, CREDIT SUBSIDIES AND BANKING MARGINS

ABSTRACT

What's the effect of a subsidised funding cost in banking margins? Brazilian National Development Bank (BNDES) recent experience offers some insights. Between 2002 and 2017, BNDES interest rate for financial intermediaries - TJLP - was a rate independent of the base rate set by the Central Bank. Since 2018, a new rate (TLP), more aligned to the long term borrowing cost for the Treasury, replaced the subsidised rate. Data from a major BNDES' credit line for small and medium firms pointed the average price-cost-margins have grown significantly after 2018. Besides, considering a dynamic panel data derived from a simple oligopolistic credit market, I estimate an increase on final banking margins of 0.7 p.p after TLP, condition on the funding cost, the base rate and intra-sector demand shocks. Finally, under TLP, I also estimate the equation for banking margins finding a negative reaction coefficient for the funding cost just as it was obtained for the base rate under the period of TJLP (2002-2017). This result is in line with a basic term structure from a New Keynesian model where the long term rate moves on the same direction as the short term rate set by the Central Bank. This is a new found in the credit subsidy effect on markup dynamics in line with previous literature findings which pointed for financial margins offsetting the monetary policy in scenarios where the funding cost is totally dependent of the base rate.

Keywords: banking, spreads, interest rate.

4.1 INTRODUCTION

Industries financed by development banks are pervasive on emerging economies. Given a weak and less competitive private credit markets, these institutions use a broad range of finance designs to focus on small and medium firms, innovation and infrastructure. One particular instrument is subsidised interest rates[1]. According to the Global Survey of Development Banks (DE LUNA-MARTINEZ et al., 2017), 51% offer credit products with a mix of market-based and subsidized rates. Besides, 64% have private financial intermediaries which lend to the final client (industry) using the funding from the development bank. Particularly, this is the case of the Brazilian Development Bank (BNDES). From a theoretical perspective, there is some justification related to positive externalities, credit rationing and the need to finance strategic sectors for the economy. These topics motivate a important role for this kind of development institution (ARMENDÁRIZ, 1999; DIAMOND, 1957; LAZZARINI et al., 2015; MAZZUCATO; PENNA, 2016). In addition, subsidy rates are also view as a amplifier of fiscal policy effects which could potential attenuate high and volatile credit spreads (CORREIA; FIORE, et al., 2018). Also, subsidy has a impact on credit market equilibrium through a intensive margin where credit demand goes up as the funding cost falls; and a extensive margin where new borrowers, who otherwise had no access to finance without the subsidy, entry on the market (LUCAS, 2016; Joseph STIGLITZ; WEISS, 1981). Finally, direct benefit or loss for consumers is a function of supply and demand elasticity's. In this case, a focal point is the pass through for the final interest rate set by the banks. In other words, how sensible is the banking margin to a subsidy on credit loans. I address this question using a major shift on Brazilian legislation in 2017 which replaced a long term subsidised interest rate (TJLP) by a rate more aligned to market rates (TLP) for loan operations from BNDES.

In addition, TLP was created in line with a series of Central Bank's proposals to get a more competitive banking industry (Agenda BC+). The idea is that the final interest rates on private credit markets (on average, 39.9% compared to 3.7% for the credit lines from BNDES and Caixa Econômica Federal)[2] were high because a series of market structure inefficiencies, including that BNDES rate was subsidised.

However, one point that was not discussed along the creation of TLP was the

[1] Following the definition from Velde and Warner (2007), "*A subsidy is an explicit or implicit transfer from the public sector to the private sector resulting in a different set of conditions and prospects for private sector projects than would normally be the case without such transfers*". Formally, in our case, subsidy is the difference between the interest rate for loan operation from the National Development Bank and the rate which would occur if there is only a private credit market. As we do not have this counterfactual, this article considers a subsidy the difference between the interest rate for loans from the National Development Bank and the borrowing cost for the Government funding this institution.

[2] Relatório Grupo de Trabalho Comissão de Assuntos Econômicos, Inovação e Competição: novos caminhos para redução dos spreads bancários (custos e margens da intermediação financeira), 2018

possible effect of a subsidised funding cost on banking competition between BNDES' financial intermediaries. In this article, I use the BNDES experience with the end of TJLP to capture the effect of this legislation change on banking margins from a representative credit market for small and medium firms.

A major limitation here is that I do not make any estimates of causal impact of the new resolution, given the policy design affected all banks at the same time and it's not possible to get a counterfactual. Nonetheless, I consider this article as a first approach to shed some light on what happened to BNDES' financial intermediaries banking margins after TLP. After all, this may be relevant for policy makers interested in designing a more competitive banking market structure.

In this sense, this article is an application to a major credit line on Brazil of Hofstetter, Tovar and Urrutia (2011) who estimated the subsidy pass-through to mortgage loans on Colombia. It's also motivated by the results of Correia, Fiore, et al. (2018) related to the impact of credit subsidies on the business cycle through its effect on financial margins. Besides, in times with more questions about the role of Development Banks, this article seeks to fill a gap on applied literature related to banking margins and subsidised funding cost from these institutions.

Historical and institutional background of BNDES are presented on the following section. Then, I get a reduced form equation for banking margins on a credit market derived from a oligopolistic model with homogeneous product for banking in order to capture the effect on financial margins on the BNDES credit market since the legislation change in 2017. Results section shows a increasing on price-cost-margins (PCM) for the financial intermediaries after TLP (2018-2019). Also, for this period, the PCM reaction coefficient to the funding cost became negative, the same sign estimated under TJLP period (2002-2017) for the base rate. This result is in line with a basic term structure from a New Keynesian framework where the short term rate set by the Central Bank is positively related to the long term rate for the Treasury's bonds. Finally, a conclusion sums up potential discussions about the results.

4.2 INSTITUTIONAL BACKGROUND

On the post second war period, few institutions represent Brazil's historical changes as well as the National Development Bank (BNDES). This institution is always a focal point on theoretical and political disputes about paths toward the development. Created in June 1952 to funding the expansion of the electric, transport and oil industry, BNDES emerged as the responsible to finance the industrialization of a natural resource exporting economy. At that time, economic literature for Latin America was dominated by the "imports substitution" view from *Comissão Econômica para a América Latina e o Caribe* (CEPAL). Industrialization was the main objective and all the financial instruments

to sustain capital accumulation were considered a necessary condition for development (BIELSCHOWSKY, 1998). A interest rate policy with credit subsidies is a example for such interventionist view (CEPAL, 1976).

From a international perspective, in the 50's and 70's, development banks were regarded as one of the main responsible for structural changes on underdevelopment economies. Through direct funding from the government which centralised internal and external capital resources, these institutions had played a fundamental role in shaping rapid growing national firms and also had helped preserve infant industries from imports competition (IDB, 2005).

However, since the 1980s, critics of these institutions have gained increasingly political influence. On the theoretical side, economic literature has been pointed the perverse effects of government failures (LE GRAND, 1991; WOLF, 1979). In this view, state owned institutions were evidences of corruption, elite capture and bad economic decisions. Privatization came as a solution to the third world problems such as lack of efficiency and it was used as a condition for financial aid agreements with IMF and World Bank on recurrent debt crisis along the 80's and 90's. Finally, weak capital markets on these economies were considered a result of unnecessary financial subsidies from state owned banks which prevent competition on private markets. In this sense, as the economy turns more open to international capital flows, this lack of funding for long term projects would be mitigated (YEAPLE; MOSKOWITZ, 1995).

Brazil's history is not so different. After a strong growth performance on the 50's, the military dictatorship took power in 1964 with a austerity policy to stabilize prices and wages (BASTIAN, 2013). However, the influence of development policies from State on the economy was rapidly recovered with a broad range of interventions on strategic sectors like energy, transport, oil, agricultural and construction (CASTRO et al., 2011a). To illustrate this, in 1966, two years after the *coup*, the Government created the main BNDES credit line for machinery acquisition from national suppliers and plant expansion of small and medium firms, the *Agência Especial de Financiamento Industrial*, **Finame**. This credit line was viewed as a strategic policy for Brazilian industrialists (COSTA; MELO; ARAUJO, 2016).

Finame credit line is based on a institutional design where a client (industry) goes to a commercial bank and asks for a BNDES credit line. In this sense, banks are free to set their own loan rates but bear the risk of default. In this way, the banks act only as financial intermediaries for the BNDES credit products.

Historical evidences suggest that the cost for all loan operations from BNDES, including Finame, have always been subsidised. Either because a cap of 12% on interest rates until 1963 (Usury's Law) in times with inflation above 20% or because high external borrowing cost for the government along the 70's and 80's, given a fiscal,

balance of payments and inflation crisis.

At what rate should BNDES lend? was not a question for the government until the 90's in a scenario where the main objective was to make possible the development of a industrial economy with less external dependence. The fact is that the unbalances generated through a series of state policies to sustain a rapid growth and a structural change from a agrarian to a urban emerging economy were faced along the 90's.

The question above based of one the main transformations during the price stabilization period. In 1991, Congress approved a law (*Lei 8.1777, 01 de Março de 1991*) which aimed to end a history of indexation on Brazilian economy through the introduction of a forward looking reference rate, called Taxa Referencial - TR (CASTRO et al., 2011b). This rate was basically a average of interbank insterest rate and it was used to base all the funding for BNDES credit operation. In 1994, four months after the introduction of a new currency (Real), Federal Government recognized the difficulties for finance BNDES' operations given the macroeconomic stabilization strategy and the 91's Law.

On the macro side, a tight monetary policy was applied through a high base interest rate to sustain a fixed exchange rate and a stable aggregate demand (CASTRO et al., 2011b). At the same time, the rate which based the BNDES operation (TR) was perceived as extremely high for the objectives of a development bank. Even in a scenario where the government was skeptical about the efficiency of the past development model based on a interventionist state, at that time policy makers openly advocated for a active investment policy from BNDES for capital accumulation and growth.[3]

In this sense, the question of how much BNDES should charge for its loans was answered in a way which reconciled respect for the market mechanism (less intervention) and the recognition that much of the long-term financing was state-dependent (more intervention). On Dec. 1994, government implemented a new resolution (*Medida Provisória 802, de 30 de Dezembro de 1994*) creating the *Taxa de Juros de Longo Prazo* (TJLP) to base the cost for BNDES funding. Also, the National Monetary Council was responsible to set this new rate[4].

