Government Banks, Competition and Interventions in Credit Markets*

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Abstract

We study a large scale intervention in the Brazilian banking sector, characterized by a sudden increase in the supply of credit provided by commercial state owned banks at low interest rates. Using confidential credit registry data, we show that the policy is successful in reducing private banks interest rates without large crowding out of private credit. However, public banks experience substantial worsening of borrower quality after the policy. We show that the deterioration of public banks' credit portfolio is connected to loans to levered firms, and rule out alternative explanations based on selection or worse screening standards. Moreover, the policy is not associated with GDP or employment growth. Our paper shows that while an expansion in public credit can lead to a reduction in the interest rates of private banks, such expansion is associated with worse borrower risk that can be connected to loans to unproductive firms.

Keywords: Credit Market Interventions, Bank Competition, Government Banks

JEL Classification: E44, E65, G21, L44

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1. Introduction

It is well know that credit markets are prone to government intervention, and that one way policymakers can affect equilibrium in credit markets is by using state owned banks[1]. Literature suggests that government owned banks are subject to political capture, and that in many situations the use of their resources for politically motivated ends leads to credit misallocation (La Porta, Lopez-De-Silanes and Shleifer (2002), Sapienza (2004), Dinç (2005), Carvalho (2014)). Nevertheless, the use of these public institutions as means through which governments can intervene in financial markets gained strength after the Great Recession, when interventions in credit markets using public banks (Coleman and Feler (2015), Jiménez et al. (2019)) took place. These studies suggest that the ability of the government to provide credit during financial crises, when private banks contract lending, can alleviate economic downturns. More generally, however, governments can use state owned banks in an attempt to address frictions that lead to inefficient equilibrium in credit markets, even outside financial crisis episodes. However, it is unclear how these interventions affect the banking sector and how governments should design such policies, as their effects depend on the interplay between competition and risk in financial markets.

In this paper we address this question by studying a large scale credit market intervention in Brazil. In 2012, the Brazilian government announced it would use two of its state owned commercial banks to provide credit at low rates, with the objective of reducing private banks' lending rates and increasing credit access. This can be seen as a competition shock from the perspective of private banks, as lending by government banks affected demand for private loans. Importantly, the absence of other systematic shocks to the economy allows us to interpret the response of private banks as being caused by the sudden changes in lending behavior of public banks. This represents an advantage over other empirical studies of the use of government banks during crisis, since the observed behavior of private banks is not a response to the crisis itself. Moreover, the magnitude of the policy and the very detailed data we use allow us to determine the specific mechanisms influencing the response of private banks to additional competition.

Our study is informative of two dimensions of competition in the financial sector. The

[1] Throughout this paper we use the expressions *State Owned Banks*, *Government Banks* and *Public Banks* interchangeably. They refer to banks whose majority shareholder is a local or federal government.

first is relative to how banks respond to additional competition by changing their lending practices, whether this benefits borrowers and which borrowers benefit the most. The second is whether or not smaller interest rates achieved by higher competition are connected to borrower risk either through selection or moral hazard. We illustrate the interplay between these two dimensions in a simple model with public and private banks, and show that different risk mechanisms lead to different predictions about the behavior of private banks in response to the intervention. In particular, more severe adverse selection or moral hazard increases the response of private banks loan supply, while more severe advantageous selection reduces the response of private banks loan supply. Moreover, the amount of public credit in an optimal intervention also depends on the sign and magnitude of the selection mechanism. This principles guide our empirical analysis, where we evaluate the extent to which public banks can affect private banks' interest rates, and assess whether or not markets seem to be characterized by selection of any sort.

We begin our empirical analysis by evaluating the effects of the competition shock on private banks lending behavior. We first document that public banks lend at lower interest rates before and after the intervention, and suddenly increase the supply of working capital loans more than three times after the policy is announced[2]. To identify the response of private banks, our empirical strategy relies on the fact that the intervention was unexpected, and that no other systematic events that could cause changes in the behavior of private banks took place. Therefore, in the absence of the policy, the difference between interest rates of public and private banks would have remained constant. Private banks respond to the increase in the supply of public credit by reducing loan interest rates, with the difference in interest rates of public and private banks falling between 5 to 7 percentage points for comparable loans, a reduction of nearly half of the pre-intervention difference. Additionally, the pass through of the reduction in interest rates caused by the increase in competition is heterogeneous. In particular, interest rates of loans to micro and small firms have a reduction 100 basis points *larger* than the reduction in interest rates of loans to medium and large firms. Furthermore, locations with only private bank branches have similar reductions in interest rates compared to locations with both types of banks, suggesting the policy led to interest rate reductions even in locations where the distance between borrowers and public

[2]This suggests these banks had credit capacity constraints and rationed their applicants prior to the intervention, an ingredient included in our theoretical model.

banks is larger.

The second step in our empirical analysis is to compare riskiness of borrowers of private and public banks. The fact that public banks charge lower interest rates than private banks in comparable loans gives us an unique opportunity to test asymmetric information mechanisms linking interest rates and risk. One possibility is that lower interest rates attract borrowers with lower propensity to borrow, whose unobservable risk is lower/higher in adverse/advantageous selection models (Mahoney and Weyl (2017)). Similarly, lower interest rates can have a causal effect on borrower risk, as in moral hazard models, indicating lower risk for public bank borrowers (Boyd and De Nicoló (2005)). Another possibility unrelated to asymmetric information is that public banks are less efficient in their screening process or purposefully target riskier firms (Jiménez et al. (2019)), in which case public banks should attract riskier borrowers overall. This can benefit private banks, who would face an improved pool of borrowers as a result of public banks attracting riskier firms (Tirole (2012), Philippon and Skreta (2012)).

The trajectory of private and government banks loan risk reveal several important patterns. First, delinquency rates prior to the intervention are very similar for private and public banks. Second, the policy is associated with a worsening of the quality of public banks' borrowers relative to the quality of borrowers of private banks. In particular, the average probability that a loan originated by a public bank becomes delinquent is 100 basis points higher than the probability of loans originated by private banks becoming delinquent after the policy, which corresponds to a 22.4% higher probability of delinquency for firms borrowing from public banks in comparison to firms borrowing from private banks. Importantly, the fact that public banks lend to similar quality borrowers before, and lower quality borrowers after the intervention, casts doubt on the idea of adverse selection or moral hazard as being meaningful forces that drive borrower riskiness. Nevertheless, the observed differences in average borrower riskiness between private and public banks are consistent with lower screening standards by public banks as part of the intervention. Alternatively, public banks might have subsidized levered borrowers to prevent short term delinquencies that would have impacted their balance sheet. Finally, taken in isolation, the evidence post intervention is also consistent with potential advantageous selection, with riskier borrowers being attracted by low interest rates.

To uncover the exact mechanisms that explain differences in loan risk for government and private banks, we compare loans to levered borrowers with loans to unlevered borrowers. If differences in riskiness are caused by specific subsidies provided by public banks to levered firms, we would expect unlevered borrowers of private and public banks to have similar risk. Moreover, if differences in riskiness are caused by public banks having lower screening standards, which might have increased after the intervention, then both levered *and* unlevered borrowers of public banks would be riskier. The second comparison is between old and new firms. In particular, if differences in riskiness were to be explained by some sort of *selection*, we would expect *new* borrowers of private banks to be *safer/riskier* if there is *adverse/advantageous* selection. Intuitively, these borrowers are expected to have lower propensity to borrow on average, since they only obtain loans when facing ex-post lower interest rates.

We document that while private banks charge lower interest rates when lending to borrowers with no outstanding debt, public banks charge lower interest rates when lending to older, levered borrowers, rather than subsidizing lending to new customers with no debt outstanding. However, new clients of public and private banks have comparable risk both before and after the intervention, contradicting the idea of uniformly lower screening standards by public banks. Risk differences for public and private banks arise from loans to borrowers with positive debt outstanding. Importantly, conditional on having no outstanding debt, old and new borrowers have similar risk, contradicting the idea that new borrowers who would be attracted by lower interest rates would be riskier, as in advantageous selection models. This, along with the evidence of additional subsidy provided by public banks to levered borrowers, suggests public banks increase their risk exposure to levered firms by incentivizing credit acquisition by these firms, and that risk is not caused by any form of selection.

A final test of the effects of the intervention is to assess potential real effects from the increase in credit supply by the government. Given the magnitude of the increase in funds by public banks, locations with more exposure to these banks should experience larger economic growth if these funds were used to finance productive projects. We address this question by comparing municipalities with only public or private bank branches. Locations with only government banks face larger credit growth after the intervention compared to

locations with only private banks. However, cities with only public banks do not experience statistically significant differences in output growth relative to cities with only private banks. Finally, we also test for differences in employment of firms who borrow from public banks and firms who borrow from private banks. The latter group benefits from larger interest rate reductions after the intervention and, according to theories that highlight the role of credit constraints in preventing firm investment, should respond by investing more. However, we find that both types of firms have comparable employment trajectories throughout the policy. We conclude that while the policy was successful in forcing reductions in the interest rates of private banks, we cannot rule out the hypothesis that state owned banks financed less productive, levered firms, during the policy, and that the interest rate reductions by private banks did not cause larger investment at the firm level.

The remainder of the paper is as follows: Section 2 reviews the related literature. Section 3 presents the theoretical framework that serves as the basis for private and public bank competition. Section 4 presents the data and relevant institutional details of the Brazilian economy. Section 5 presents evidence of the effects of the intervention on public and private banks' credit variables. Section 6 documents lending patterns to levered and unlevered firms and risk differences for these firms. Section 7 assess the real effects of the policy. Section 8 concludes.

2. Related Literature

Our paper adds to the broad literature that studies government interventions in financial markets. Bertrand, Schoar and Thesmar (2007) shows that a removal of government regulations in France led to productivity gains, and that by ceasing to provide subsidized loans to unproductive firms allowed such firms to restructure, overall improving credit allocation. More recently, given the increase in government interventions in financial markets, more studies analyzed how these interventions can lead to credit misallocation. Recent examples include Acharya et al. (2021), who show how guarantees provided by European governments distorted lending incentives of banks, which ultimately engaged in zombie lending. Moreover, Acharya et al. (2020) argues that such zombie lending is associated to disinflation

and productivity loss that is currently observed in Europe[3]. Close to our paper, Jiménez et al. (2019) use a small loan facility implemented using a state owned bank in Spain, and argue that despite public banks attracting worse quality borrowers, the social value of such interventions during a crisis is still positive. Our paper adds to this literature by showing that government banks can affect private banks lending behavior and expand credit access, but at the cost of worse borrower quality. Importantly, we found no real effects from the extensive margin of additional credit supply, which is in line with the idea that the intervention might have caused credit misallocation.

The effectiveness of interventions in credit markets also depends on the existence of adverse or advantageous selection (Stiglitz and Weiss (1981), De Meza and Webb (1987)) and on the connection between asymmetric information and competition (Mahoney and Weyl (2017) and Biswas and Koufopoulos (2019)). We contribute to this literature by developing a simple framework that accommodates public and private banks competing in a market with asymmetric information frictions. On the empirical front, Crawford, Pavanini and Schivardi (2018) shows that market power can alleviate the negative effects of increased adverse selection[4]. In contrast to their structural estimation, our empirical approach relies on the fact that public banks charge arguably exogenous interest rates, thereby attracting consumer with lower propensity to borrow. This reduced form approach allows us to study specific borrower groups which would be particularly affected by different forms of selection, adding confidence to our results.

One important distinguishing feature of our contribution relative to other papers studying government interventions is that our context resembles a competition shock to the banking sector. In that perspective, our paper is connected literature studying bank competition. The first dimension that we contribute to is the connection between bank competition and risk. Theoretically, an inverse relationship between competition and financial stability can be obtained by assuming lower interest rates that result from competition lead to lower bor-

[3]Focusing in the US, Veronesi and Zingales (2010), shows that interventions during the Great Financial Crisis were costly to tax payers, while benefiting bank debtholders

[4]More generally, the interplay between asset quality and asymmetric information is important in the design and outcomes of credit market interventions. By acquiring worse assets - or, equivalently, funding worse borrowers - the government can restore proper market functioning, as in Tirole (2012). The interventions can also be used in situations where excessively high interest rates prevent efficient projects from taking place, as shown by Philippon and Skreta (2012)

rower risk, as in Boyd and De Nicoló (2005)[5]. Our results, however, cast doubt on the idea that moral hazard is a meaningful force that can lead to improvements in financial stability from increased competition.

Empirically, Jiang, Levine and Lin (2019) shows that increased competition can lead to higher risk due to effects on banks profits, relationship lending and to financing of riskier borrowers. Similarly, Goetz (2018) also points out to positive stability effects stemming from additional competition in the banking sector. This contrasts our results, where the intervention is characterized by a worsening of lending standards by the public banks, despite low interest rates implemented by these institutions relative to private banks.