Persio Arida, president of BNDES at that time (94) and of one the main authors of the new Law, argued that the BNDES rate should be similar to the Treasury borrowing cost from the market considering bonds with a similar maturity to BNDES loan portfolio (COSTA; MELO; ARAUJO, 2016; BCB, 2019). Note that this point consider that base rate, a short term rate aligned to the monetary policy mandate for price stabilization,

[3] See *Exposição de Motivos da Medida Provisória nº 802, de 30 de Dezembro de 1994* where the Finance and Industry Ministers exposed the main problems posed by the stabilization strategy and the 91's law for a investment policy from BNDES.

[4] The President of Central Bank, the Finance and the Industry Ministers are part of this Council.

should be different than the BNDES rate, a long term rate to sustain a capital accumulation for a emerging economy. The main problem of this propose was at that time Brazilian Treasury did not have significant long term liabilities. That's why National Monetary Council set the TJLP to reflect the interest rate for long term foreign debt after the law was approved by the Congress. As we can see on Figure 11, TJLP was sensible to the Asian Crise of Dec.98 when liquidity for emerging economies fell abruptly.

On October 1999 (*Medida Provisória No 1.921, de 30 de Setembro de 1999*), a new change on TJLP set the inflation target and a risk premium as determinants for the BNDES rate. There was no surprise here given since June of this year, Central Bank had adopted a inflation target regime (N. BARBOSA, 2011).[5]

Between 2000 and 2017, there was no significant change on TJLP legislation. However, between 2000 and Jul.03, the difference between Selic and TJLP have peaked. Along 2002-03, the main reason was the turbulent period for the monetary policy. At that time, the victory of the opposition party to the pro-market incumbent government brought some fear to the financial markets.

From 2004 until 2014, BNDES had been under a new period after a decade plying a role in designing privatization of major state companies. In line with a more interventionist view from the left wing government, this institution was directly used for a long term project to sustain a major development policy and in some years had a portfolio equivalent to almost 10% of the GDP and it was responsible to 20% of loans on the Brazilian credit market (LAZZARINI et al., 2015).[6] In line with a counter cyclical role for development banks, for example, after the 2008 crisis, a broad credit easing with fixed (subsidised) interest rates on loan operations was implemented to sustain investment at a desirable level.[7] In addition, over this period, TJLP was a direct instrument used by the Finance Ministry to oppose the base rate that was under control of Central Bank[8]. In summary, it was a period with a active role for BNDES which became much larger in size and scope.

After fourteen years of a discretionary policy on TJLP, over the course of 2017, the new government announced a series of changes on BNDES operational policies, including the replacement of this rate. Discussions on the fiscal impact, objectives of

[5] The Real Plan was based on a fixed foreign exchange rate. However, in Jan. 99, Central Bank had to deal with a huge market pressure against Real. Following this, a flexible exchange rate and an inflation targeting regime was established to sustain market expectations and preserve the price stability.

[6] This is also a controversial period for the policies implemented by the bank. Critics question the accountability of the institution. Corruption on lending activities and bad economic decision to funding major national groups are also always pointed by harsh opponents of the BNDES. By it's turn, this institution has sustained that policies implemented along these years followed independent guidelines.

[7] PSI was a credit line which ends in 2015. Final interest rates were set by the government as fixed nominal rates covering a fixed bank spread (at 3 p.p. or 1.7 p.p. depending on the firm size).

[8] At that time, different views between the Finance Minister and the President of Central Bank were a recurrent topic on newspaper. See for example Folha de São Paulo, 2005

the bank and a series of other issues were tabled throughout the process[9].

Finance Minister at that time and BNDES board members were the main authors of the new resolution which created the Taxa de Longo Prazo (TLP). The point was to align the funding cost for BNDES with the borrowing cost for the Government, the initial idea brought by Persio Arida on 90's.[10] Specifically, TLP is based on NTN-B5, a Treasury bond for five years, and the inflation rate for the last two months[11].

BNDES's President have summed up this view in 2019: *We know that TJLP were a mechanism for elites to escape from a tight monetary policy to sustain a stable fiscal policy. This scenario changed with TLP, a rate aligned with the long term cost for the Treasury borrows from the market* (Valor Econômico, 26.02.2019). Besides, Central Bank president also pointed TLP as a way to get a more competitive credit market along a series of proposals to foster competition on financial markets (Agenda BC+)[12]. He said: *TLP will be the reference rate for BNDES, turning monetary policy more efficient and contributing to a lower structural interest rate for the economy and a more strong private capital market* (Estado de São Paulo, 03.04.2018). The same idea was presented by Report from BCB which stated that TLP was a necessary condition to get a lower final interest rate for industry and consumers.[13]

As we can see, this legislation change is in line with a broad attempt by the government to get a more competitive private credit market on Brazil. Policy makers openly announced as one of the main objectives of this reform to change the conduct on banking industry. In this sense, this article is a first attempt to consider the effects of TLP on the BNDES' financial intermediaries margins on a major credit line (Finame) for small and medium firms.

4.3 MODEL

The market is made up of N banks. Each bank is an institution engaged in intermediation activities, i.e. fund-raising (D) and lending (L). Here, the financial intermediary i is confronted with the following operational cost function:

$$C(D_i, L_i) = \gamma_d D_i + \gamma_l L_i \tag{4.1}$$

[9] BBC, 2017
Fazenda.Gov, 2017

[10] See *Exposição de Motivos Medida Provisória Nº 777, de 26 de Abril de 2017*

[11] $TJLP_t = (1 + IPCA_t)(1 + TLP - Pr)$. $IPCA_t$ is a average for the inflation rate for the two months before and TLP-Pré is a average for the rate for 3-Year Treasury Bond.

[12] BC+ Competitividade

[13] Relatório de Economia Bancária, Banco Central, 2017

And a profit expression given by:

$$\pi_i = r_{li}L_i + rM_i - r_{di}D_i - C(D_i, L_i) \tag{4.2}$$

Where L_i is the credit loaned at a rate of r_{li}. M_i is the bank's net position in the interbank market, paid at an exogenous rate (set by the Brazilian Central Bank) r. D_i is the total funds raised by the bank, at a rate r_{di}. The bank's liquid position can be rewritten as: $M_i = (1-\alpha)D_i - L_i$ where α is the portion of funds raised withheld by the Central Bank as compulsorily deposits. One can rewrite the profit function in terms of loan spreads $(r_l^i - r)$ and funding cost $(r(1-\alpha) - r_d^i)$:

$$\pi_i = (r_{li} - r)L_i + (r(1-\alpha) - r_{di})D_i - C(D_i, L_i) \tag{4.3}$$

In terms of Finame design, product (loans) is homogeneous to all BNDES's financial intermediaries. Besides, competition in quantity seems to fit more the strategic setting of this credit line given financial intermediaries may work with sales goals as anecdotal evidence suggests. Assuming Cournot competition, the demand for loans is a function of the bank's own loans L_i and the rest of the banks $r_l(L_i + \sum_{j\neq i} L_j)$ and the rate that each bank must offer (r_d) for raising funds is a function of the total volume of available resources in the market: $r_d(D_i + \sum_{j\neq i} D_j)$.

Banks select (D_i, L_i) to maximize profits below conditional on the response of each competitor (D^*_{-i}, L^*_{-i}):

$$\pi_i = [r_l(L_i + \sum_{j\neq i} L_j) - r]L_i + [r - r_d(D_i + \sum_{j\neq i} D_j)]D_i - C(D_i, L_i) \tag{4.4}$$

Considering only bank i, in the symmetric equilibrium case, the first order conditions can be rewritten to yield the well known market mark-up rule, or loan spread over loan rate expression, where the bank i market share is $s_i^* = \frac{1}{n}$ and the market elasticity for loans is $\epsilon_l = -\frac{\partial L_i^*}{\partial r_l}\frac{r_l}{L_i^*}$:

$$\frac{r_l^* - (r + \gamma_l)}{r_l^*} = \frac{s_i^l}{\epsilon_l(r_l^*)} \tag{4.5}$$

$$\frac{r(1-\alpha) - (r_d^* + \gamma_d)}{r_d^*} = \frac{s_i^d}{\epsilon_d(r_d^*)} \tag{4.6}$$

Focus on the relationship between the base interest rate r and the loan interest rate r_l^*, as freixasrochet show, given the elasticity, in the extreme case of perfect competition ($s_i^l \to 0$), the banks pass through only the increase in r. On the other

extreme given by cartel equilibrium or monopoly ($s_i^l = 1$), the cost pass through is greater than one.

Model is expanded including loans from a funding source that requires a funding cost that differ from deposits (see also vanhoose). This external organization[14] provides lending funds at a different rate $\bar{r}$. These funds are targeted as they cannot be used for other lending. Lending activities are divided in two: L_i and $L_l^{'}$, where the later are the external institution funded loans. The funding rate in the second market, $\bar{r}$, is determined by the organization. We also assume, following the institutional design of BNDES indirect loans for capital goods we study, resources are only transferred to the bank balance sheet once a loan is signed, i.e., there is no inventory of funds for the lending bank to manage.

The profit function in this case is:

$$\begin{aligned}\pi_i =&[r_l(L_i + \sum_{j\neq i} L_j) - r]L_i + [r - r_d(D_i + \sum_{j\neq i} D_j)]D_i + [r_l^{'}(L_i^{'} + \sum_{j\neq i} L_j^{'}) - \bar{r}]L_i^{'} \\ &- C(D_i, L_i, L_i^{'})\end{aligned} \tag{4.7}$$

In the loan market funded by the organization, bank spreads follow the usual:

$$\frac{r_l^{*\prime} - (\bar{r} + \gamma_{l'})}{r_{l'}^*} = \frac{1}{N\epsilon_d(r_{l'}^*)} \tag{4.8}$$

In a comparative static analysis, under perfect competition and a finite demand elasticity, $|\epsilon_l| < \infty$, a positive shock in $\bar{r}$ will not alter the spread $(r_{l'}^* - \bar{r})$. Under imperfect competition, bank spread increase with an increase in the funding cost and this increase is greater further the market is from perfect competition.