Moreover, we show that in response to a shock to competition, banks react by lowering interest rates and that the pass through of the competition shock is *larger* for smaller firms. To the best of our knowledge, this is the first study that documents a heterogeneous pass through of lower interest rates caused by competition, which adds to the literature studying the how competition in the banking sector benefits small firms (Rice and Strahan (2010) and Ryan, O'Toole and McCann (2014))[6]. Furthermore, new borrowers of private banks obtain lower interest rates than existing customers, which is in consistent with previous empirical research in relationship lending (Degryse and Ongena (2005), Ioannidou and Ongena (2010)) and indicates that lending relationships allow banks to extract rents from firms.

Our contribution is closely related to the literature that studies government ownership of banks. Traditionally, this literature attempts to differentiate between a development view of government banks, in which such institutions would promote growth by funding socially beneficial projects which would otherwise not be funded, and a political view in which such institutions allocate funds to achieve political objectives. The seminal paper of La Porta, Lopez-De-Silanes and Shleifer (2002), which studies cross country differences in government ownership and how that is related to financial and broad economic development, is one example. Similarly, Dinç (2005) documents how credit provided by state owned banks is influenced by political cycles. Other studies take a more focused, within country approach, using loan level data. Sapienza (2004), for example, shows how Italian public banks

[5]A similar approach is used by Martinez-Miera and Repullo (2010), who extends the model to include the effects of lower interest rates on profits, leading to a u-shaped relationship between competition and risk

[6]In contrast to Ryan, O'Toole and McCann (2014), our study shows that micro firms benefit the most from the increase in competition. In their study, micro firms' financial constraints are comparatively less affected by market power than small and medium firms

provide cheaper credit than their private counterparts, and connects these more favorable conditions to political influences at the local level. More recently, Carvalho (2014) shows that political influences over the allocation of credit from a Brazilian development bank can lead to misallocation problems.[7]

After the recent global financial crisis the policy oriented aspect of government banks started to be explored. Since ownership of banks allows governments to influence credit markets through direct lending, state owned banks were used to provide credit and counter reductions in credit supply of private banks. Coleman and Feler (2015) explore the use of public banks in Brazil during the Great Recession, highlighting how government banks credit mitigated the downturn. Similarly, Jiménez et al. (2019) use loan data application to study an small credit facility in Spain, which allows them to draw conclusions about borrower quality. In particular, while state owned banks face worse applicants and experiences higher default, the intervention has positive social returns.

Finally, our contribution adds to the vast literature that studies the Brazilian banking sector. Given the size and importance of government owned banks in the country, many papers use Brazilian data to learn about the economics of these institutions, such as Carvalho (2014), Coleman and Feler (2015) and Cortes, Silva and Van Doornik (2019). Two papers focus on the interplay between public and private banks, with Coelho, De Mello and Rezende (2013) showing evidence that private banks do not compete with public banks, and Sanches, Silva Junior and Srisuma (2018) showing that public banks generate positive spillovers to private banks, and that as a result bank privatization can lead to a reduction in the number of banks in a certain location. Similar to our project, Schmitz (2020) studies the introduction of the same policy in Brazil with a focus on corporate credit, documenting that while federal banks increased credit to ex-ante riskier SME firms, private foreign banks focused on safer SME firms and private national banks increased their market share in the large firms segment. Our project complements these studies by showing that public banks can affect private banks loan interest rates, and that attempts to increase credit supply result in losses to these government institutions due to worsening of borrower quality. Moreover, we document several patterns of competition in corporate loans, including interest rate differences by borrower type.

[7] Other papers include Iannotta, Nocera and Sironi (2013) and Assuncao, Mityakov and Townsend (2012)

3. Theoretical Framework

The nature of the intervention is such that public banks were charging lower interest rates than private banks in similar products, while having a lower market share before the intervention. Given that the sudden increase in the amount of credit originated by public banks right at the beginning of the intervention was not accompanied by a decrease in average loan interest rates, this suggests public banks operate with a fixed supply of credit and ration some of their applicants.

The second important feature of the intervention is the differential between interest rates of private and public banks, and the emphasis on the attempted reduction of interest rates by private banks via competitive pressure by government banks. A long strand of the literature focused on credit markets assumes interest rates and borrower risk are connected. In particular, adverse selection models such as Stiglitz and Weiss (1981) and moral hazard models such as Boyd and De Nicoló (2005) and Martinez-Miera and Repullo (2010) incorporate the idea that lower interest rates *reduce* borrower risk. A different, less common approach is to assume that interest rates and borrower risk are negatively related (De Meza and Webb (1987), Biswas and Koufopoulos (2019)), in which case higher interest rates are associated with safer borrowers. These different approaches have important implications for the study of interventions in credit markets since they lead to different conclusions about the optimal amount of credit in the economy (Mahoney and Weyl (2017)). Building on those facts, we construct a model that predicts that the optimal amount of public credit is sensitive to the magnitude and the sign of the selection mechanism.

We assume that demand for credit Q is well defined as a function of interest rates R is given by $Q(R) =^{e} -\epsilon R$, where ϵ is the semi-elasticity of demand with respect to interest rates. We introduce public credit by assuming that the government bank sets prices $R_G < R_P(Q)$ and efficiently rations its applicants, that is, the public bank will lend to borrowers with the highest willingness to pay. Effectively, what this means is that private banks will face the residual demand of borrowers who are not able to obtain credit from the public bank.[8] Since the public bank efficiently rations its applicants, private banks' residual demand will be given by $Q_P(R_P) = Q(R_P) - \bar{q}$, from which we derive the inverse demand function $R_P(Q) =$

[8] We assume the public bank sets a quantity $\bar{q} < Q(R_P)$.

$-\frac{\ln(Q_P+\bar{q})}{\epsilon}$.

To capture the idea that an increase in public credit can lead to a change in borrower riskiness, we allow for the average probability of default P faced by private banks to be a function of the amount of credit provided by public banks and private banks, $\bar{q}$ and Q_P, respectively. In other words, we write $P(Q_P, \bar{q})$, with $\frac{\partial P}{\partial \bar{q}} \lessgtr 0$. This assumption can be seen as a reduced form way to capture adverse or advantageous selection.[9] To see why, suppose markets are characterized by adverse selection. In that case, borrowers with the highest propensity to borrow are going to be riskier. Given our Efficient Rationing assumption, such borrowers would borrow from public banks and relatively safer borrowers would borrow from private banks. In other words, in the presence of adverse selection and Efficient Rationing by public banks, these institutions would attract *worse* borrowers, improving the pool of borrowers for private banks, with $\frac{\partial P}{\partial \bar{q}} < 0$. Similar argument can be used to show that in the presence of advantageous selection $\frac{\partial P}{\partial \bar{q}} > 0$. Moreover, changes in private banks' quantities would also lead to changes in risk, since that would lead to changes in the interest rate R_P and to the average propensity to borrow of the firms willing to borrow. For simplicity, we assume that $P(Q_P + \bar{q}) = \xi + \gamma(Q_P + \bar{q})$, where $\gamma < 0$ indicates adverse selection, and $\gamma > 0$ indicates advantageous selection.

Private banks are identical and have linear costs $c(q_i) = cq_i$. We can write the profit of a bank i as:

$$\Pi(q_i, q_{-i}, \bar{q}) = q_i R\left(\sum_j q_j + \bar{q}\right)[1 - P(\bar{q})] - cq_i \tag{1}$$

Since quantities are connected to default probabilities, banks will internalize the effect of their quantity choices on their profits through the selection channel. Whether or not this leads to more or less crowding out of private credit in response to an increase in public credit depends on the exact form of selection, as shown in Proposition 1:

Proposition 1. *If $|\gamma|$ is sufficiently low, then $\frac{\partial q_i}{\partial \bar{q}} < 0$ both in advantageous and adverse selection cases.*

In the presence of adverse selection, the crowding out effect of an increase in government credit is *larger* than in the baseline case with no risk. The intuition is the following: when

[9] Even in the absence of selection, as long as public banks attract safer or riskier borrowers than private banks, we will have $\frac{\partial P}{\partial \bar{q}} \neq 0$

the government bank increases credit, private banks reduce quantities in response to the decrease in marginal revenue. When there is advantageous selection that adjustment will be smaller since the marginal effective revenue (net of default) is decreasing and convex in quantities (as in Figure 3), which means the decrease in unit revenue is *smaller* when the government increases its supply of credit. The same reasoning explains why the adjustment is *larger* when there is adverse selection.

Consequently, when there is advantageous selection, *total credit should increase more* relative to the baseline case with no selection. Moreover, if the advantageous selection issue is sufficiently large, this can lead to a mute response of private banks in terms of quantities, as we argue below:

Proposition 2. *In the case of advantageous selection, as* $\gamma > 0$ *increases,* $\frac{\partial q_i}{\partial \bar{q}} \to 0$.

Although a similar conclusion can be drawn for the case of adverse selection (whereas the crowding out effect would be larger the larger the selection problem), our empirical results suggest the response of private banks quantities was limited. Proposition 2 shows that such a lack of response can be motivated in a simple Cournot model as resulting from a severe advantageous selection problem, where decreases in the interest rates resulting from an increase in the supply of credit would lead to a *deterioration* of the quality of the pool of borrowers.

One important difference is that, in this case, private banks' interest rate would *fall* following the intervention. As stated in Proposition 1, the response of private banks is less negative in this case, which means the effect on total quantities will be larger and, consequently, the intervention will lead to an even larger decrease in interest rates in the presence of advantageous selection. We illustrate Proposition 2 in Figure E.7 in the Appendix. We can see that, as the degree of advantageous selection increases (that is, γ increases), the reduction in supply of private banks in response to credit supply increases by the government bank becomes smaller. In other words, advantageous selection can dampen the crowding out of private credit resulting from the intervention.

Our theoretical framework thus informs us of the expected response of private banks if some form of selection exists in the market for corporate loans in Brazil. Importantly, the response of private banks will be different depending on the direction and magnitude of either form of selection. We test the predictions of our model in our empirical analysis.

4. Data and Institutional Setup

4.1. Data

Our main sources of data comes from two sources: (i) Confidential credit registry data from the Brazilian Central Bank *SCR* database[10]; (ii) labor contracts data from the *Annual Review of Social Information - RAIS* database. We complement the confidential data with publicly available data from various sources as outlined below.

SCR Credit Registry Banks are required to disclose details of loans originated with amounts above a certain threshold[11], allowing us to observe the near universe of loans to firms in Brazil. The database includes basic information about loan contracts, such as the type of credit, interest rates, amount, maturity, borrower tax id and collateral. Most information from the credit registry is available to the banks in Brazil, being one of the main sources of credit history information available to banks[12]. We construct a time series of loan origination by looking at all loans in each month which have a positive amount outstanding at the end of that month. While we lose very short term loans in the process, the majority of the corporate loans have maturities of more than one month. We also use the outstanding amounts to track firms credit history prior to the month in which they contract a loan, so we can track firms' past relationships with specific banks.

The credit registry data also allows us to track loan delinquency since it also has information about outstanding amounts past due date. However, loan identifiers are not constant across time, which means we cannot track individual loans. We address this issue by tracking the delinquency information at the firm-month-loan type-bank dimension, up to one year after origination. This means we can identify firms which become delinquent in a loan within a certain loan type that they have borrowed from a certain bank in a specific month. Since our definition of borrower quality reflects borrower information and since many firms are smaller firms with only one origination in the same month, our approach for obtaining

[10] Several papers studying the Brazilian economy use the SCR as their main source of data. Examples include Fonseca and Van Doornik (2019), Joaquim, Gustavo; Van Doornik (2019) and Cortes, Silva and Van Doornik (2019)

[11] BRL 5,000.00 (around $2,500) until December 2011, 1,000.00 (around $ 500.00) from January 2012 onward.

[12] Some information available to us is not available to banks. For example, banks do not observe interest rates negotiated between clients and other banks.

delinquency information is comprehensive despite the constraints. Additionally, it allow us to identify firms with a negative credit history at the moment in which they originate a loan.[13]

Finally, the SCR credit registry contains information about the funding sources for each loan originated, differentiating between banks' own funds and external funding. This distinction is important since subsidized credit from development banks, for example, are accounted for as loans with external sources of funding in the SCR. By restricting ourselves to loans using banks' own resources we restrict the analysis to loans whose liability counterparts are banks' deposits and capital, rather than onlending from development banks, which are likely different than regular loans from a competition perspective.

Annual Review of Social Information - RAIS We use the *RAIS* database to collect employment information about consumers and firms. Brazilian firms are required to inform their annual employee headcount, along with individual labor contract information, which includes detailed information such as hiring dates, employer and employee tax ids and average yearly wages. We use the RAIS data to obtain income and employer information about consumers, and to construct size proxies for firms based on number of employees and payroll costs, by matching the unique firm tax IDs from the SCR and the RAIS datasets.[14]

Both datasets may contain firm ids without a correspondent in the other dataset. While this is expected in the case of RAIS (since not all firms have access to credit and/or decide to borrow in a given year), this is less obvious for SCR. Firms which do not have employees do not have to fill the annual RAIS information, which means these are firms which are not in the RAIS dataset. These can be individual entrepreneurs or holdings of other corporate entities which use the holding id to obtain loans. Since these firms represent less than 15% of the total amount originated by public banks as part of the policy, we do not include such firms in our sample.

[13] Following Jiménez et al. (2014), we include only loans past due date for more than 90 days in the construction of our delinquency variable. We follow the same rule when identifying firms with negative credit history in a certain month, where we track a firm's credit history for 12 months prior to origination.

[14] Although we do not observe balance sheet and income statement information for all firms, we estimate firm revenue based on average 3 digit information from surveys of commerce, industry and services. The procedure is detailed in C.

Auxiliary Data We also collects information from public sources, including bank balance sheet, bank branches and municipality characteristics. Bank balance sheet, income statement and regulatory capital information for all financial institutions in the country is available at quarterly frequency in the IF data website. Branch balance sheet information containing detailed information about assets and liabilities at branch level is available at monthly frequency from the ESTBAN database. The database also includes the municipality of location for each branch, and allows for the identification of entry/exit of banks in each municipality. Finally, the *Brazilian Institute of Geography and Statistics (IBGE)* provides economic data at municipality level, including a breakdown of GDP and its individual components from the expenditure perspective. The institute also performs three large surveys that we use to complement our firm data information. The *PIA - Annual Industry Survey*, the *PAC - Annual Commerce Survey* and the *PAS - Annual Services Survey*, which contain two and three digit aggregated income statement information about firms in these macro sectors.

There are five types of corporate loans that most commercial banks provide using their own funding sources, which does not include loans from development entities: working capital, discounted receivables (loans in which firms anticipate the receipt of cash flows from sales and other accounts receivables), auto loans, credit cards and overdraft accounts. We focus on working capital loans since they were one of the types covered during the policy, and since they have longer maturity, which allows us to track borrower delinquency over time more accurately.[15] Appendix C contains the details of the construction of the main dataset used in our analysis. Table 1 shows borrower summary statistics from our data:

[15]Importantly, such loans are also one of the the primary source of funds for firms, as can be seen in Appendix A.

Table 1: Summary Statistics

Variable	Mean	Median	SD	Min	Max
Panel A - Loans					
Amount (R$)	77,611	35,121	129,873	5,037	4,000,000
Maturity (months)	18.38	18	11.13	1	60
Interest Rate (% Yr)	33.84	30.29	15.59	10.03	111.9
Panel B - Firms					
Num. of Employees	12.24	4	90.85	1	13,981
Payroll Costs (R$ per Month)	15,716	3,659	204,450	540	1,701,000

Note: This table reports summary statistics for the main variables in our dataset. There are N_{obs} =3,285,824 observations and N_{firms} = 941,597 firms in the matched sample,

4.2. Economic Context

The Brazilian banking sector has an oligopolistic structure that has consolidated as a result of privatization processes and other restructurings in the banking sector that took place as part of several financial reforms employed in the late 90s and early 2000s. Most states had their financial institutions by that time, which were sold to private national and foreign banks as part of an effort to stabilize state fiscal deficits and modernize the financial sector. While large national banks, such as Itau, Bradesco and Unibanco, acquired some of these regional state banks, the intense privatization process also allowed foreign banks to gain access to Brazilian credit markets, with Santander, ABN Amro and HSBC engaging in important acquisitions during the period. Bank consolidation would further advance with the merger of Itau and Unibanco, and the sale of ABN Amro's operations in the country to the Spanish conglomerate Santander.

Despite the large scale privatization process described above, state owned banks remained an important part of the financial sector in Brazil. In particular, the federal government has direct control of two large commercial banks: *Banco do Brasil* (from now on BB) and *Caixa Economica Federal* (from now on CEF), with BB being the largest bank in Brazil by asset value. In addition to regular corporate and retail products, BB is a major provider of agricultural credit. The bank is under direct control of the Brazilian government as the majority shareholder is the Ministry of the Economy, through the Brazilian National Treasury. In contrast, CEF was originally created as a savings bank, focusing mainly on savings accounts and

retail products throughout its history, and is the main provider of real estate credit in Brazil. Contrary to BB, it does not have shares traded in public markets. In both cases, however, the Ministry of the Economy is responsible for nominating the CEO of both banks. Effectively, this implies both institutions are under control of the Brazilian government and are actively used as means to implement credit policies.

In addition to the two, large commercial banks mentioned above, the Brazilian government also controls three other institutions: the *Banco Nacional de Desenvolvimento Social* (BNDES), the *Banco do Nordeste* and the *Banco da Amazonia*. BNDES is the largest development bank in the country and provides subsidized lending to firms and financing for local government infrastructure projects. As with BB and CEF, BNDES is also extensively used as a mean to implement credit policies in the country. *Banco do Nordeste* and *Banco da Amazonia* are smaller commercial banks which operate within specific regions.

4.3. The Intervention

In this section we discuss the lead up to the intervention, highlighting the perspective of the government and the contexts in which it was implemented, and provide an overview of aggregate evidence of the behavior of interest rates and loan supply.

After the early years of the Great Recession, the Brazilian economy followed the trend that many emerging countries experienced in the first years after the crisis. Since most Brazilian banks are not too exposed to US and European financial markets, the financial sector in Brazil was much less affected by the financial crisis than developed countries. This, along with favorable commodities prices, resulted in strong economic growth in 2010 and 2011, when Brazilian GDP grew by 7.5% and 4.3%, respectively. Nevertheless, by the end of 2011, the Brazilian government became worried about a potential economic slowdown, and implemented a series of economic policies to prevent a downturn. In the same direction, monetary policy was loosed, with the SELIC target, the main reference interest rate in the economy, going from 12.50% in July 2011 to 7.25% in October 2012.

Interest rates for consumers and firms, however, were particularly large, even when compare to other developing countries. The average lending rate in 2011 was 43.8% in Brazil, compared to 14.1% in Argentina and 4.91% in Mexico, for example.[16] Despite expansionary

[16]Source: IMF International Financial Statistics, available at https://data.imf.org/regular.aspx?key=61545855

monetary policy, loan interest rates remained high, and in March 2012 the government announced the use of BB and CEF to promote credit supply increases for several types of loans, both to consumers and firms, at subsidized interest rates. The reasoning behind the implementation of the policy was that by increasing the amount of credit provided by government banks and charging lower interest rates the government would successfully increase competitive pressure on private banks. Facing additional competition, private banks would be forced to reduce loan interest rates in order to avoid losing customers. Achieving lower interest rates was a fundamental goal for economic policymarkets in Brazil, who held the belief that lower interest rates were necessary for sustainable economic growth and would prevent a slowdown of economic activity.[17]

While the policy was widely advertised after its announcement, specific details about its implementation, coverage and duration were imprecise. Initially, each of the two banks indicated that minimum interest rates would be reduced for loan categories included in the program, along with funding amounts which were to be directed to the policy. However, it was not clear which borrowers would have access to the lowest interest rates, or if there were specific requirements to obtain public credit after the intervention.

5. The Effects of the Intervention on Equilibrium Credit

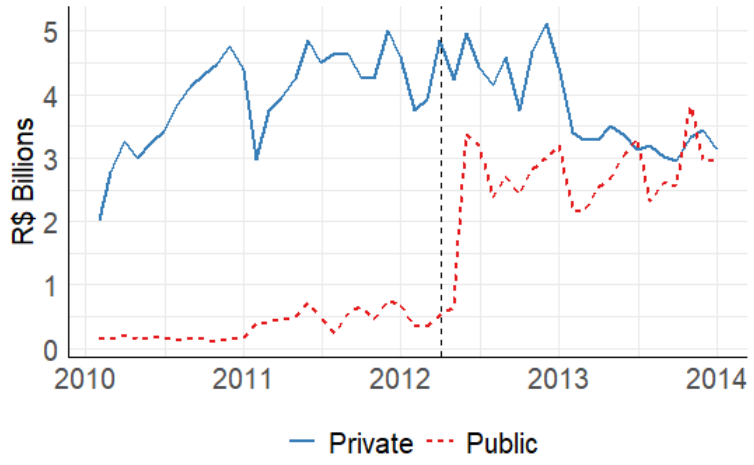
The intervention was designed to cause private banks to react to the increase in government provided credit, leveraging on the fact that the largest private and public banks were competing in similar locations. However, it is unclear how such policy affects private banks and which contract margins these institutions adjust. Moreover, theory suggest that the effectiveness of the intervention depends on economic forces determine borrower risk. In this section we study how the intervention affected credit markets, looking at the aggregate effect on total credit, the response of private banks' interest rates and the trajectory of average borrower quality before and after the policy.

[17] The former Brazilian President Dilma Roussef was particularly dissatisfied with high interest rates spreads - the difference between interest rates charged by banks and the base interest rate in the economy. In her labor day's speech, which took place after the intervention, she says *"The Brazilian economy will only be completely competitive when our interest rates (...) match the interest rates employed in international markets (...) It is unacceptable that Brazil, which has one of the most stable and profitable financial sectors in the world, continue to have one of the highest interest rates (...) Government owned banks proved that it is possible to reduce interest rates in loan operations, credit cards and even payroll loans. It is important that Private Banks follow suit"*.

5.1. Overview of Loan Amounts and Interest Rates Before and After the Intervention

We start our empirical analysis investigating how credit originated by public and private banks behaved before and after the intervention. First, this is important for us to understand whether or not public banks successfully increase their lending, since additional supply by these government institutions would have to be met by borrowers in need of funds. Second, this analysis will also indicate the extent to which there was crowding out of private credit in response to the intervention. On the one hand, we might observe firms who borrow from private banks switching to public banks, leading to a decrease in the amount of credit supplied by private banks. On the other hand, private banks might adjust other contract characteristics, such as interest rates, to accommodate the increase in competition arising due to the policy implementation. Figure 1 shows the total amount of credit private and public banks lend per month:

Figure 1: Total Amount of Credit



Note: This figure shows the total sum of the contract amount of working capital loans originated by private and public banks each month. Source: SCR Database.

The striking feature of Figure 1 is that, despite a sudden and large increase in public banks' lending right after the announcement of the intervention, this does not trigger an immediate reduction in loans originated by private banks, which is stable throughout most of 2012. Despite the fact that government banks had small market share prior to the intervention, state owned banks are able to rapidly increase their lending, without a large effect

on the amount of credit provided by private banks or in their customer base. In particular, Appendix F Table F.1 shows that in response to a 1% increase in public banks' credit at the municipality level, private banks' credit falls by 0.02%. This translates into a 4% crowding out of private credit in response to the increase in supply of public banks during the intervention. Moreover, Table F.2 shows that, despite the increase in the availability of cheaper credit, very few firms switch from private to public banks. This is in line with the idea that lending relationships are sticky and characterized by hold up issues (Petersen and Rajan (1994)). Furthermore, the fact that the response of private banks' quantities is small is in line with potential advantageous, rather than adverse selection, as argued in Proposition 2.

One possibility is that public banks worked with a fixed credit supply and were rationing their applicants, which would explain how these banks were able to suddenly increase their loan origination. Additionally, to the extent that public banks are not profit maximizers, they can charge lower interest rates than private banks, thus facing larger demand for loans. This can help explain why borrowers who potentially were being rationed by public banks would not obtain loans from private banks.[18]

The lack of effects of the policy in private credit amounts suggests that private banks adjusted other margins to compensate for the increase in competition, with one important margin being interest rates. To assess whether or not there are meaningful differences between pricing by private and public banks, we analyze average loan interest rates. The behavior of interest rates is relevant not only because it can provide additional evidence of credit rationing by public banks before the policy, but also because loan rates are a fundamental aspect of the policy. The reasoning supporting the implementation of the policy was that, by charging lower interest rates and increasing credit supply, public banks would increase competitive pressure on private banks, forcing these banks to respond by lowering their interest rates. Figure 2 shows the average interest rates of working capital loans of public and private banks:

The notion that public banks are able to provide loans at lower interest rates since their objective is not to maximize profit is evident in Figure 2. We can see that government banks provide substantially cheaper credit that private banks, both before and after the intervention. Moreover, the policy is followed by a large decrease in the interest rates of private

[18] In terms of size distribution, firms borrowing from both private and public banks are usually micro and small firms, as can be seen in Appendix E Figure E.2.