An important question for banks involves the possibility of interdependence of asset and liability decisions (VANHOOSE, 2017). This point is more clear by dividing bank assets into loans and bonds, and bank liabilities into deposit funds (D) and non-deposit funds (N). The bank's profit function is thus altered as follows:

$$\pi_i = (r_l^i - r)L_i + (r_l - \bar{r})L_i' + (r(1-\alpha) - r_d^i)D_i + r_s S^i - r_N N_i - C(D_i, L_i, S_i, N_i) \tag{4.9}$$

r_s is the interest on public bonds, exogenous to bank. r_N is a function (analogous to D) of $N_i + \sum_{j\neq i} N_j$. L_i the volume of loans on the credit market without BNDES and

[14] The term external organization is used to make clear that this institution does not provide direct loans to customers and thus do not compete directly with banks. The strict and high loan thresholds enforced by BNDES suggest this assumption.

r is the fund-raising cost given by the base interest rate; L'_i is the volume of indirect BNDES funding lines and $\bar{r}$ is the cost of fund-raising given by the TJLP.

The bank's objective is to make a selection $(L_i, L'_i, D_i, S_i, N_i)$ so to maximize profit. We assume that in the bond market, the bank has no market power. In the remaining markets, it encounters a negatively sloped demand curve.

From the first-order conditions and using a demand elasticity adjusted for market share, we obtain:

$$\begin{aligned} r^*_L &= [\frac{\epsilon_L}{(\epsilon_L - 1)}](r + \gamma_L) \\ r^*_{L'} &= [\frac{\epsilon_{L'}}{(\epsilon_{L'} - 1)}](\bar{r} + \gamma_{L'}) \\ r^*_D &= [\frac{\epsilon_D}{(\epsilon_D - 1)}](r(1-\alpha) + \gamma_D) \\ r^*_N &= [\frac{\epsilon_N}{(\epsilon_N - 1)}](r + \gamma_N) \\ r_s &= \gamma_S \end{aligned} \tag{4.10}$$

Therefore, the economy's base rate (r) does not determine the equilibrium level of the rate charged by the financial intermediaries of BNDES, which is determined rather by $\bar{r}$, the market elasticity and corresponding marginal cost. If we rewrite the first-order condition in market L' (BNDES funding lines) in terms of spreads $(r_{L'} - \bar{r})$, we get:

$$\begin{aligned} r^*_{L'} - \bar{r} &= \beta_1 \bar{r} + \beta_2 \gamma_{L'} \\ \beta_1 &= [\frac{1}{1 - \epsilon_{L'}}] \\ \beta_2 &= [\frac{\epsilon_{L'}}{\epsilon_{L'} - 1}] \end{aligned} \tag{4.11}$$

The term $\beta_2 \gamma_{L'}$ reflects the operational costs to provide these loans. We can assume that these are constant per loan amount[15].

Under this separability in the profit function of external loans and own loans, the base interest rate does not affect the loan spreads unless they represent demand shifts that alter demand for loans itself. And this is exactly what is expected for monetary policy in an inflation targeting regime. For example, consider a recessionary shock (increase in the basic rate r). In this case, given inflationary expectations, interest rates will rise. If the demand for aggregate investment is a decreasing function of the (real) interest rate then the demand for credit in the economy will fall (BERNANKE; GERTLER, 1986), including the demand for BNDES credit, even if its interest rate does not change. Other questions regarding business expectations may also play an important role here: if an

[15] The anecdotal evidence would appear to suggest that costs in connection with loan processing do not vary significantly over time.

increase in the base rate signals to market agents a deterioration in economic activity, the perspectives for future receipts, for a given investment, will also worsen, reducing the agent's expected profit margins. In the BNDES credit market, this trend is reflected by a leftward shift in the demand curve.

4.4 EMPIRICAL STRATEGY

Empirical approach is based on Equation 4.11. This model is expanded including shifts in the demand for loans to control for changes in the demand elasticity. It's also considered 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, yielding a dynamic model of loan spreads (BOND; REENEN, 2007). The same dynamic specification is seen in Almarzoqui and Naceu (2015), Maudos and Solis (2009), and Turgutlu (2010). Bank i spread on period t, denoted by $r^*_{i,t} - \bar{r}_t$, is the difference between the final loan interest rate and the funding cost (interest charged by BNDES to banks that contract BNDES funded loans). Model is specified:

$$\begin{aligned} r^*_{i,t} - \bar{r}_t =& \rho_1(r^*_{i,t-1} - \bar{r}_{t-1}) + \rho_2(r^*_{i,t-2} - \bar{r}_{t-2}) + \beta_1 r_t + \beta_2 r_{t-1} + \gamma_1 \bar{r}_t + \gamma_2 \bar{r}_{t-1} + \\ &+ X_t^{'}\theta + \delta_i + \epsilon_{i,t} \end{aligned} \tag{4.12}$$

The matrix $X_{i,t} = [HHi_t; BK_t]$ measures model shifters. HHi_t is the market's Hirshman Herfindahl Index. A higher HHi increases the pass-though from costs to spread. BK_t is an indicator of capital goods production[16]. The idea here is to control for potential sector demand shocks. Both indicators can be considered endogenous (or only pre-determined) as there is a well known endogeneity between markups and concentration and, at the same time, the capital goods activity level may depend on the price of loans that finance their sale. $r^*_{i,t}$ is the final rate charged, at t, by intermediary i to the borrower of the external organization's funding line. $\bar{r}_t$ is the cost of borrowing funds from the external organization. r_t is the economy's base interest rate. Set by a external committee, $\bar{r}_t$ is exogenous with respect to individual bank shocks. r_t is exogenous, as the Brazilian Central Bank does not consider the performance of an individual bank's idiosyncratic credit performance. Therefore, $\bar{r}_t$ e r_t are exogenous as they are determined by a monetary authority that does not consider bank units individually. Thus:

$$E[\epsilon_{i,t}|\bar{r}_t, r_t] = 0 \quad \forall i, t \tag{4.13}$$

[16] Series 21863: Production indicators (2012=100) – Capital goods. Avaialble on the Brazilian Central Bank's Time Series Management System.

The difference $r^*_{i,t} - \bar{r}_t$ is the bank i spread at t. Specifically, it consists of a weighted average of the spreads charged by all of the operations carried out at t. Consider that at t the bank executed n loan operations based on a given funding line of the external organization:

$$r^*_{i,t} - \bar{r}_t = \sum_{j=1}^{n} \frac{LoanValue_{j,t} Spread_{j,t}}{TotalValue_t} \tag{4.14}$$

Coefficients β_1 e β_2 from Equation 4.12 represent the response of the bank spread to a shock on the base rate at t and t-1, respectively. Negative values indicate that a general recessionary shock (increase in r) in the economy, controlled by the market structure, by the cyclical variable represented by the BK production and by direct funding cost (TJLP), is associated with lower spreads. This would be consistent with the previous model.

From the standpoint of the external organization, γ_1 and γ_2 reflect the sensitivity of the spreads to changes on the rates charged to banks at t and $t-1$, respectively. Specifically, given the linear model, the cost pass-through to prices is $\gamma_1 + 1$ in the short term and $\frac{\gamma_1+\gamma_2}{1-\rho_1-\rho_2}$ in the long term. Because we are considering market equilibrium, the goal is to test whether $\frac{\gamma_1+\gamma_2}{1-\rho_1-\rho_2} > 0$, i.e. whether the transfer of intermediaries is greater than a given shock to the respective funding cost.

Finally, indicators with invariant effects over time and idiosyncratic to intermediaries are represented by δ_i. Here, we control for certain characteristics of banks, e.g., private and state enterprises. More importantly, a fixed effect may accommodate heterogeneous spreads among banks.

To capture the effects on banking margins after the introduction of TLP in 2018, Equation 4.12 is changed:

$$\begin{aligned} r^*_{i,t} - \bar{r}_t = I_t + \rho_1(r^*_{i,t-1} - \bar{r}_{t-1}) + \rho_2(r^*_{i,t-2} - \bar{r}_{t-2}) + \beta_1 r_t + \beta_2 r_{t-1} + \gamma_1 \bar{r}_t + \gamma_2 \bar{r}_{t-1} + \\ \beta^*_1 I_t \bar{r}_t + \beta^*_2 I_{t-1} \bar{r}_{t-1} + X_t' \theta + \delta_i + \epsilon_{i,t} \end{aligned} \tag{4.15}$$

$$\bar{r}_t = \begin{cases} TJLP & \text{if } t < 2018 \\ TLP & \text{if } t > 2017 \end{cases} \tag{4.16}$$

$$I_t = \begin{cases} 0 & \text{if } t < 2018 \\ 1 & \text{if } t > 2017 \end{cases} \tag{4.17}$$

The main point is that the funding cost variable $\bar{r}_t$ on the model until 2017 is independent of the base rate given discretionary control from the Government. After

2017, it's not possible to assume this. It's not clear which relationship between short term (r_t), set by the Central Bank, and the market long term interest rates ($\bar{r}_t$) will prevail. Also, this is a major dubious point for macroeconomic literature.

In general, it's considered that Central Bank controls the short term interest rate. As the aggregate demand (investment and consumption) is a function of the long term interest rate in a standard New Keynesian model, monetary policy has greater efficiency as more sensible the long term interest rate is to the short one (CAMPBELL; SHILLER, 1991). Given a simple version from mankiw:

$$r_t^{(2)} = \omega + \lambda r_t^{(1)} + (1 - \lambda) E_t r_{t+1} \tag{4.18}$$

The expectation hypothesis is based on the assumption that the long term interest rate is an average sum of short term interest rate plus a risk premium (ω). Above, this is the case with $\lambda = 1/2$. Given a stable expectation for r_{t+1}, with $\lambda > 1/2$, long term interest rate over reacts to short term. This would be the case with a myope expectation. However, in all cases, there is a positive relationship and this is the point that matters for the banking model.

Given a term structure as above, as the short term interest rate determines the behavior of the long term, we must have β with the same sign than γ.

Note that compared to the period under TJLP, monetary policy is expected to be much more effective with TLP on BNDES credit market liquidity, condition on the same dynamics for banking margins. Under this assumption, the development bank, once cited as a counter cyclical institution to sustain loan operation under tight monetary policies, no longer exists.

Also, it's important to note that even after TLP we can identify the effect of credit demand cyclical effect and the funding cost on banking margins as the two rates, although related, are different. However, as the new policy (TLP) affected all the banks at the same time, we are not able to estimate a counterfactual for TLP.

Thus, in order to get a sense about the changes on margins after the new legislation, I estimate the model for the whole sample period (2002-2019) condition on a level change on margins with a dummy I_t and a change on funding cost coefficient after TLP.