Figure 2: Average Loan Interest Rates

Note: This figure shows the average yearly interest rates of working loans credit originated by private and public banks. Source: SCR Database.

banks. Despite such reduction, the difference in interest rates of private and public banks remains large after the intervention, with private loans on average 12.8pp more expensive before the intervention, and 7.4pp more expensive after the policy. That difference is more pronounced in loans for small and micro firms, as can be seen in Appendix E Figure E.3.

One related possibility is that private banks are changing other margins of their loan contracts, such as maturity and loan amounts. For example, private banks might offer loans at shorter maturities than they were prior to the intervention, and the overall effect of smaller interest rates would be reduced. Similarly, private banks can also extend loans with smaller amounts to their borrowers, which would also limit the extent to which the policy benefits firms who borrow from private banks. We explore these possibilities in Appendix E Figure E.5 and Figure E.6. Importantly, there are no substantial differences in the distribution of maturities and loan size for private banks in the post period relative to the period prior to the intervention. This confirms that the main margin of adjustment were interest rates.

While the aggregate evidence suggests private banks responded by reducing interest rates, there are many limitations to this aggregate analysis. Loan contracts have other characteristics that banks and firms agree on, and might justify higher interest rates by private banks. For example, private banks might provide longer maturity but demand higher interest rates. Another possibility is that, in order to access loans from public banks, firms have to provide collateral, or other guarantees which are might not be available for smaller

firms. Finally, public banks might attract applicants with lower ex-ante risk (such as larger, consolidated firms), which are able to borrow at particularly low interest rates. In other words, in order to evaluate the effectiveness of the policy in forcing a reduction in private banks' interest rates, we have to focus on comparable loans, which we do next by exploring the details of our data.

5.2. Are Private Banks Reducing Loan Interest Rates?

At the core of the intervention is the government belief that private banks would respond to the additional competition by their public counterparts by reducing interest rates on their loans. The aggregate evidence in Figure 2 indicates that there was a reduction, but it was not enough to bring the difference between public and private banks' interest rates to zero. Importantly, these aggregate differences can reflect borrower or loan contract characteristics among which private and public banks differ in their lending decisions. To account for this possibility we leverage on the detailed structure of our data, which allows us to look at individual loan issuance, and compare loans issued by private and public banks before and after the intervention, while controlling for firm and contract specific features and a broad range of fixed effects.

Our setup resembles a differences-in-differences specification, but with both types of banks being *treated* by the policy. This poses an additional challenge of isolating changes in such difference that arise because of the intervention, since in general average differences between interest rates of public and private banks, even for comparable borrowers using comparable contracts, can indicate changes that are not associated with the policy. However, the context of our analysis allow us to confidently state that there are no other systematic shocks that could cause meaningful changes in the difference between private and public interest rates. In particular, there are no large mergers, bank failures or other macroprudential policies which would differently affect different banks. Furthermore, the absence of financial crisis means we do not have to worry about the different behavior of private and public banks during such episodes, which could also explain observed changes in the difference between interest rates. Therefore our identification hypothesis is that, given the absence any systematic shocks that differently hit private and public banks, changes in the difference between private and public banks' interest rates are caused by the intervention.

Formally, we estimate Equation 2:

$$i_{jtmbf} = \sum_{\tau=1}^{m} \delta_{-\tau} \times Private_b + \sum_{\tau=1}^{q} \delta_{\tau} \times Private_b + \alpha_{mti} + \alpha_{bank} + \alpha_{t,j(maturity)} + \alpha_{t,f(size)} + \varepsilon_{jtmbf} \quad (2)$$

Where i_{tmbf} denotes the interest rate of a loan issued in month t, municipality m, by bank b to firm f, $Private_b$ is a dummy equal to 1 if bank b is a private bank, and α_{mit}, α_b, $\alpha_{t,j(maturity)}$ and $\alpha_{t,f(size)}$ are fixed effects. The use of a broad range of fixed effects guarantees that we are comparing loans in the same region, month and for firms of the same industry, and that bank specific characteristics are also accounted for. Additionally, time-maturity and time-size fixed effects guarantee we are comparing loans with the same maturity for firms with the same size. All in all, this specification guarantees our results are not capturing portfolio re-balancing changes.[19] The results are shown in Figure 3:

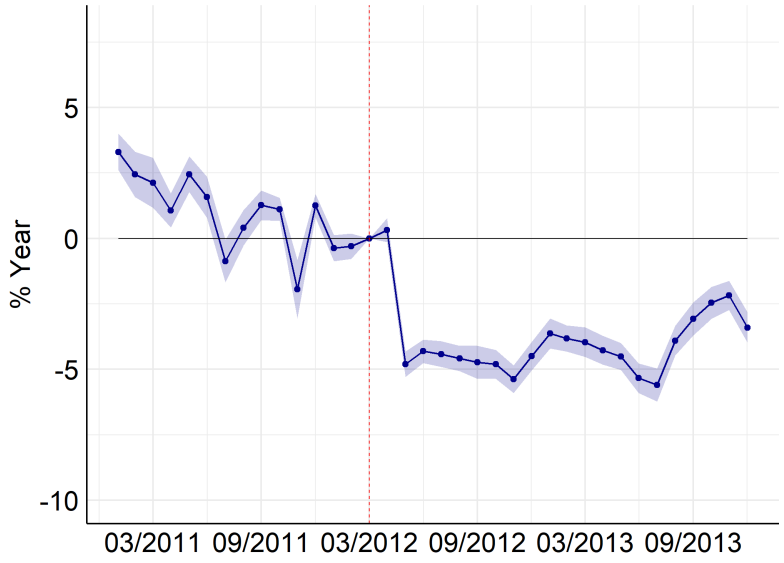
The results in Figure 3 indicate that, despite a linear trend prior to the intervention, interest rates of private banks fall sharply relative to the interest rates of public banks after the policy. The large reduction in November 2011 can be associated with industry specific trends in sectors that rely on working capital loans to pay for end of year wage expenses. In particular, in Appendix E Figure E.8, we show that if one adds time, municipality and industry fixed effects *separately* in Equation 2, the coefficient associated with November 2011 falls by half, without any meaningful changes in our coefficients of interest after March 2012. Overall, the spread between public and private banks' interest rates falls by 5 pp, a reduction of about 33% of the pre-policy difference. The results are also robust to the inclusion of a private bank specific linear trend, as shown in Appendix E Figure E.9, and indicate that the competition shock caused by the increase in supply by public banks *caused* a reduction in private banks' interest rates.[20]

The results so far indicate that private banks responded to the increase in competition

[19] An important issue with loans originated by public banks is that there were very few operations in 2010 for uncollateralized loans, and consequently very few loans that became delinquent according to our criteria (an average of 170 loans per month). Given our regression specification includes several fixed effects and controls, estimates for the difference become noisy in the dynamic specification. Since the number of loans issued by public banks doubles in 2011, allowing us for more precise identification, we chose to restrict the delinquency analysis to 2011 onward. This still gives us more than one year prior to the intervention and allows us to understand trends for public and private banks before the policy was implemented.

[20] Appendix F Table F.3 shows that interest rates reductions occurred even in locations with only private bank branches, and that micro and small firms face larger reductions than medium and large firms.

Figure 3: Differences in Differences - Interest Rates



Note: Regression estimates for δ_τ from equation 2 at the loan level, with March 2012 as the reference month, weighted by loan amount. Dependent variable i_{jtmbf} is the interest rate of a loan j issued in municipality m, month t, from bank b to firm f. Standard errors clustered at bank-municipality level. Coefficients include 95% confidence interval.

generated by the policy by reducing their loan interest rates, although a large spread between average loan rates of public and private banks persisted even after the intervention. Additionally, given the magnitude of the increase in government provided credit, one might expect changes in average borrower quality as a result of the intervention. One hypothesis is that, by targeting certain types of borrowers, public banks distort optimal allocation of credit and subsidize risky borrowers after the intervention. Alternatively, theoretical models predict that, in the presence of some form of selection, differences in interest rates would lead to differences in the quality of the borrowers of each type of bank. A final possibility is that public banks have worse screening standards, leading them to finance firms which are less productive and riskier than firms financed by private banks both before and after the intervention. In particular, if public banks absorb riskier firms, this would also allow for interest rate reductions by private banks, as private banks would be lending to an overall safer pool of borrowers.

5.3. Public Banks and Private Banks Borrower Risk

We have seen that private banks charge higher interest rates than public banks, both before and after the intervention, and that the policy led to an expansion in the number of firms with access to working capital loans. Both characteristics - differences in interest rates, along with expansion credit supply by public banks - can lead to changes in the risk that banks bear in their loan portfolio. Differences in borrower risk can be a result of different economic mechanisms, which have different implications regarding the desirability of the policy. One possibility is that public banks use the intervention to subsidize levered firms with whom they have relationships. Importantly, if these are unproductive firms which can only stay afloat by relying on funds obtained during the intervention, this would lead to a deterioration of loan portfolio quality for public banks once the policy ends. Alternatively, worse borrower quality for public banks can also be caused because these banks banks are less efficient in their screening process than private banks. Consequently, expand credit using these banks would further increase problems associated with allocating credit through government controlled institutions. In both cases the intervention is undesirable, since it allows unproductive firms to obtain funds that would otherwise be better allocated to other, more productive firms.

A different possibility is that markets are be characterized by the presence of adverse selection, in which case there is not enough credit in equilibrium. Importantly, given the differences in interest rates between public and private banks, one would expect public banks to attract safer borrowers than private banks, both before and after the intervention. Intuitively, borrowers with low propensity to borrow would be interested in borrowing only from public banks, which charge lower interest rates. To the extent that such propensity to borrow is correlated with unobserved risk, as in adverse and advantageous selection models, we expect borrowers of private and public banks to have different risk. Importantly, in adverse selection models, the intervention is desirable since it increases the fraction of productive firms that receive credit in equilibrium, and by reducing overall loan portfolio risk since it causes private banks to reduce their interest rates.

The first step to understand how the intervention affected risk is to compare the trajectory of borrower risk for public and private banks, before and after the policy. To do that, we rely on information about loan delinquency which we obtain from the credit registry data.

In particular, we say a firm which borrowed in a particular month with a certain bank is delinquent if either of the loans to that firm in that particular month became delinquent for more than 90 days withing a year after origination[21]. For example, if a firm obtains a loan in May 2012, we track that firm's delinquency amounts until May 2013. If such a firm fails to pay its loan instalments for at least 90 days, we define such firm as a delinquent for loans it contracted in May 2012.

It is worth pausing for a moment to understand the implications for our measure of risk. Since we track loans for a period of one year, loans originated in different months will be exposed to different economic shocks that will likely reflect higher or lower default. For example, a loan issued in March 2013 will be exposed to economic shocks happening in early 2014, while the same is not true for a loan issued in March 2011. Thus, differences in delinquency trajectories will also reflect different shocks affecting firms over time. For that reason in our analysis of delinquency we jointly analyze public and private banks, since borrowers of both types of banks will be subject to the same systematic shocks, conditional on borrowing on the same month.

We first analyze the individual average delinquency over time for private and public banks, in order to evaluate parallel trends and to understand how private and public banks' borrower quality evolves over time. Formally, we estimate the following specification:

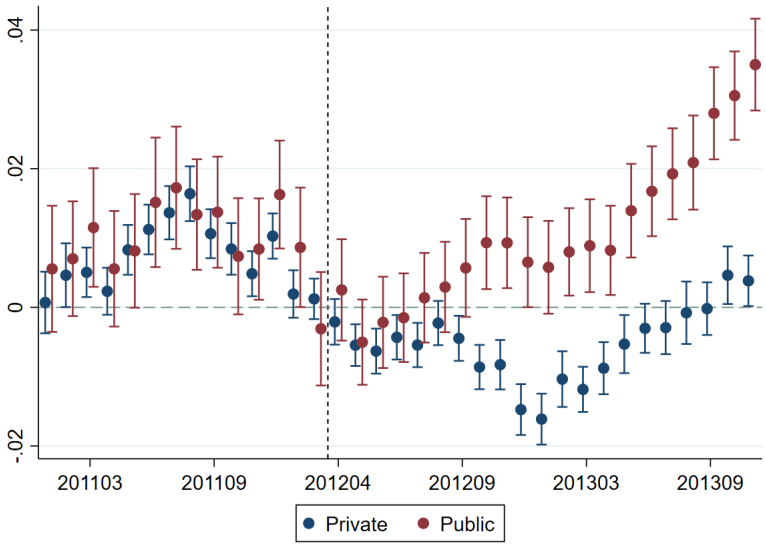
$$delinq_{tmbf} = \alpha_{mj} + \alpha_b + \sum_{\tau=1}^{m} \delta_{-\tau} + \sum_{\tau=1}^{q} \delta_\tau + \Gamma_1 \mathbf{X}_{tmbf} + \Gamma_2 \mathbf{Z}_{tmbf} + \varepsilon_{tmbf} \tag{3}$$

Where $delinq_{tmbf}$ is a dummy equal to 1 if a loan originated by firm f located in municipality m in month t borrowed from bank b becomes delinquent within one year after origination, α_{tmj} and α_b are time-municipality-industry and bank fixed effects and δ_τ is a dummy equal to 1 in month τ. Each δ_τ indicates the average delinquency probability relative to March 2012, our baseline date. We estimate equation 3 for public and private banks separately, and show the specific time coefficients δ_τ with standard errors in Figure 4. Interestingly, prior to the intervention public and private banks have very similar delinquency trajectories, despite large differences in the average interest rate of their borrowers. However, after the intervention public banks experience a deterioration of their loan portfolio,

[21] The choice of 90 day cutoff follows other papers in the literature, such as Jiménez et al. (2014) and Jiménez et al. (2019)

while private banks' borrower quality remains mostly stable.[22]

Figure 4: Differences in Borrower Delinquency



Notes: Results for the δ_τ from the estimation of Equation 3 for public and private banks separately. Loan Controls $\mathbf{X}_{tm}$ include: Maturity Categories, Loan Amount and Rating Categories. Borrower Controls $\mathbf{Z}_{tm}$ include: Firm Ownership dummies, log of number of employees, log of estimated revenue and a dummy indicating positive debt outstanding. Standard errors are clustered at the bank-municipality level.

To formally test average delinquency differences between private and public banks for comparable borrowers obtaining loans in the same month, we estimate the following specification:

$$delinq_{tmbf} = \alpha_{tmj} + \beta_1 Public_b \times Post_t + \beta_2 Debt_{ft} + \Gamma_1 \mathbf{X}_{tmbf} + \Gamma_2 \mathbf{Z}_{tmbf} + \varepsilon_{tmbf} \tag{4}$$

Where $delinq_{tmbf}$ is a dummy equal to 1 if a loan originated by firm f located in municipality m in month t borrowed from bank b becomes delinquent within one year after origination, α_{tmj} and α_b are time-municipality-industry and bank fixed effects, $Public_b$ is a dummy equal to 1 if bank b is a public bank, $Post_t$ is a dummy equal to 1 after March 2012 and $Debt_{ft}$ is a dummy equal to 1 if firm f has positive debt outstanding in month t. Importantly, the use of time-municipality-industry fixed effects guarantees that the differences in delinquency not explained by shocks that affect firms in the same location, that operate in

[22] As the intervention was widely advertised within the country, it is possible that it helped raise awareness about the low interest rates of private banks, ultimately attracting more borrowers with lower propensity to borrow to public banks.

similar industry, in the same month. Furthermore, we control for firm-bank characteristics, such as past credit history, including delinquency amounts, and outstanding debt, which are also shown to affect interest rates. The results of the estimation of equation 4 is show in Table 2:

Table 2: Differences in Delinquency

	(1)	(2)	(3)
Public × Post	0.0107***	0.00721**	0.0134***
	(0.00230)	(0.00224)	(0.00239)
Debt		0.0270***	0.0280***
		(0.000801)	(0.000830)
Time××FE	✓	✓	✓
Bank FE	✓	✓	✓
Weighted by Num. Loans			✓
R^2	0.158	0.159	0.173
Observations	1818371	1818371	1818371

Standard errors in parentheses

* $p < 0.01$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table shows the results of the estimation of Equation 4. Loan Controls $\mathbf{X}_{tm}$ include: Maturity Categories, Loan Amount and Rating Categories. Borrower Controls $\mathbf{Z}_{tm}$ include: Firm Ownership dummies, log of number of employees, log of estimated revenue. Standard errors are clustered at the bank-municipality level.

Relative to public banks, private experience *lower* delinquency rates after the intervention, despite the fact that private banks charge substantially larger interest rates throughout the years. The coefficient of interest, β_1, shows that after the intervention loans originated by public banks had between 130 and 70 basis points higher probability of becoming delinquent relative to loans originated by private banks.

The evidence obtained from average borrower delinquency for public and private banks casts doubt on the idea that an asymmetric information mechanism that generates a negative relationship between interest rates and borrower quality is at play. In particular, despite lower interest rates, government banks attract borrowers with similar risk as private banks' borrowers after the intervention, and experience a deterioration of their borrower quality after the policy started. This can also indicate that the policy was associated with a relaxation of lending standards by government banks.[23]

[23]This is similar to evidence from Jiménez et al. (2019) studying a similar policy implemented in Spain,

6. Intervention Driven Increases in Risk

The results so far are consistent with the idea that public banks financed riskier borrowers after the intervention, but are not necessarily less efficient than private banks when it comes to borrower screening since delinquency rates are comparable pre-policy. Moreover, to the extent that the average propensity to borrow of firms who borrow from public banks is lower than the average propensity to borrow of firms who borrow from private banks, the trajectory of borrower risk observed after the intervention is hard to reconcile with adverse selection, since public banks lend to worse borrowers despite charging lower interest rates.

However, it is not clear whether or not public banks adopted lower lending standards as part of the intervention, or if they engaged in zombie lending by lending to levered firms which eventually fail to pay loans that help them stay afloat. Jiménez et al. (2019), for example, document that public banks accept applications from borrowers with worse credit scores in a similar intervention implemented in Spain, and that the intervention was nevertheless efficient from a social welfare perspective. Another possibility is that markets are characterized by advantageous selection, where worse borrowers have lower propensity to borrow, and the differences only became apparent after public credit became large relative to total credit. Finally, one cannot rule out the possibility that loan markets in Brazil are still characterized by adverse selection, but with public banks less effective at screening and ultimately attracting knowingly riskier applicants. To rule out these alternative explanations we explore the details of our dataset, which allows us to track borrowers over time and divide firms according to their past relationships.

6.1. Are Public Banks Subsidizing Specific Firms?

The results in table 2 suggest that debt plays a significant role in explaining delinquency. Thus, we start by dividing firms between levered and unlevered[24], and investigate whether or not banks price discriminate between these different types of firms. This allows us to draw connections to the literature that studies zombie lending, where zombies defined as inefficient, less productive firms which borrow at subsidized interest rates, such as in Acharya

where public banks accepted applications from borrowers with a lower credit score than did private banks.

[24]Where leverage is defined as a borrower having positive debt outstanding relative to any loan it contracted in the past

et al. (2020). In our context, if public banks engage in zombie lending, they will subsidize levered firms by charging lower interest rates than what they charge from unlevered firms. Importantly, this is an additional advantage for these firms, since as we have seen before state owned commercial banks charge lower interest rates than private banks in comparable loans.

One important aspect to keep in mind is that, since the majority of the unlevered firms in our sample are new borrowers who have no previous lending relationship with banks, differences between levered and unlevered borrowers might reflect differences between new and old firms. The relationship lending literature (Ioannidou and Ongena (2010)) indicates that old borrowers might pay large interest rates than new borrowers, and that can potentially bias our results. Therefore, to understand the extent to which banks discriminate between new and old borrowers, we divide unlevered firms between new and old, and test for pricing differences for these clients as well. Finally, we also analyze differences between firms with bad credit history and other firms.

Formally, we estimate the following regression separately for public and private banks to investigate if the intervention is associated with different pricing strategies for these institutions:

$$i_{tmbf} = \alpha_{tim} + \alpha_b + \beta_0 + \beta_1 Post_t \times Type + \Gamma_1 \mathbf{X}_{tmbf} + \Gamma_2 \mathbf{Z}_{tmbf} + \varepsilon_{tmbf} \tag{5}$$

Where $Type$ is either of the two options in each pair $\{levered, unlevered\}$ and $\{old, new\}$. We start with the results for private banks, which are shown in 3:

Column (1) in Table 3 shows that the reduction in interest rates of private banks caused by the policy is 1.5 pp. larger for unlevered firms after the intervention. In other words, unlevered firms pay *smaller* interest rates than levered firms when borrowing from private banks after the policy. Similarly, column (2) shows that, within the subset of unlevered firms, old firms pay 1.6 pp. higher interest rates than new clients after the intervention.

These results are consistent with the idea that old, levered firms are expected to pay higher interest rates in equilibrium, and that the increase in competition faced by private banks leads to larger gains for new borrowers. To the extent that lending relationships are sticky, private banks had to adjust interest rates for older customers less after the policy. Next, we turn to the results for public banks, which are shown in Table 4:

Table 3: Interest Rate Sensitivity - Private Banks

	(1)	(2)
Levered	0.220***	
	(0.0736)	
Post × Levered	1.573***	
	(0.104)	
Old		-0.408
		(0.249)
Post × Old		1.629***
		(0.284)
Unlevered Only		✓
Time × Ind × Mun FE	✓	✓
Bank FE	✓	✓
R^2	0.515	0.544
Observations	1732394	323360

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table shows the results of the estimation of Equation 5 including loans issued by private banks only. Loan Controls $\mathbf{X}_{tm}$ include: Maturity Categories, Loan Amount and Rating Categories. Borrower Controls $\mathbf{Z}_{tm}$ include: Firm Ownership dummies, log of number of employees, log of estimated revenue. Standard errors are clustered at the bank-municipality level.

The coefficients shows a stark contrast between private and public banks, especially after the intervention. Column (1) of Table 4 confirms that public banks subsidize levered firms **after** the intervention, with interest rates 1.5pp. lower in loan to levered firms compared to unlevered firms. Importantly, Column (2) of Table 4 that difference is not explained by old borrowers paying smaller interest rates than new borrowers overall, but is connected to firms with positive leverage as captured by bank debt outstanding.

A related question is whether or not the subsidies provided by government banks to levered firms leads to an increase in levered. Another possibility is that the policy also led to a change in the composition of government banks' loan portfolio towards levered firms. To answer the first question, we use a leverage proxy, given by total debt outstanding divided by total payroll costs. Firms with more assets are more likely to have more payroll costs, and our measure should capture changes in leverage over time. Figure 5 shows the ratio of debt outstanding over payroll costs for public and private banks during the implementation of the policy:

Table 4: Interest Rate Sensitivity - Public Banks

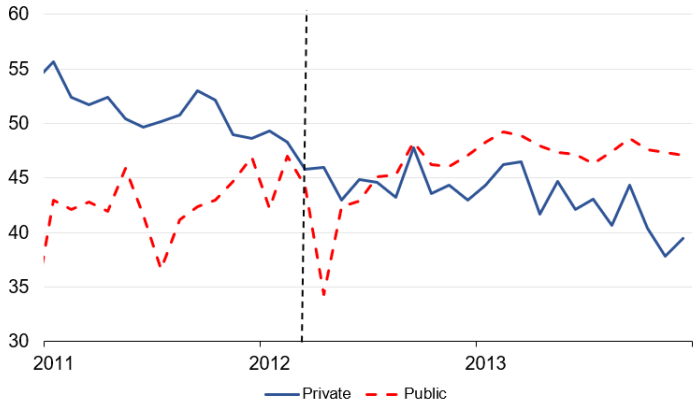
	(1)	(2)
Levered	1.082***	
	(0.119)	
Post × Levered	-2.503***	
	(0.123)	
Old		0.145
		(0.382)
Post × Old		0.239
		(0.504)
Unlevered Only		✓
Time × Ind × Mun FE	✓	✓
Bank FE	✓	✓
R^2	0.505	0.689
Observations	787623	38401

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table shows the results of the estimation of Equation 5 including loans issued by public banks only. Loan Controls $\mathbf{X}_{tm}$ include: Maturity Categories, Loan Amount and Rating Categories. Borrower Controls $\mathbf{Z}_{tm}$ include: Firm Ownership dummies, log of number of employees, log of estimated revenue. Standard errors are clustered at the bank-municipality level.

Figure 5: Debt Over Payroll Costs - Public and Private Borrowers

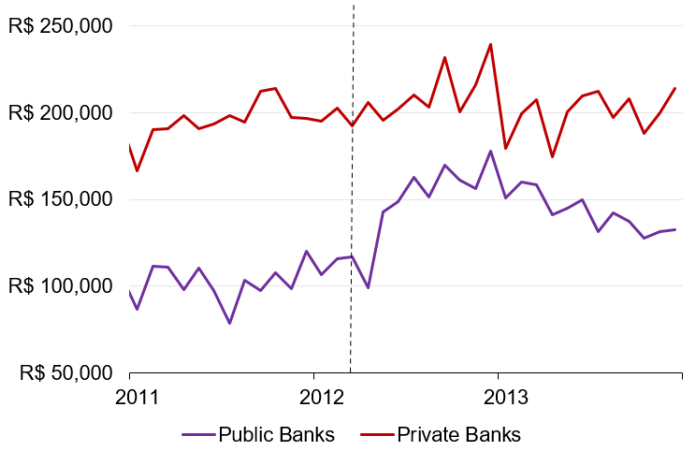


Note: This figure shows the total amount of debt outstanding over total payroll costs for firms that borrow from public and private banks. Source: SCR Dataset and RAIS Dataset.