Estimates of Equation 4.15 by OLS and Fixed Effect Models would generate inconsistent estimators given a auto regressive term and a fixed effect on right side (*dynamic painel bias*). Although they given inconsistent estimators, both OLS and Fixed Effect Model are informative for the upper and lower bound for the parameters from the equation above (BOND; REENEN, 2007). A model to control for the problems posed

by the auto regressive and the fixed effect component on 4.15 is given by the GMM estimator (ARELLANO; BOND, 1991). Two assumptions are required: the validity of the instruments set and that no auto correlation exists. For the validity, we consider the J-Hansen test whose null hypothesis is the validity of all restrictions for the over-identified model (CAMERON; TRIVEDI, 2009). Finally, Arellano and Bover (1995) and Blundell and Bond (1998) suggested the Sys-GMM to circumvent the bias for small samples if dependent variable has a high persistence dynamic. It's particularly the case here given a high persistence on financial margins found on literature (ALMARZOQUI; NACEU, 2015; MAUDOS; SOLIS, 2009). Also, for flexibility, I do not impose any restriction on the variance of $\epsilon_{i,t}$. Therefore, a benchmark model considered here is GMM-Sys Two Step (SYS 2 GMMM)[17]

4.5 DATA

Information on indirect BNDES operations is provided through its Download Center, which contains data on the value, interest rates, spreads and final cost to borrowers under each contract executed between intermediaries and customers. Based on these data, we calculated bank level average spreads from Equation 4.14; as well as the market share of each institution in each period and the market HHi at each t. Indirect operations encompass the main funding lines (BNDES Finame, BNDES Finame Agrícola, BNDES Finame Leasing and BNDES Automático). The first ones one account for a significantly share and, for this reason, is the subject of the present analysis. In fact, it represented 84% of all operations pegged to the TJLP in the period.

BNDES Finame is "Funding through authorized financial institution intermediaries for the production and acquisition of new domestically manufactured machinery, equipment, and computer and automation goods, as approved by BNDES".[18]

Only loans which the funding cost was pegged to the TJLP or TLP were considered. We use monthly data from 2002 to October 2019, aggregated to quarterly data, given the frequency of base interest changes. Over most of the data period, the Central Bank of Brazil met to decide base interest rates in six weeks intervals, longer than a month.

Information on the basic interest rate (COPOM Series) and the capital goods production index (Series 21863: Production Indicators (2012=100) – Capital goods) was obtained from the Brazilian Central Bank available on its Time Series Management System.

[17] The one step estimator (SYS 1 GMM) considers the homoskedastic assumption. See Appendix.
[18] BNDES - FINAME Link

4.6 RESULTS

A first look on summary statistics for the period with TJLP and TLP on Table 14-15 gives a scenario where the margin for financial intermediaries fell lesser than the funding cost. This means that the price cost margin (PCM) almost triple on average (1.77 with TLP and 0.65 with TJLP). The economy base rate and funding cost reduces by more than 2 (Copom from 14.52 to 6.38; TJLP with 7.83 and TLP with 3.02). Production Index (BK) illustrates the recession on the economy with a Minimum (50.5) on 2015 when the GDP fell 3.4%. It's also possible to see stagnation for 2018 and 2019 (on average a grow rate below 1.0%)[19] with a fell on BK index from 81.0 to 78.15 on average.

Besides, comparing the funding cost for BNDES with the estimated funding for Treasury[20], convergence has not ccurred yet. There is a difference between these rates and thus a subsidy could still be in practise for BNDES Finame loan operation. Also, it's important to note that over the period for TLP (2018, 2019) in some months it was registered deflation which amplify the fell for the new funding cost.

I also consider the evolution of margins, price cost margins (PCM) and maturity for all loans by year for the whole sample period separated by the size of the client (industry). As we can see on Fig 12-14, the trend for margins and PCM are the same for all categories considered. In addition, the maturity profile did not change before and after TLP.

For a consistency relevant market definition, it's important to consider the loan operation only for small and medium firms (*Micro, Pequena e Média*). I weighted for the loan size the average for margins and PCM's for each bank in each month since 2002 on Fig. 15. Note that the margin for financial intermediaries has not changed as much as the PCM had after TLP. The market structure variable for the market share distribution (HHi) also has not changed. In addition, we can see the turbulent period for the market along the years of 2009 and 2014 given the PSI credit line program. [21]

Although it's not possible to get a counterfactual for TLP, I consider the model from the previous section to get a estimate on the influence of this regulatory change on the financial margins. First, on Table 16, I estimate Equation 4.15 for the whole sample period (2002-2019). I_{TLP} is significant and positive for all models considered except for the OLS case. Condition on the funding cost, base rate and production variables, this means that on average financial margin increased in 0.7 p.p after TLP, considering the benchmark models (GMM). On the long run, the increase is of $\frac{0.7}{1-0.270} = 0.97$ p.p.

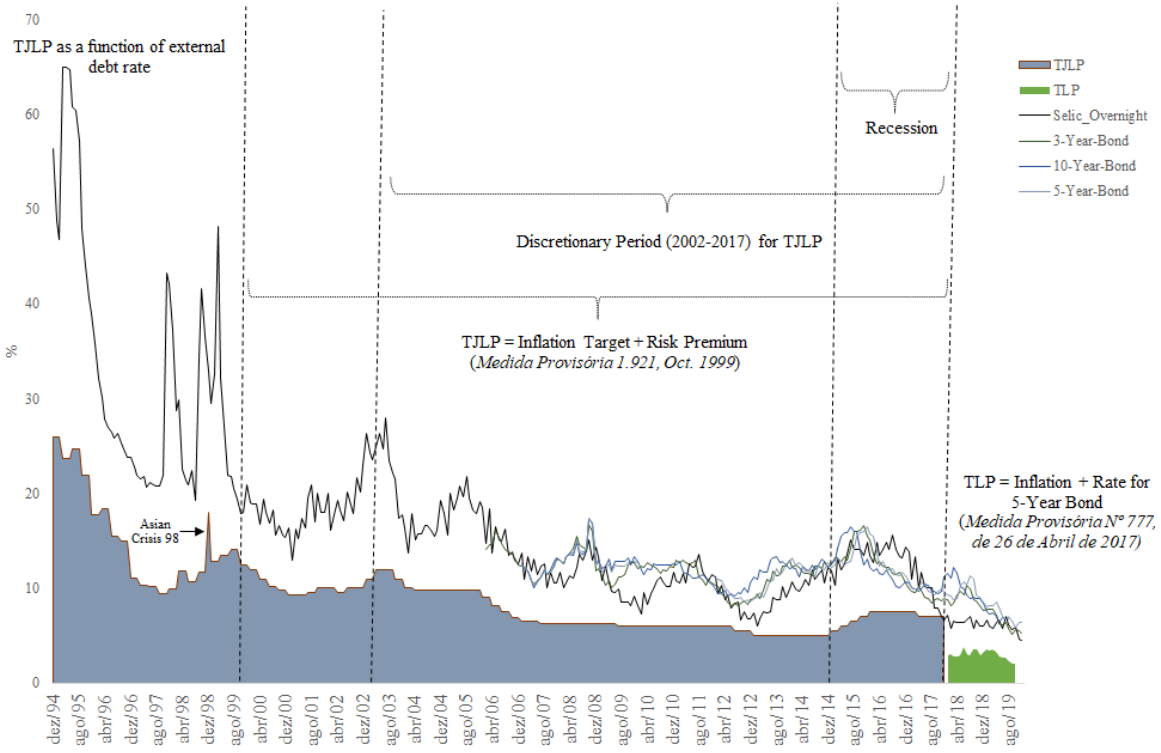
For the production index (BK) results are robust across the sample period.

[19] See in `https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=BR`

[20] Average Rates for 3,5 and 10 years for Brazilian Treasury Bonds reported by Bloomberg

[21] I always included a control dummy for the period for the models estimation. Results are robust.

FIGURE 11 – TJLP and TLP History: End of Subsidy?



Source: Time series for TJLP is available on BNDES Website and the base rate (copom) comes from Central Bank Data Time Series (Series Number 4189). TLP is the sum of the "TLP-Pré" available on BNDES site and the inflation rate for the month which is the IPCA Table available by IBGE (Tabela 1737). Rates for 3, 5, 10 Year Brazilian Treasury Bonds are from Bloomberg.

TABLE 14 – Descriptive Statistics - BNDES Finame with TJLP, 2002-2017

	Margin	PCM	Copom	TJLP	Market Share	HHi	BK
Mean	4.90	0.65	14.52	7.83	0.04	0.14	81.0
Standard Deviation	1.35	0.22	4.54	1.95	0.08	0.05	19.78
Min	0.9	0.125	7.0	5.0	0.00	0.07	50.4
Max	14.48	2.07	26.32	12.0	1.0	1.0	127.1
N	4231	4231	4231	4231	4231	4231	4231

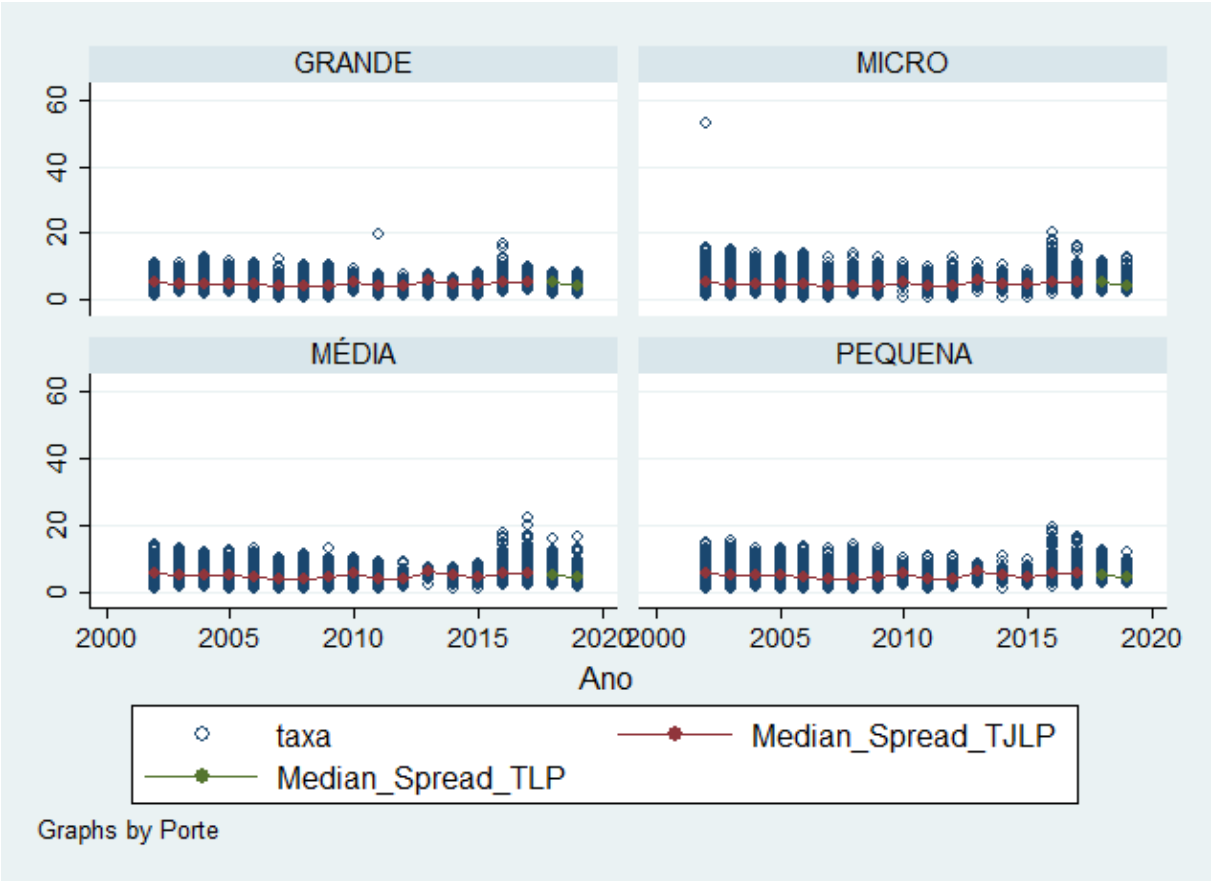
First column is Bank's margin in loan operation on FINAME. PCM is the price cos margin, the ratio between margin and the funding cost (TJLP). Copom is the base rate set by Central Bank.
TJLP is the funding cost from BNDES until 2017.
HHi is the Herfindahl-Hirschman Index.
BK is a monthly index of Capital Good production (Series 21863, Central Bank of Brazil)

The coefficient is negative for t indicating the a intra-sector positive demand shock is associated with a lower financial margin.

Note that the auto regressive ($Margin_{t-1}$ and $Margint-2$) estimates coefficients are robust across all the models and sample periods suggesting a high persistence banking margin in line with previous results (ALMARZOQUI; NACEU, 2015; MAUDOS; SOLIS, 2009).

Besides, the most important result is related to the funding cost coefficient. For

FIGURE 12 – Finame Margins, 2002-2019



Source: Spreads are the margins for financial intermediaries on BNDES Finame based on the data took from Central dos Dowloand (BNDES WebSite).

TABLE 15 – Descriptive Statistics - BNDES Finame with TLP, 2018-Oct. 2019

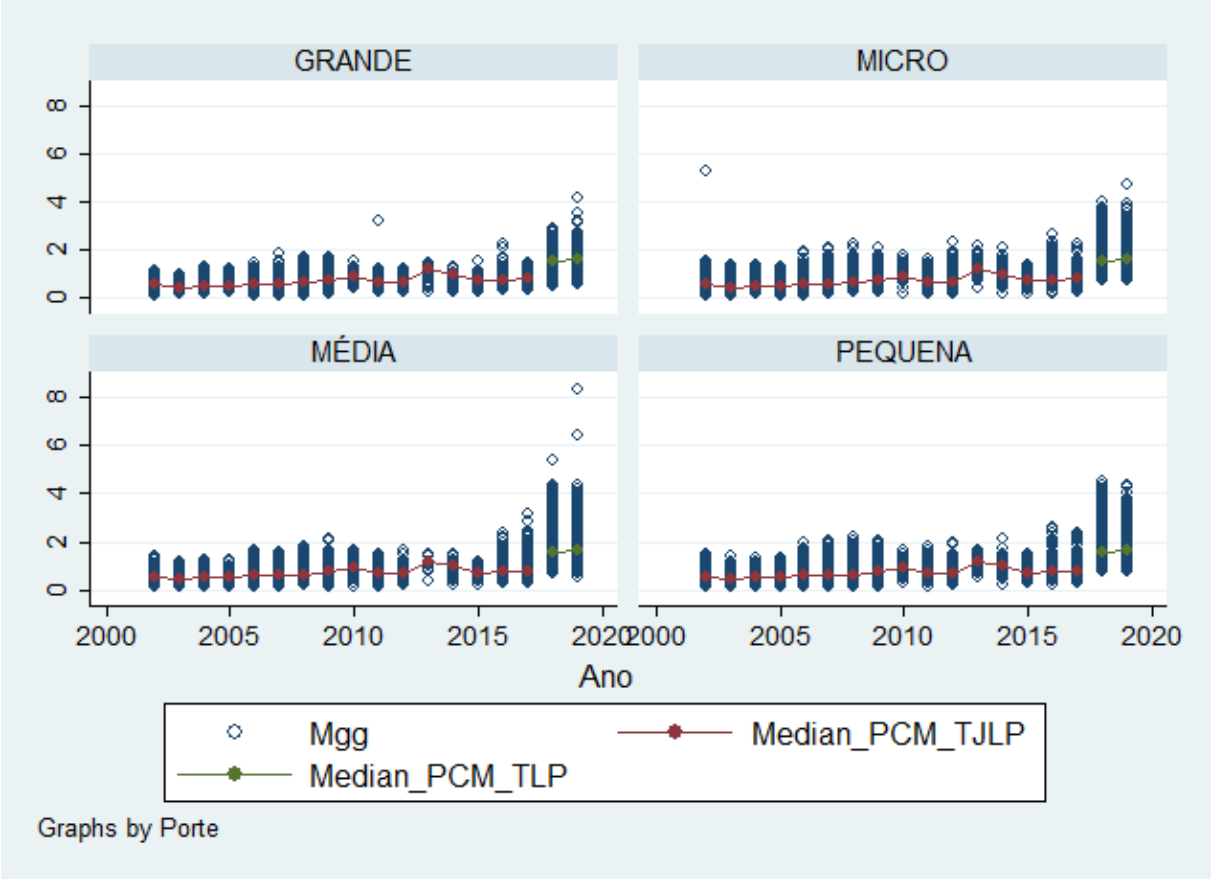
	Margin	PCM	Copom	TLP	Market Share	HHi	BK
Mean	5.24	1.77	6.38	3.02	0.03	0.13	78.15
Standard Deviation	1.17	0.49	0.50	0.47	0.06	0.02	7.25
Min	2.94	0.94	5.38	1.99	0.00	0.00	63.2
Max	10.31	4.17	13.58	3.84	0.38	0.19	89.0
N	588	588	588	588	588	588	588

First column is Bank's margin in loan operation on FINAME. PCM is the price cost margin, the ratio between margin and the funding cost (TLP). Copom is the base rate set by Central Bank.
TLP is the funding cost from BNDES since 2018.
HHi is the Herfindahl-Hirschman Index.
BK is a monthly index of Capital Good production (Series 21863, Central Bank of Brazil)

$Fund$, on average, we get that a change on 1 p.p on the funding cost means a higher - 0.24 for SYS 2 GMM - financial margin on the short run. For the long run, $\frac{0.24}{1-0.270} = 0.32$.

But this coefficient is lower with TLP which can be seen by the negative coefficient of the interaction variable $I_{TLP}Fund$ on time t for all models except the SYS-2-GMM (significant for $t-1$). In fact, when we consider only the sample period of TLP, on Table 17, the funding cost coefficient is negative just like it was obtained for the base rate

FIGURE 13 – Finame Price Cost Margin (PCM), 2002-2019



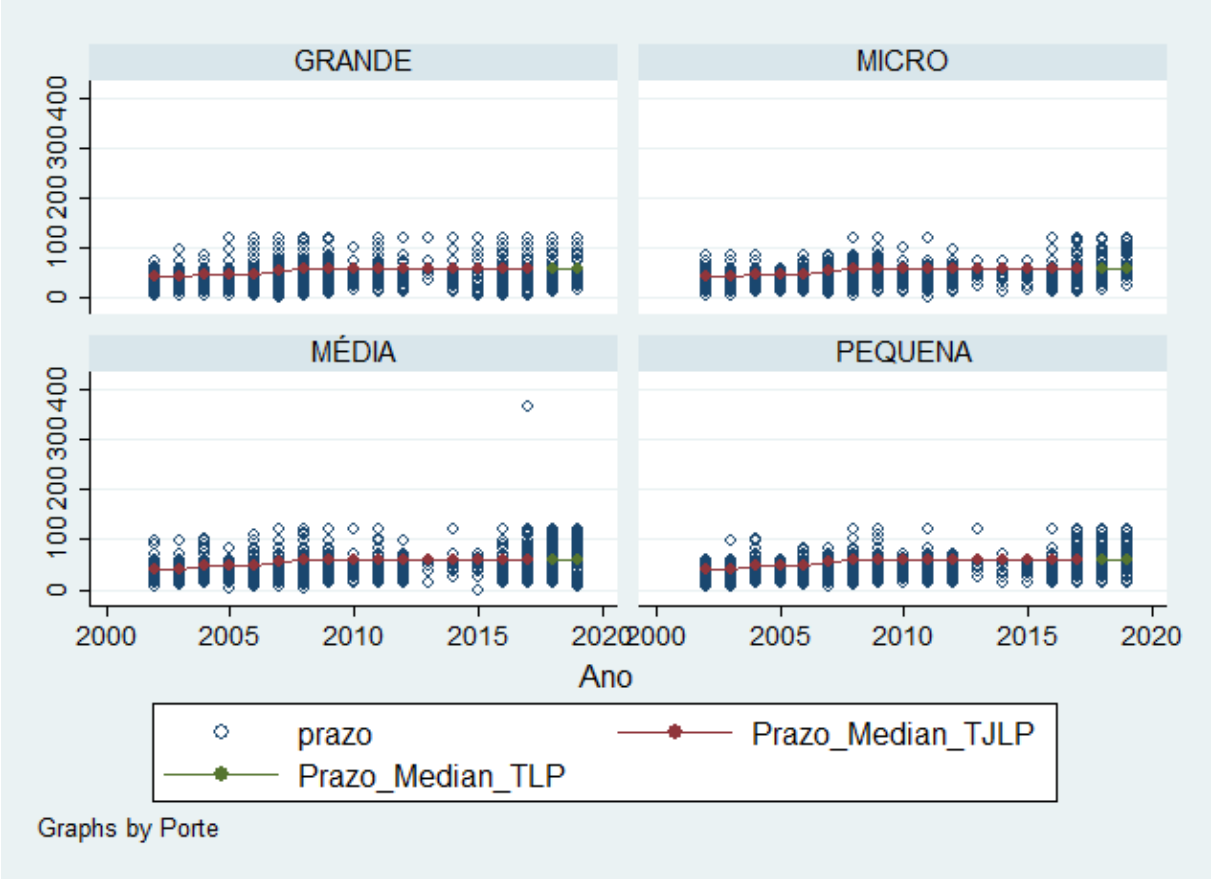
Source: PCM are the ration between Spreads and the funding cost (TJLP or TLP) for financial intermediaries on BNDES Finame based on the data took from Central dos Dowloand (BNDES WebSite).