While firms who borrow from private banks are in general more levered than firms who borrow form government banks prior to the policy, there is a clear shift in the composition of public banks' loan portfolio after the beginning of the policy. Firms borrowing from

public banks have a debt over payroll costs ratio 7% larger after the intervention relative to prior to the intervention. To answer the second question, of whether or not there is some portfolio changes by public banks towards more levered firms, we study the amount of debt outstanding for other types of credit of firms borrowing from private and public banks. We focus on other types of credit to avoid a mechanic relationship between loan origination and debt outstanding. This analysis indicates that public banks shift the composition of their loans portfolio towards firms with more debt outstanding in other types of loans excluding working capital, as can be seen in Figure 6:

Figure 6: Total Debt Outstanding - Other Types of Credit



Note: This figure shows the total amount of debt outstanding in other types of credit for firms borrowing from private and public banks over time. Source: SCR Dataset.

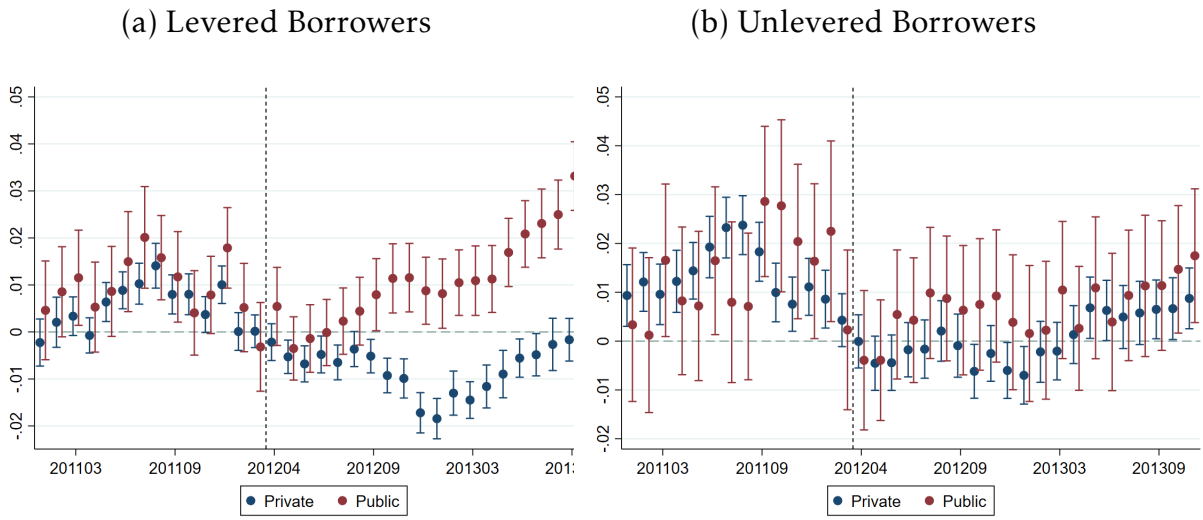
Overall, the evidence is consistent with public banks providing subsidies for levered borrowers, which became more levered after the intervention. Our main hypothesis is that this change in the loan portfolio of public banks towards more levered firms, along with an increase in the leverage of such firms, led to an increase in riskiness that ultimately can explain the patterns observed in Figure 4. We explore risk differences for levered and unlevered firms in the next section.

6.2. Levered and Unlevered Firm Risk

Our hypothesis that government banks subsidized riskier firms after the intervention requires levered firms to bear more risk than unlevered firms when borrowing from such banks. Alternatively, if public banks have lower screening standards or are clearing the

market for private banks by absorbing riskier firms, both types of firms will have worse quality relative to private bank borrowers after the policy. We redo our analysis of public and private banks' borrower quality over time, estimating equation 3 for each group separately. The estimates for the coefficients δ_τ and the respective standard errors are shown in Figure 7:

Figure 7: Delinquency Trends By Borrower Type



Notes: Results for the δ_τ from the estimation of Equation 3 for public and private banks separately. Each panel estimates the regression for levered and unlevered borrowers separately. Loan Controls $\mathbf{X}_{tm}$ include: Maturity Categories, Loan Amount and Rating Categories. Borrower Controls $\mathbf{Z}_{tm}$ include: Firm Ownership dummies, log of number of employees, log of estimated revenue. Standard errors are clustered at the bank-municipality level.

Figure 7 Panel (a) that levered borrowers of state owned banks become delinquent more often than those of private banks after the policy. In contrast, Panel (b) shows that new borrowers of public and private banks have comparable risk, both before and after the policy. This indicates that levered firms which obtain government provided credit during the intervention have worse quality than levered firms who borrow from private banks. Furthermore, we can rule out the hypothesis that government banks relaxed their credit standards for all borrowers as part of the policy, since new borrowers of both public and private banks have similar risk.

To further rule out potential adverse or advantageous selection, we test for delinquency differences between new and old borrowers. In particular, we know from Table 3 that private banks charge lower interest rates from new borrowers relative to old borrowers which

are unlevered. If risk differences are explained by adverse/advantageous selection, new borrowers would be *safer/riskier* since these borrowers are more likely to have low propensity to borrow. However, if leverage is the main factor contributing to risk differences, these borrowers would have comparable risk since we condition on borrowers without debt outstanding. We test this hypothesis by estimating the following regression:

$$delinq_{tmbf} = \alpha_{tim} + \alpha_b + \beta_0 Old + \Gamma_1 \mathbf{X}_{tmbf} + \Gamma_2 \mathbf{Z}_{tmbf} + \varepsilon_{tmbf} \tag{6}$$

Where $delinq_{tmbf}$ is a dummy equal to 1 if the firm f in municipality m becomes delinquent in a loan issued at time t from bank b, and Old is a dummy equal to 1 for old borrowers. The results are shown in Table 5. Importantly, there are no meaningful differences in the risk of new and old borrowers, which goes against the idea that advantageous selection might be driving the differences in risk between public and private banks.

Table 5: Delinquency Differences - Old and New Borrowers

	Private	Public
Old Borrowers	-0.000290	-0.00215
	(0.00307)	(0.00323)
Time × Ind × Mun FE	✓	✓
Bank FE	✓	✓
R^2	0.219	0.272
Observations	152593	91648

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Results from the estimation of Equation 6. Loan Controls $\mathbf{X}_{tm}$ include: Maturity Categories, Loan Amount and Rating Categories. Borrower Controls $\mathbf{Z}_{tm}$ include: Firm Ownership dummies, log of number of employees, log of estimated revenue. Standard errors are clustered at the bank-municipality level.

Our results indicate that the by subsidizing lending by levered firms, government banks increased the riskness of their loan portfolio, which led to a deterioration in credit quality over time. This is consistent with the idea that public banks, with a relaxation in their capacity constraints, provided more loans to unproductive zombie firms, which ultimately defaulted on these loans extended by government banks.

7. Real Effects of the Intervention

Our results so far indicate that, by increasing credit supply during the intervention, government banks subsidized levered firms which eventually became delinquent and led to a deterioration in these banks' loan portfolio. If indeed these firms are zombies and are not using the funds they acquire to finance productive investments, we would expect limited real effects from the increase in credit supply. Conversely, if these are ex-ante riskier firms with productive investment opportunities, one would expect to see differences in output where the expansion of government credit was the largest. In other words, the policy might have caused real effects such as GDP or employment growth due to an *extensive* margin associated with more credit to new borrowers and borrowers without access to working capital loans prior to the intervention. Importantly, the policy could also lead to real effects through an *intensive* margin, whereas firms borrowing from private banks experienced a reduction in their interest rates that is *not* explained by other economic shocks to their ability to generate cash flows, such as regional or industry specific shocks. This exogenous reduction in interest rates can lead to more investment if such firms are constrained by the interest rates they pay in their loans. In other words, there are two margins through which the policy could have had real effects in the Brazilian economy, which we explore below.

7.1. Extensive Margin of Credit

To understand how the intervention might have had real effects, we ask whether or not the increases in public credit that were part of the policy led to more economic growth. A natural way to approach this question is to compare municipalities with different levels of exposure to the intervention and compare the trajectory of GDP in these locations. The challenge is to obtain a plausibly exogenous variation in exposure to the policy that takes into account the potential endogeneity of credit allocation by public banks. In particular, one cannot simply regress municipality GDP on public credit, for example, since public banks might be targeting municipalities where growth prospects are particularly weak. In this case, our regressions would be downward biased and more likely point out to a lack of real effects of the credit expansion.

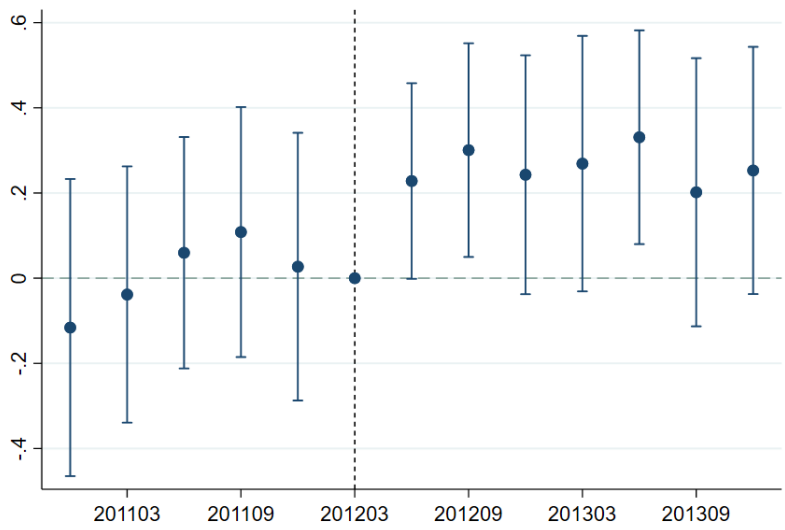
To address these concerns, we explore institutional features of the Brazilian banking sec-

tor. Specifically, we leverage on the fact that most municipalities that had only private or only public banks by 2010 were the result of privatization processes that took place several years before. In other words, the entry decision of public and private banks took place several years before the intervention took place. This alleviates concerns that we are capturing banks location decisions that might be correlated with other contemporaneous economic shocks. First, we estimate the following regression:

$$\Delta credit_{tmr} = \alpha_m + \alpha_{tr} + \sum_{-1}^{m} \delta_\tau Pub_m + \sum_{1}^{q} \delta_\tau Pub_m + \varepsilon_{tmr} \tag{7}$$

Where $\Delta credit_{tmr}$ denotes log of total credit originated in municipality m, quarter t and region r, α_m and α_{tr} are municipality and micro region-time fixed effects and Pub_m is a dummy equal to 1 if a certain location has only government bank branches. We limit our analysis to municipalities that have branches of only one bank - either a public bank, or a private bank. Equation 7 can be seen as a first stage analysis where we test whether or not credit in public versus private monopolies was comparable before the policy, and whether places with only government banks experience higher credit growth after the intervention. The results are shown in Figure 8:

Figure 8: Public and Private Monopolies - Credit



Notes: Results from the estimation of Equation 7. Standard errors are clustered at the municipality level.

One can see that the trajectory of corporate credit before the intervention is similar in

both types of municipalities, and changes suddenly in the quarters after the policy begins. This indicates that we can compare municipalities with only private or public banks to evaluate whether the increase in credit associated with the policy has real effects. We do so by estimating a difference-in-differences specification using local GDP and its individual components as the dependent variables:

$$y_{tmr} = \alpha_m + \alpha_{tr} + \beta Pub_m \times Post_t + \varepsilon_{tmr} \tag{8}$$

Where y_{tmr} denotes local GDP growth or value added growth in municipality m, year t and micro-region r, α_m and α_{tr} are municipality and micro region-time fixed effects, Pub_m is a dummy equal to 1 if a certain location has only government bank branches, and $Post_t$ is a dummy equal to 1 after March 2012. Importantly, the use of micro-region time fixed effects means we are comparing neighboring cities, which reduces concerns that our results are biased by local demand shocks and other omitted variable bias related issues.