(Copom) over 2002-2017, as we can see on Table 18. This is exactly in line with a term structure with a positive correlation with short and long term rates. In addition, the base rate lost his significance for the period 2018-2019. This not means that Central Bank does not affect the financial margins from BNDES operations given that the short term (base rate) still influences the long term which for its turn affects TLP.

These results point for a important finding on the relationship between market rates and subsidised funding cost for banking industry. Over TJLP period (2002-2017), the funding cost variable was independent of the short one (set by the Central Bank). In a concentrated market structure, with the price-cost-margin as a function only of the demand elasticity, the pass-through is positive (greater than 1 given $TJLP > 0$). However, when there is a direct influence of the base rate on the funding cost for banking, as in any traditional model for banking activity, this coefficient captures a mixed of demand (for credit) and cost variation. In the case of BNDES credit market, results for the TLP coefficient pointed for financial margins negative correlated with the base rate.

Therefore, for the business cycle, under a inflation target regime, this means that financial margin, at a certain degree, offset the monetary policy. This is line with the

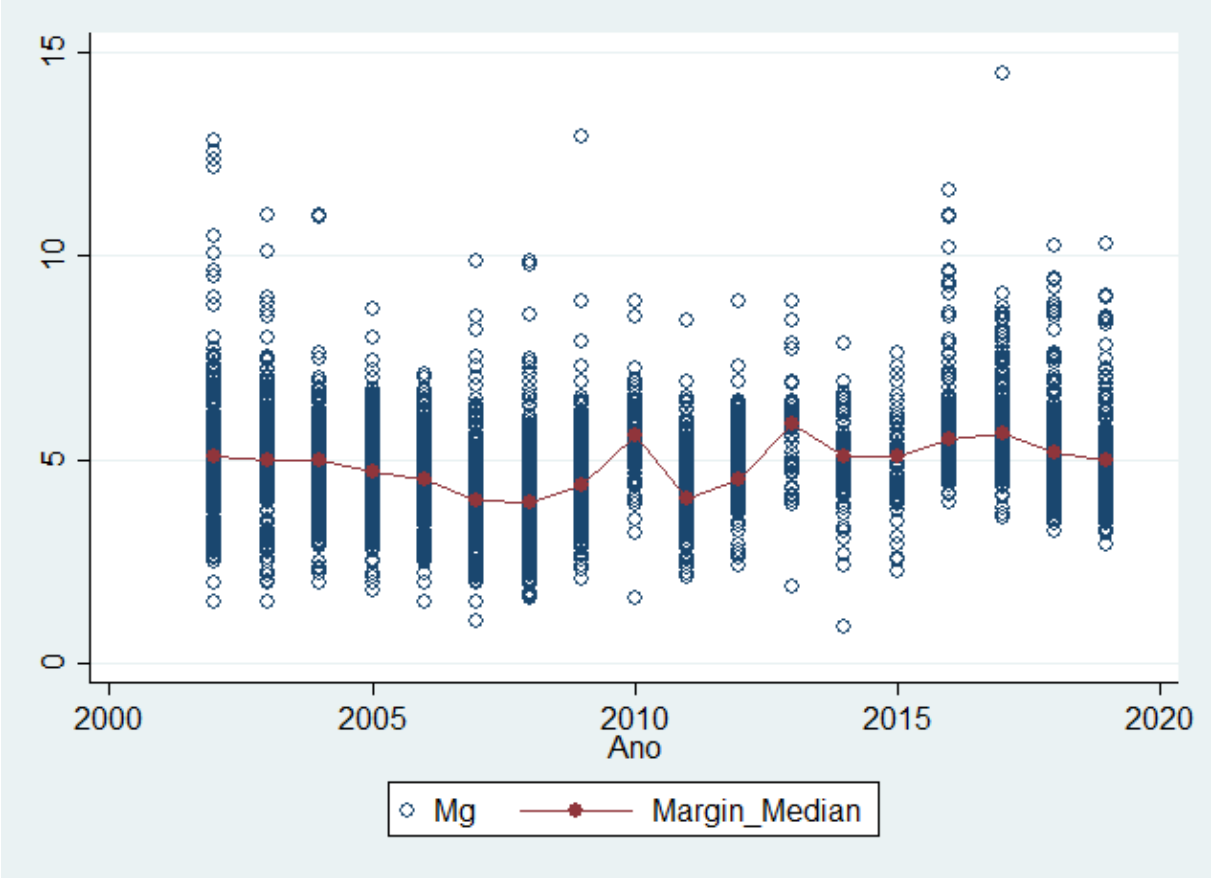
FIGURE 14 – Finame Maturity, 2002-2019



Source: Maturity for loan operation on BNDES Finame based on the data took from Central dos Dowloand (BNDES WebSite).

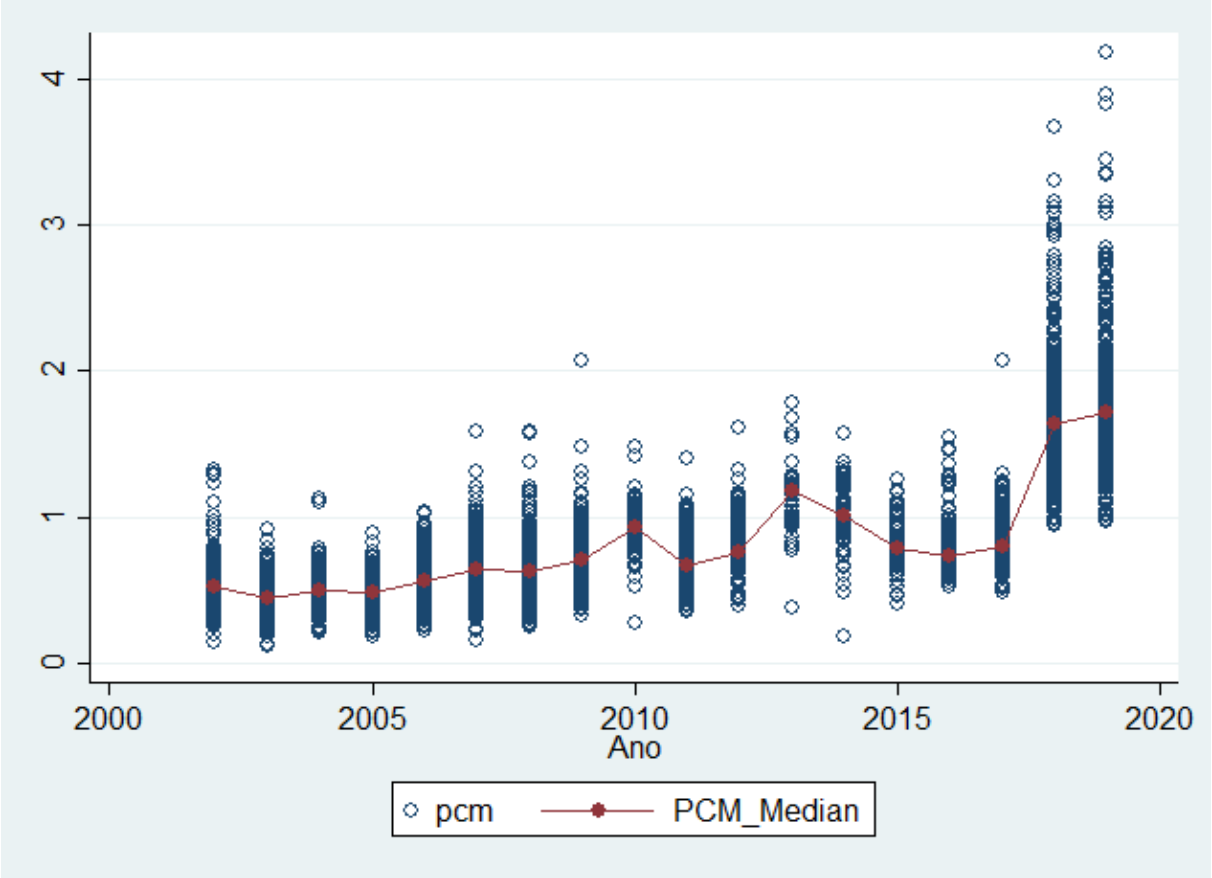
motivation of a part of the literature related to alternative instruments for macro policy post-08 crisis. Particularly, the idea of a credit subsidy was brought as way to amplify the macroeconomic policy which for many was always restricted to the monetary policy through the base rate (LUCAS, 2016; CORREIA; FIORE, et al., 2018; CHRISTIANO; EICHENBAUM; REBELO, 2011; CORREIA; FARHI, et al., 2013). For the case of banking industry on BNDES credit lines, as I pointed before, margins were sensible to the change on interest policy for the funding cost as they compensate changes on this variable after the introduction of TLP. This brings the question about the root cause of the difference in dynamics observed on this financial margins when there is subsidy on the funding cost as it was the case of TJLP. However, margins dynamics still is a field on macro with many questions and a few answers as illustrated by Blanchard (2008): "How markups move, in response to what, and why, is however nearly *terra incognita* for macro . . . [W]e are a long way from having either a clear picture or convincing theories, and this is clearly an area where research is urgently needed."