Table 6: Difference in Differences - Local Output Growth

	GDP		Agriculture		Services		Industry	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post × Public	1.018*	-0.148	3.839***	-0.427	0.0169	1.051	0.764	1.642
	(0.550)	(0.827)	(1.184)	(1.742)	(0.544)	(0.822)	(1.642)	(2.342)
Time FE	✓		✓		✓		✓	
Time × Region FE		✓		✓		✓		✓
Municipality FE	✓	✓	✓	✓	✓	✓	✓	✓
R^2	0.125	0.474	0.147	0.564	0.161	0.493	0.153	0.450
Observations	7462	6414	7474	6441	7477	6428	7485	6441
N								

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

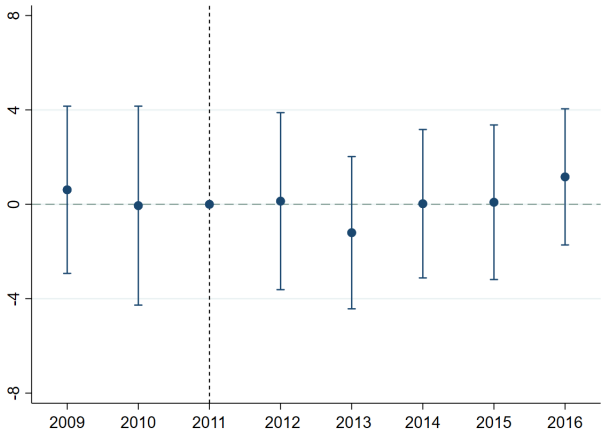
Notes: Results from the estimation of Equation 9. Standard errors are clustered at the municipality level.

The results in Table 6 indicate that, despite the large increase in credit in places with only public bank branches, such increase did not have real effects. We also perform a similar test, but using a dynamic DiD specification, where we compare GDP growth for treatment and control municipalities over time:

$$y_{tmr} = \alpha_m + \alpha_{tr} + \sum_{-1}^{m} \delta_\tau Pub_m + \sum_{1}^{q} \delta_\tau Pub_m + \varepsilon_{tmr} \tag{9}$$

Where y_{tmr} denotes local GDP growth in municipality m, year t and region r, α_m and α_{tr} are municipality and micro region-time fixed effects. The coefficients of interest are the δ_τ, which indicate the GDP growth in a treatment location relative to a control location in year τ, relative to the difference in growth in 2011, our baseline year. The results for GDP growth are shown in Figure 9:

Figure 9: Extensive Margin Effects - Local GDP



Note: This figure shows the results from regression 9 using local GDP growth as the dependent variable. Standard errors clustered at municipality level. Coefficients include 95% confidence intervals. Source: IBGE municipality data and ESTBAN dataset.

There are not real effects in GDP associated with the increase in credit by public banks during the policy.[25] The evidence indicates that that the extensive margin of credit - the increase in credit volume - is not associated with larger GDP, which is in line with the idea that government banks were not financing productive projects in these locations, but rather lending to zombie firms.

7.2. Intensive Margin of Credit

We have seen that the increase in public credit during the intervention led to a reduction in interest rates of private banks, one of the main objectives of the Brazilian government when

[25]There is, however, one important caveat to this comparison. The reduction in interest rates of private banks also happens in locations where there are no public bank branches, and to the extent that this intensive margin of credit supply can also have real effects, our coefficients would be downward biased.

implementing the policy. Importantly, if high interest rates were preventing these firms from investing at optimal levels, this reduction can lead to an increase in output through an increase in investment by firms who borrow from private banks.

To isolate this effect, we rely on two characteristics of our context that allows us to isolate firms which benefit the most from interest rate reductions. First, to ensure we are not capturing any extensive margin effects (namely, firms which started borrowing from private or public banks *after* the intervention only), we focus on firms which were borrowing from these banks prior to the policy. Second, since existing clients that borrow from public banks experience smaller reduction in interest rates after the intervention, and since interest rates they accessed were already smaller, we conjecture that such firms would benefit *less* from any intensive margin effects. In other words, we compare firms borrowing from private banks before and after the policy with firms borrowing from public banks before and after the policy.

To measure these potential effects, we rely on our employment level data, which allows us to track firm employment over time. One interpretation is that if firms invest more, they would require more workers if their production function has capital and labor as complements (such as in standard Cobb-Douglas functions). Another interpretation is that since firms can use working capital loans to finance their wage expenditures, reducing the cost of such loans would allow for more hiring by these firms. Overall, the comparison of labor over time should indicate whether or not the intensive margin of credit had real effects on firms.

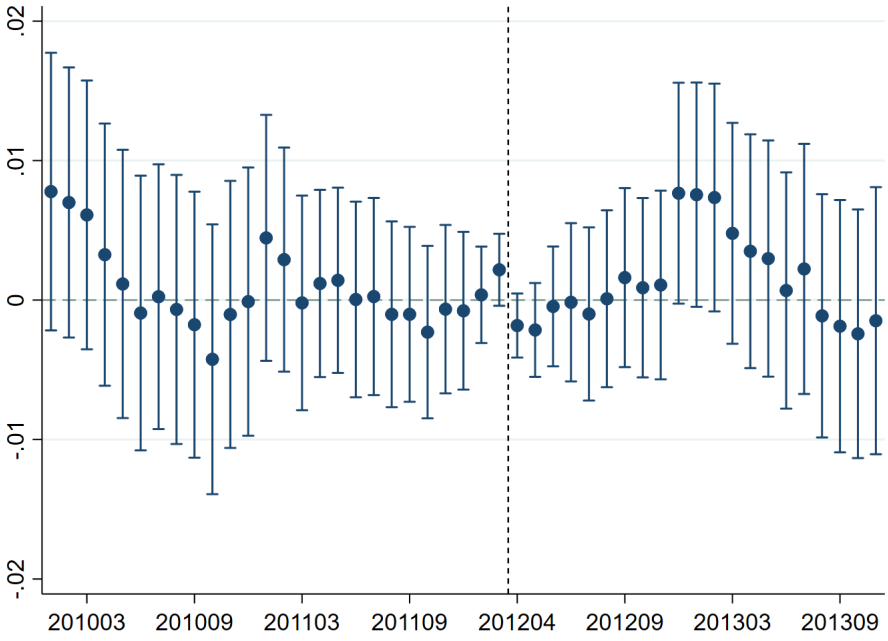
We test this by comparing employment of firms with exclusive relationships with private and public banks. We focus on firms with exclusive relationships since firms borrowing from both types of banks are usually larger, and also have access to cheaper sources of funding. Specifically, we test if firms with relationships with private banks hire more workers:

$$Log(emp)_{tmbf} = \alpha_{tmj} + \sum_{-1}^{m} \delta_\tau Private_b + \sum_{1}^{q} \delta_\tau Private_b + \varepsilon_{tmbf} \tag{10}$$

Where $Log(emp)_{tmbf}$ is the log of firm f employment in month t, α_{tmj} are time-region-municipality fixed effects, which capture region and industry specific shocks, and $Private_b$ is a dummy equal to 1 if the bank with which firm f has exclusive relationships, bank b, is

a private bank. The coefficients of interest δ_τ capture the employment differences between firms borrowing from private and public banks in month τ. We normalize these coefficients by the value in March 2012, the beginning of the intervention. The results are shown in Figure 10:

Figure 10: Intensive Margin Effects - Firm Employment



Note: This figure shows the coefficients δ_τ from regression 10. Standard errors clustered at municipality level. Coefficients include 95% confidence intervals. Source: SCR Dataset and RAIS Dataset.

Importantly, while firms that borrow from private banks seem to employ more workers in late 2012 and early 2013, the effects are short lived and not statistically significant. Overall, there are almost no differences in employment levels of firms borrowing from private or public banks stemming from the policy. Since the subset of firms is kept constant - namely, firms with exclusive relationships with either private or public banks, that had access to working capital loans prior to the intervention - our lack of results speaks directly to the notion that the intensive margin of credit could have led to employment growth. Instead, the reduction in interest rates by private banks does not translate into more employment, and suggests such firms were not constrained by the interest rates they paid prior to the policy.

8. Conclusion

The use of tools to affect equilibrium in credit markets is a common policy implemented by governments which are trying to address problems related to financial crisis. Outside crisis episodes, theory suggests that such interventions can be beneficial if they address problems such as adverse selection or excessive monopoly power, but they can also be harmful if they increase the share of credit that is directed to less profitable projects. In this paper we study a credit market intervention implemented by the Brazilian government using public commercial banks, which is characterized by a large increase in the supply of credit to firms at subsidized interest rates. We document a tradeoff between the government's ability to affect equilibrium interest rates, and the costs of the policy. While the policy was effective in forcing private banks to reduce the interest rates, it was also associated with a deterioration in credit quality that potentially led to credit misallocation. Loans issued by public banks during the intervention were around 1 pp. more likely to default than comparable loans issued by private banks, and such deterioration in the loan portfolio quality of government banks is connected to loans issued to levered firms.

In particular, the policy is characterized by public banks subsidizing loans to firms with positive debt outstanding with whom they had previous relationships, shifting the composition of their loan portfolio towards firms with more debt outstanding. We argued that lending to levered firms cause the worsening of borrower quality experienced by public banks, and that such worsening is not observed in loans to new borrowers. By doing so we rule out alternative explanations as to why the intervention is characterized by the worsening in credit quality, such as selection or poor screening by public banks. This findings have important implications for papers highlighting the role of asymmetric information mechanisms linked to interest rates. Our analysis suggests these forces are not sufficiently strong to generate meaningful variations in borrower risk.

Finally, we cannot rule out the hypothesis that the increase in credit was not used to finance productive projects, as despite a larger increase in loan amounts in public monopolies relative to private monopolies, these locations do not have better economic growth in the years following the policy. Moreover, the reduction in the interest rates of private banks is also not able to generate variations in output, casting doubt on the idea that the policy had

positive real effects. Our results indicate that public banks can affect equilibrium interest rates of private banks, but such reduction might come at the cost of a deterioration in the quality of their loan portfolio.

References

Acharya, Viral V, Lea Borchert, Maximilian Jager, and Sascha Steffen. 2021. "Kicking the Can Down the Road: Government Interventions in the European Banking Sector." *The Review of Financial Studies*, 34(9): 4090–4131. 5

Acharya, Viral V., Matteo Crosignani, Tim Eisert, and Christian Eufinger. 2020. "Zombie Credit and (Dis-)Inflation: Evidence from Europe." 5, 28

Assuncao, Juliano, Sergey Mityakov, and Robert. Townsend. 2012. "Ownership Matters: the Geographical Dynamics of BAAC and Commercial Banks in Thailand." 8

Bertrand, Marianne, Antoinette Schoar, and David Thesmar. 2007. "Banking Deregulation and Industry Structure: Evidence from the French Banking Reforms of 1985." *The Journal of Finance*, 62(2): 597–628. 5

Biswas, Swarnava (Sonny), and Kostas Koufopoulos. 2019. "Bank competition and financing efficiency under asymmetric information." *Journal of Corporate Finance*. 6, 9

Boyd, John H., and Gianni De Nicoló. 2005. "The theory of bank risk taking and competition revisited." *Journal of Finance*, 60(3): 1329–1343. 3, 7, 9

Carvalho, Daniel. 2014. "The Real Effects of Government-Owned Banks: Evidence from an Emerging Market." *The Journal of Finance*, 69(2): 577–609. 1, 8

Coelho, Christiano A, João M P De Mello, and Leonardo Rezende. 2013. "Do Public Banks Compete with Private Banks? Evidence from Concentrated Local Markets in Brazil." *Journal of Money, Credit and Banking*, 45(8): 1581–1615. 8

Coleman, Nicholas, and Leo Feler. 2015. "Bank ownership, lending, and local economic performance during the 2008–2009 financial crisis." *Journal of Monetary Economics*, 71: 50–66. 1, 8

Cortes, Gustavo S, Christiano Silva, and Bernardus F N Van Doornik. 2019. "Credit Shock Propagation in Firm Networks: evidence from government bank credit expansions." 8, 12

Crawford, Gregory S., Nicola Pavanini, and Fabiano Schivardi. 2018. "Asymmetric information and imperfect competition in lending markets." *American Economic Review*, 108(7): 1659–1701. 6

Degryse, Hans, and Steven Ongena. 2005. "Distance, Lending Relationships, and Competition." *The Journal of Finance*, 60(1): 231–266. 7

De Meza, David, and David C Webb. 1987. "Too Much Investment: A Problem of Asymmetric Information." *The Quarterly Journal of Economics*, 102(2): 281. 6, 9

Dinç, I. Serdar. 2005. "Politicians and banks: Political influences on government-owned banks in emerging markets." *Journal of Financial Economics*, 77(2): 453–479. 1, 7

Fonseca, Julia, and Bernardus Van Doornik. 2019. "Financial Development, Labor Markets, and Aggregate Productivity: Evidence from Brazil." *Working Paper*. 12