FIGURE 15 – Margin for Small and Medium Firms by Bank, 2002-2019



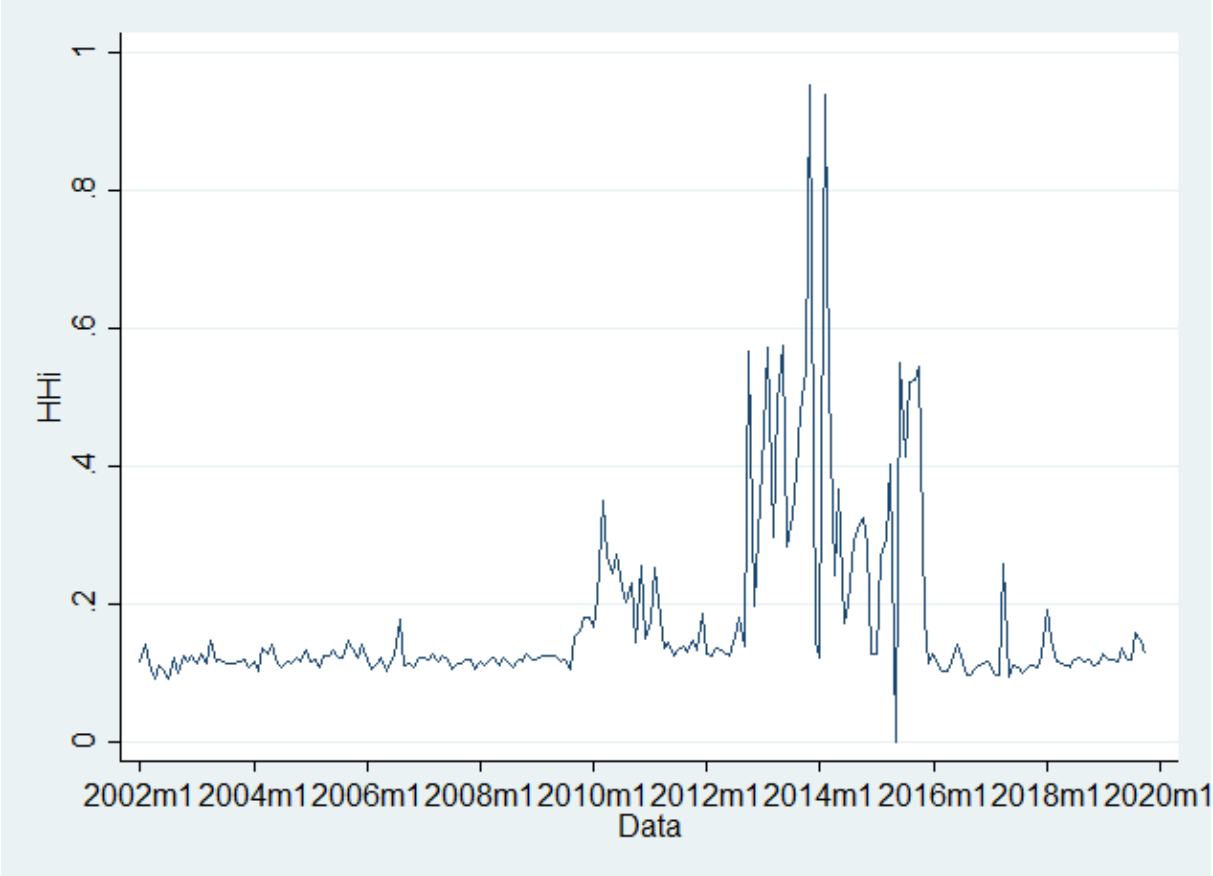
Source: Based on BNDES Finame data took from Central dos Dowloand (BNDES WebSite).

FIGURE 16 – Price Cost Margin (PCM) for Small and Medium Firms by Bank, 2002-2019



Source: Based on BNDES Finame data took from Central dos Dowloand (BNDES WebSite).

FIGURE 17 – HHi for Finame and Small and Medium Firms, 2002-2019



Source: Based on BNDES Finame data took from Central dos Dowloand (BNDES WebSite).

TABLE 16 – BNDES Finame: Models, 2002-2019

Variable	OLS	FE	SYS 1 GMM	SYS 2 GMM
Margin$_{t-1}$	0.489***	0.412***	0.402***	0.353
Margin$_{t-2}$	0.362***	0.291***	0.235***	0.270***
I$_{TLP}$	0.452	0.680***	0.731***	0.716*
Fund$_t$	0.013**	0.043*	0.048*	0.243*
Fund$_{t-1}$	0.028	0.036**	0.040	-0.054
IxFund$_t$	-0.079***	-0.108**	-0.131*	-0.395
IxFund$_{t-1}$	-0.077	-0.099*	-0.080	-0.174**
Copom$_t$	-0.004	0.008	0.013	0.038
Compom$_{t-1}$	-0.029	-0.051**	-0.059**	-0.097**
BK$_t$	-0.295***	-0.426***	-0.444***	-0.077
BK$_{t-1}$	0.021	-0.072	-0.089**	0.302*
HHi$_t$	0.871***	1.300***	1.620**	1.563*
Estatal	0.080			
Constant	1.831***	3.435***	3.855***	0.00
N	3589	3589	3589	3589
R^2	0.682	0.498		
Hansen			163.161	163.161
AR(1) pvalue			0.000	0.125
AR(2) pvalue			0.064	0.630
F	402.683	290.116	124.837	611.01

Note: *p<.1; **p<.05;***p<.01
The 2 step estimator (SYS 2 GMM) does not impose any restriction on the error variance matrix.
SYS 1 GMM imposes homoskedastic assumption.
BK is a industrial production for machinery.
AR(k) test for autocorrelation of residuals.
Hansen null hypothesis is validity of over identification of the restrictions. In all GMM models, this was not rejected.
$Fund$ is equal to $TJLP$ until 2017. Since 2018, equal to TLP.
I_{TLP} is a dummy variable for 2018 and 2019 when TLP began.
$IFund$ is a interaction between I_{TLP} and $Fund$.

TABLE 17 – BNDES Finame: Models, 2018-2019

Variable	OLS	FE	SYS 1 GMM	SYS 2 GMM
$Margin_{t-1}$	0.400***	0.148***	0.241***	0.323
$Margin_{t-2}$	0.376***	0.185***	0.213*	0.221
TLP_t	-0.106	-0.166	-0.255***	-0.172**
TLP_{t-1}	0.033	-0.052	0.013	0.038
$Copom_t$	-0.173	-0.443	-0.229	0.028
$Compom_{t-1}$	0.289	1.040**	0.747	0.289
BK_t	-0.273	-0.277	-0.336	-0.074
BK_{t-1}	-0.474	-0.809**	-0.828***	-0.505*
HHi_t	2.860	0.613	1.123	1.559
Estatal	0.122			
Constant	3.403	4.864*	5.095*	2.946
N	436	436	436	436
R^2	0.565	0.163		
Hansen			22.345	19.754
AR(1) pvalue			0.000	0.122
AR(2) pvalue			0.597	0.900
F	28.527	8.587	31.283	7.993

Note: *p<.1; **p<.05;***p<.01
The 2 step estimator (SYS 2 GMM) does not impose any restriction on the error variance matrix.
SYS 1 GMM imposes homoskedastic assumption.
BK is a industrial production for machinery.
AR(k) test for autocorrelation of residuals.
Hansen null hypothesis is validity of over identification of the restrictions. In all GMM models, this was not rejected.

TABLE 18 – BNDES Finame: Models, 2002-2017

Variable	OLS	FE	SYS 1 GMM	SYS 2 GMM
$Margin_{t-1}$	0.601***	0.472***	0.468***	0.218***
$Margin_{t-2}$	0.258***	0.169***	0.115**	0.202***
$Copom_t$	-0.055***	-0.059***	-0.050***	-0.052***
$Copom_{t-1}$	-0.012	-0.039**	-0.037**	-0.052***
$TJLP_t$	0.298***	0.337***	0.278***	0.262***
$TJLP_{t-1}$	-0.180***	-0.140***	-0.097*	-0.038
HHi	0.767**	1.160***	1.052**	1.282**
BK_t	-0.947***	-1.041***	-0.925***	-1.079***
BK_{t-1}	0.468	0.271	0.143	0.07
State	-0.018			
Constant	2.786***	4.852***	5.155***	6.811***
N	1560	1560	1560	1560
R^2	0.68	0.488		
Hansen df			299	299
Hansen			77.698	67.799
AR(1) pvalue			0.000	0.001
AR(2) pvalue			0.395	0.018
F	195.658	156.179	60.012	28.923

Note: *p<.1; **p<.05;***p<.01
The 2 step estimator (SYS 2 GMM) does not impose any restriction on the error variance matrix.
SYS 1 GMM imposes homoskedastic assumption.
BK (capital good production index) and HHi are treated as endogenous variables in the model.
State is a dummy variable for state owned banks.
AR(k) test for autocorrelation of residuals.
Hansen null hypothesis is validity of over identification of the restrictions. In all GMM models, this was not rejected.

4.7 CONCLUSION

Public debate about the end of TJLP and its replacement by TLP has been centered on fiscal issues regarding the impact of the subsidized rate, with little attention to the role played by BNDES on banking competition. This article analysed the effect of this regulatory change on financial intermediaries banking margins from a major BNDES' credit line (Finame).

As it was pointed on the institutional section, the basic idea behind TLP was to equalize the funding cost for BNDES and the borrow rate for Treasury considering bonds with similar maturities to the development bank's loan portfolio. In addition, in line with a broad policy to enhance banking competition on credit markets (Agenda BC+), Central Bank have presented the end of subsidised rates as a necessary condition for low final interest rates for industry and consumers.

However, after TLP, the average price-cost-margins have grown significantly. Although is not possible to get a counterfactual for TLP, the estimated model found a increase of 0.7 p.p on financial intermediaries' margins for the period from 2018 until October 2019, using a dynamic panel data, condition on the funding cost, the base rate, production index for intra-sector demand shock and fixed effect for banks. In addition, a major result is the sign change for the coefficient of the funding cost variable. Between 2002 and 2017, a change on TJLP was associated with a same sign variation in the margins as expected in a concentrated market structure *à la Cournot*. Under TLP, a rate reflecting the long term funding for the Treasury, the coefficient is negative as it was found for the coefficient of the base rate between 2002 and 2017. This result could be interpreted in line with a traditional term structure where the short term rate set by the Central Bank influences the long term rate for Treasury bonds, given a stable market expectation. In this article, results pointed for financial margins offsetting changes in the funding cost on a major credit line from BNDES.

Finally, as the volatility of the Copom rate was by construction greater than that of the TJLP, we need to be cautious about drawing overly generalized conclusions from the results presented here regarding the spreads's expected future behavior. Specifically, market structure factors (market share and it's distribution, rivalry and entry barriers) may vary considerably if the funding cost from BNDES converges to the average historical Copom rate, for example. In this sense, it's important to consider that a eventually reverse on the recent negative trend for Copom would directly affect the funding cost for BNDES. As we can see on Table 14, the average base rate is almost double the TJLP. A high rate level could act as a significant barrier to entry for bank intermediaries on BNDES credit lines. This is presented in other credit markets (without BNDES) where there is evidence for higher market concentration, low rivalry and greater spreads. This kind of structure is sustained by entry barriers based on high levels of funding costs to

new financial institutions.

Therefore, for the policy makers interested in designing a more competitive banking industry, it's important to consider the effects presented in this article as a cautionary note from a major credit line on the country. Besides, in times where the role played by BNDES is at a center of public debate, ignoring its influence on banking competition seems not reasonable given the objectives set by the government to develop a more efficient and competitive credit market for industry and consumers.

5 CONCLUSION

The relationship between banking market structure and monetary policy is a typical topic in the economic literature and it has been resumed based on new results for loan markups dynamics in high income countries.[1] This thesis sought to explore this correlation for an emerging economy with a poorly developed credit market for small and medium-sized companies, in which large state and private institutions coexist in a concentrated market structure where a significant part of the credit transactions had a subsidized funding cost until 2017. These features may prevent replicating predictions from standard textbooks models for bank margins dynamics in the economic cycle.

This institutional setting of the Brazilian credit market - grounded on big state-owned commercial banks and subsidized funding cost given by the National Development Bank (BNDES) to private and public banks - allowed this thesis to empirically investigate the response of financial intermediaries markups to variations in the funding cost, demand shocks and to changes in subsidy policy. This creates a research opportunity to disentangle the funding cost for subsidized credit transactions from the basic interest rate set by the Central Bank under an inflation targeting regime. As shown in Chapters 2 and 4, these attributes are crucial to explain bank margins offsetting variations in the basic rate of the economy and amplifying shocks in funding costs, in the credit lines financed by BNDES for small and medium-sized firms.

In addition, economic policy response to the 2008 Financial Crisis, through intensive use of state-owned commercial banks in granting credit to prevent a bigger downturn in Brazilian industrial product, created a scenario where it was possible to observe private banks reaction to this new conduct of state-owned ones in certain credit markets. The presence of public institutions, which often operate with goals other than profit maximization, poses atypical elements in the standard models of strategic interaction between financial intermediaries. In this sense, these imperfections are modelled in Chapter 3 in a mixed oligopoly structure. Estimation results point to a low price reaction for big private banks to state-owned banks conduct variation. Thus, most of the observed reduction in margins during the expansion period of state-owned banks can be attributed to changes in subsidized funding costs. In general, these results are consistent with an imperfect market structure where large banks - state and private - could exercise market power.

In summary, in this thesis, a detailed loan database was considered to understand the role played by public banks and subsidized funding costs on bank's margins. Motivated by the need to design an efficient and competitive credit market for economic

[1] See Nekarda and Ramey (2020) for a updated empirical results review.

recovery in Brazil, these two factors are focal points in public policy discussions. In addition to initiatives to open and reduce barriers to entry in the financial sector, it's possible the recovery path requires new designs for funding cost. In line with an imperfect Brazilian market structure, at least for the BNDES credit lines for small and medium-sized firms, the funding cost for financial intermediaries does not need to be fully dependent to the basic rate set by the Central Bank, which expressly pursues a different target from the general purpose that legitimize the existence of a development bank in an emerging economy.

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A APPENDIX

In this appendix I show the GMM-Sys Two Step estimator as the benchmark model in the context of all three essays.

Consider the banking margin model below:

$$\begin{aligned} r^*_{i,t} - \bar{r}_t = I_t + \beta(r^*_{i,t-1} - \bar{r}_{t-1}) + \beta_1 r_t + \beta_2 r_{t-1} + \gamma_1 \bar{r}_t + \gamma_2 \bar{r}_{t-1} + \\ + X'_t\theta + \delta_i + \epsilon_{i,t} \end{aligned} \tag{A.1}$$

To simplify notation, $y_{i,t} = r_{i,t} - r^*_t$. In this case, equation A.1 can be rewritten:

$$\begin{aligned} y_{i,t} =& \beta y_{i,t-1} + \beta_1 r_t + \beta_2 r_{t-1} + \gamma_1 \bar{r}_t + \gamma_2 \bar{r}_{t-1} + \\ & + X'_t\theta + \phi BK_t + \delta_i + \epsilon_{i,t} \\ & E[\epsilon_{i,t}] = 0 \qquad \forall i, t \end{aligned} \tag{A.2}$$

Estimate A.2 by OLS would generate inconsistent estimators given a auto regressive term and a fixed effect on right side. Endogeneity arises given $y_{i,t}$ and $y_{i,t-1}$ depend of δ_i. Thus, considering $v_{i,t} = \delta_i + \epsilon_{i,t}$, $y_{i,t-1}$ is positive correlate with $v_{i,t}$ we have a *dynamic painel bias*.

A first way to circumvent this problem would consider estimate A.2 by Fixed Effect. In this model, we have:

$$\begin{aligned} y_{i,t} - \bar{y_i} =& \beta(y_{i,t-1} - \bar{y_i}) + \beta_1(r_t - \bar{r}) + \beta_2(r_{t-1} - \bar{r}) + \gamma_1(\bar{r_t} - \bar{\bar{r}}) + \gamma_2(\bar{r_{t-1}} - \bar{\bar{r}}) + \\ & + (X'_{i,t} - \bar{X_t})\theta + \phi(BK_t - \bar{BK}) + (\epsilon_{i,t} - \bar{\epsilon_i}) \end{aligned} \tag{A.3}$$

In this case, just a part of the problem would be mitigated because $\bar{\epsilon_i}$, by construction, is a function of $\epsilon_{i,t-1}$ which is correlated with $y_{i,t-1}$. So, even here, endogeneity still exists. Also, note the negative bias in β given a negative correlation between $y_{i,t-1}$ and $(\epsilon_{i,t} - \bar{\epsilon_i})$.

Although they given inconsistent estimators, both OLS and Fixed Effect Model are informative for the upper and lower bound for the parameters from the equation above (BOND; REENEN, 2007).

A model to control for the problems posed by the auto regressive and the fixed effect component on A.2 is given by the GMM estimator (ARELLANO; BOND, 1991).

For the Difference Case (GMM-Diff), the basic idea is differentiate A.2 to get:

$$\begin{aligned}\Delta y_{i,t} =&\beta\Delta y_{i,t-1} + \beta_1\Delta r_t + \beta_2\Delta r_{t-1} + \gamma_1\Delta\bar{r_t} + \gamma_2\Delta\bar{r}_{t-1}+\\ &+ \Delta X_{i,t}^{'}\theta + \phi\Delta BK_{i,t} + \delta_i + \Delta\epsilon_{i,t}\end{aligned} \tag{A.4}$$

In this case, although $\Delta y_{i,t-1}$ is correlated with $\Delta\epsilon_{i,t}$, there is a set of instruments to control for. Note that for $t = 3$, $y_{i,t-1}$ is correlated with $\Delta y_{i,t-1}$ but not with $(\epsilon_{i,t} - \epsilon_{i,t-1})$, by construction. Thus, $y_{i,t-1}$ is a valid instrument for $\Delta y_{i,t-1}$. Similarly, for $t = 5, 6, 7, ..T$:

$$E[y_{i,t-s}\Delta\epsilon_{i,t}] = 0 \quad \forall i, t = 2, 3, ...T \quad e \quad 2 \leq s \leq T - 1 \tag{A.5}$$

The number of instruments is given by $r = \frac{1}{2}(T - 1)(T - 2)$. In our case, it's clear that r is greater than the number of regressors and thus it's a over identified model. The optimal choice for over identified models can be obtained by:

(i) the *one step* estimator, considering the model below:

$$\begin{aligned}y_{i,t} =&\gamma y_{i,t-1} + \beta^{'} x_{i,t} + \epsilon_{i,t}\\ &E[y_{i,t}] = 0\\ &Var(\epsilon_{i,t}) = \sigma^2\end{aligned} \tag{A.6}$$

In this case:

$$(\gamma \quad \hat{\beta}) = [(\Delta y_{-1}\Delta X)'WV_n^{-1}W'(\Delta y_{-1}\Delta X)]^{-1}[(\Delta y_{-1}\Delta X)^{'}WV_n^{-1}W^{'}\Delta y] \tag{A.7}$$

Where X is all variables from the right hand side of A.2 except for the autoregressive term. W is the instrument matrix (exogenous variables and lags of y). V is the co-variance matrix, under the homoskedastic assumption.

(ii) the *two step* estimator is obtained considering matrix V in a more flexible form:

$$V^* = \frac{1}{N}\sum_{i=1}^{N}(W_i^{'}\Delta\hat{u}_i\Delta\hat{u_i}^{'}W_i)^{-1} \tag{A.8}$$

In this case, Δu_i are the residuals from the first stage. Contrary to the *firs step*, it's not imposed any restriction for the variance of $\epsilon_{i,t}$.

In both cases, two assumptions are required: the validity of the instruments set and that no auto correlation exists.

For the second point, it's important to note: $Cov(\Delta\epsilon_{i,t}, \Delta\epsilon i, t-1) = Cov(\epsilon_{i,t} - \epsilon_{i,t-1}, \epsilon_{i,t-1} - \epsilon_{i,t-2}) = -Cov(\epsilon_{i,t-1}, \epsilon_{i,t-1}) = -Var(\epsilon_{i,t-1})$. Thus, there is auto correlation

for the first lag on residuals from Diff-GMM. Given this, we are interested for testing on lag two, $AR(2)$.

For the validity, we consider the J-Hansen test whose null hypothesis is the validity of all restrictions for the over-identified model (CAMERON; TRIVEDI, 2009).

Finally, Arellano and Bover (1995) and Blundell and Bond (1998) suggested the Sys-GMM to circumvent the bias for small samples if dependent variable has a high persistence dynamic. It's particularly the case here given a high persistence on financial margins found on literature (ALMARZOQUI; NACEU, 2015; MAUDOS; SOLIS, 2009).

In this case, the estimation also consider (in addiction to the orthogonality condition):

$$E[\Delta y_{i,t-1}(\delta_i + \epsilon_{i,t})] = 0 \qquad \forall \quad t = 3, ...T \tag{A.9}$$

In all essays from this thesis, we are considering the benchmark model the most flexible one which in this case is the GMM-Sys Two Step.