Goetz, Martin R. 2018. "Competition and bank stability." *Journal of Financial Intermediation*, 35: 57–69. 7

Iannotta, Giuliano, Giacomo Nocera, and Andrea Sironi. 2013. "The impact of government ownership on bank risk." *Journal of Financial Intermediation*, 22(2): 152–176. 8

Ioannidou, Vasso, and Steven Ongena. 2010. ""Time for a Change": Loan Conditions and Bank Behavior when Firms Switch Banks." *The Journal of Finance*, 65(5): 1847–1877. 7, 29

Jiang, Liangliang, Ross Levine, and Chen Lin. 2019. "Does Competition Affect Bank Risk?" 7

Jiménez, Gabriel, José-Luis Peydró, Rafael Repullo, and Jesús Saurina. 2019. "Burning Money? Government Lending in a Credit Crunch." *UPF Economics Working Paper Series Working Paper No. 1577*. 1, 3, 6, 8, 25, 27, 28

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina. 2014. "Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk-Taking?" *Econometrica*, 82(2): 463–505. 13, 25

Joaquim, Gustavo; Van Doornik, Bernardus. 2019. "Bank Competition, Cost of Credit and Economic Activity: Evidence from Brazil." *Working Paper*. 12

La Porta, Rafael, Florencio Lopez-De-Silanes, and Andrei Shleifer. 2002. "Government ownership of banks." *Journal of Finance*, 57(1): 265–301. 1, 7

Mahoney, Neale, and E. Glen Weyl. 2017. "Imperfect competition in selection markets." *Review of Economics and Statistics*, 99(4): 637–651. 3, 6, 9

Martinez-Miera, David, and Rafael Repullo. 2010. "Does Competition Reduce the Risk of Bank Failure?" *Review of Financial Studies*, 23(10): 3638–3664. 7, 9

Petersen, Mitchell A, and Raghuram G Rajan. 1994. "The benefits of lending relationships: Evidence from small business data." *The journal of finance*, 49(1): 3–37. 19

Philippon, Thomas, and Vasiliki Skreta. 2012. "Optimal interventions in markets with adverse selection." *American Economic Review*, 102(1): 1–28. 3, 6

Rice, Tara, and Philip E Strahan. 2010. "Does Credit Competition Affect Small-Firm Finance?" *The Journal of Finance*, 65(3): 861–889. 7

Ryan, Robert M., Conor M. O'Toole, and Fergal McCann. 2014. "Does bank market power affect SME financing constraints?" *Journal of Banking Finance*, 49: 495–505. 7

Sanches, Fabio, Daniel Silva Junior, and Sorawoot Srisuma. 2018. "Banking privatization and market structure in Brazil: a dynamic structural analysis." *The RAND Journal of Economics*, 49(4): 936–963. 8

Sapienza, Paola. 2004. "The effects of government ownership on bank lending." *Journal of Financial Economics*, 72(2): 357–384. 1, 7

Schmitz, Emerson Erik. 2020. "Effects of State-Owned Banks' Programs to Stimulate Credit: evidence from Brazil." *BCB Working Paper Series 519*. 8

Stiglitz, Joseph E., and Andrew Weiss. 1981. "Credit Rationing in Markets with Rationing Credit Information Imperfect." *The American Economic Review*, 71(3): 393–410. 6, 9

Tirole, Jean. 2012. "Overcoming adverse selection: How public intervention can restore market functioning." *American Economic Review*, 102(1): 29–59. 3, 6

Veronesi, Pietro, and Luigi Zingales. 2010. "Paulson's gift." *Journal of Financial Economics*, 97(3): 339–368. 6

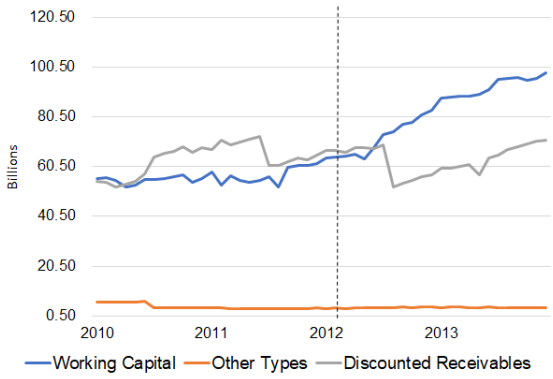
Online Appendix

A. Corporate Borrowing in Brazil

In this appendix we overview the basic patterns of corporate lending in Brazil, the market share of public and private banks, and the trajectory of outstanding amounts in the loan portfolio of each type of bank for different types of loans.

We start by comparing the outstanding amount of different types of credit - namely, working capital loans, discounted receivables and other categories - to identify which categories were subject to larger credit supply increases:

Figure A.1: Total Amount Outstanding - Public Banks



Note: This figure shows the total amount outstanding for different types of loans for public banks. Source: SCR Dataset.

Figure A.1 shows that, relative to working capital loans and other types of credit, discounted receivables represent a smaller share of public banks' loan portfolio. Additionally, the amount outstanding of working capital loans growths substantially after the intervention, with an increase of 52.3% between March 2012 and December 2013. On the other hand, discounted receivables and other types of credit experience smaller growth of 7.1% and 9.6%, respectively.

B. Proofs and Derivations

B.1. Proposition 1

Proof. First order conditions for profit maximization are

$$a(1-\xi)-c-[\gamma a+b(1-\xi)]\left(\sum_{j\neq i}q_j+\bar{q}\right)+\gamma b\left(\sum_{j\neq i}q_j+\bar{q}\right)^2-2q_i\left[\gamma a+b(1-\xi)-2\gamma b\left(\sum_{j\neq i}q_j+\bar{q}\right)\right]+3\gamma b q_i^2=0 \tag{11}$$

Using symmetry, we can write $\left(\sum_{j\neq i}q_j+\bar{q}\right)=(N-1)q_i+\bar{q}$, so the FOC can be written as:

$$q_i^2\gamma bN(N+2)-q_i(N+1)[b(1-\xi-\gamma\bar{q})+\gamma(a-b\bar{q})]+(a-b\bar{q})(1-\xi-\gamma\bar{q})-c=0 \tag{12}$$

$$[R(Q)+q_iR'(Q)](1-P(Q))-q_iP'(Q)R(Q)-c'(Q)=0 \tag{13}$$

Using the implicit function theorem, we can write:

$$\frac{\partial q_i}{\partial\bar{q}}=-\frac{R'(Q)(1-P(Q))-P'(Q)[R(Q)+2q_iR'(Q)]}{(N+1)R'(Q)(1-P(Q))-P'(Q)[(N+1)R(Q)+2Nq_iR'(Q)]} \tag{14}$$

Which can be written as:

$$\frac{\partial q_i}{\partial\bar{q}}=\frac{-2\gamma b(N+1)q_i+b(1-\xi-\gamma\bar{q})+\gamma(a-b\bar{q})}{2\gamma bN(N+2)q_i-(N+1)[b(1-\xi-\gamma\bar{q})+\gamma(a-b\bar{q})]} \tag{15}$$

Clearly, when $\gamma=0$ we go back to the usual case with no risk, where $\frac{\partial q_i}{\partial\bar{q}}=-\frac{1}{N+1}$. When there is selection, the expression above depends on the sign and magnitude of $P'(Q)=\gamma$ - that is, whether the market has adverse or advantageous selection.

In particular, when γ is sufficiently close to zero we have $\frac{\partial q_i}{\partial\bar{q}}<0$, since the numerator converges to $b(1-\xi)>0$ as $\gamma\to 0$ and since the denominator is negative from the second order condition of the maximization problem.

Now, looking at the general expression formula, notice that:

$$\begin{aligned}
&(N+1)R'(Q)(1-P(Q)) - P'(Q)[(N+1)R(Q) + 2Nq_iR'(Q)] \\
<&(N+1)[R'(Q)(1-P(Q)) - P'(Q)(R(Q) + 2q_iR'(Q))] \\
<&0
\end{aligned}$$

Where the inequality comes from $P'(Q)R'(Q) < 0$. Then, we can write:

$$\frac{\partial q_i}{\partial \bar{q}} = -\frac{R'(Q)(1-P(Q)) - P'(Q)[R(Q) + 2q_iR'(Q)]}{(N+1)R'(Q)(1-P(Q)) - P'(Q)[(N+1)R(Q) + 2Nq_iR'(Q)]} \tag{16}$$

$$> -\frac{R'(Q)(1-P(Q)) - P'(Q)[R(Q) + 2q_iR'(Q)]}{(N+1)[R'(Q)(1-P(Q)) - P'(Q)(R(Q) + 2q_iR'(Q))]} \tag{17}$$

$$= -\frac{1}{N+1} \tag{18}$$

Therefore, in the presence of advantageous selection the crowding out effect of an increase in government credit is *smaller* than in the baseline case with no risk.

If $\gamma < 0$, we have that

$$0 > (N+1)R'(Q)(1-P(Q)) - P'(Q)[(N+1)R(Q) + 2Nq_iR'(Q)] > (N+1)[R'(Q)(1-P(Q)) - P'(Q)(R(Q) + 2q_iR'(Q))] \tag{19}$$

Where the inequality comes from $P'(Q)R'(Q) > 0$. Then, we can write:

$$\frac{\partial q_i}{\partial \bar{q}} = -\frac{R'(Q)(1-P(Q)) - P'(Q)[R(Q) + 2q_iR'(Q)]}{(N+1)R'(Q)(1-P(Q)) - P'(Q)[(N+1)R(Q) + 2Nq_iR'(Q)]} \tag{20}$$

$$< -\frac{R'(Q)(1-P(Q)) - P'(Q)[R(Q) + 2q_iR'(Q)]}{(N+1)[R'(Q)(1-P(Q)) - P'(Q)(R(Q) + 2q_iR'(Q))]} \tag{21}$$

$$= -\frac{1}{N+1} \tag{22}$$

■

B.2. Proposition 2

Proof. Let $\alpha(\gamma) \equiv 2\gamma b(N+1)q_i - b(1-\xi-\gamma\bar{q}) - \gamma(a-b\bar{q})$ and $\beta(\gamma) \equiv 2\gamma b q_i$, and notice that we can write:

$$\frac{\partial q_i}{\partial \bar{q}} = -\frac{\alpha(\gamma)}{(N+1)\alpha(\gamma) - \beta(\gamma)}$$

Then

$$\begin{aligned}\frac{\partial^2 q_i}{\partial \bar{q}\partial\gamma} &= -\frac{\alpha'(\gamma)[(N+1)\alpha(\gamma) - \beta(\gamma)] - [(N+1)\alpha'(\gamma) - \beta'(\gamma)]\alpha(\gamma)}{[(N+1)\alpha(\gamma) - \beta(\gamma)]^2} \\ &= -\frac{\beta'(\gamma)\alpha(\gamma) - \alpha'(\gamma)\beta(\gamma)}{[(N+1)\alpha(\gamma) - \beta(\gamma)]^2}\end{aligned}$$

Where $\alpha'(\gamma) \equiv \frac{da}{d\gamma} = 2b(N+1)q_i - (a - 2b\bar{q})$ and $\beta'(\gamma) \equiv \frac{db}{d\gamma} = 2bq_i$. Using these expressions, we can write:

$$\begin{aligned}\beta'(\gamma)\alpha(\gamma) - \alpha'(\gamma)\beta(\gamma) &= 2bq_i[2\gamma b(N+1)q_i - b(1-\xi-\gamma\bar{q}) - \gamma(a-b\bar{q})] - [2b(N+1)q_i - \gamma(a-2b\bar{q})]2\gamma b q_i \\ &= -2b^2(1-\xi)q_i\end{aligned}$$

Which leads to:

$$\frac{\partial^2 q_i}{\partial \bar{q}\partial\gamma} = \frac{2b^2(1-\xi)q_i}{[(N+1)a(\gamma) - b(\gamma)]^2} > 0 \tag{23}$$

Therefore, $\frac{\partial q_i}{\partial \bar{q}} < 0$ is increasing in γ when $\gamma > 0$.

■

C. Data Appendix

The starting point in the construction of our main dataset is to collect loan origination information for working capital loans on a monthly basis. We focus on loans with fixed interest rates which are financed by banks' own capital. We then perform the following exclusions:

- Drop firms from utilities and public industries (CNAE 2 digit industry codes 33-39 and 84);
- Drop loans with annual interest rates smaller than 5%, which are likely miss classified as fixed interest loans;
- Drop loans with credit scoring worse than D, which include only renegotiations;
- Include only limited liability, corporations and sole proprietors firms;

We winsorize loan amounts, maturity and interest rates at the 1% in each tail. We then merge this dataset with a monthly employment dataset constructed based on RAIS Annual files. We only include firm observations for firms with a RAIS registry, which corresponds to more than two thirds of our data.

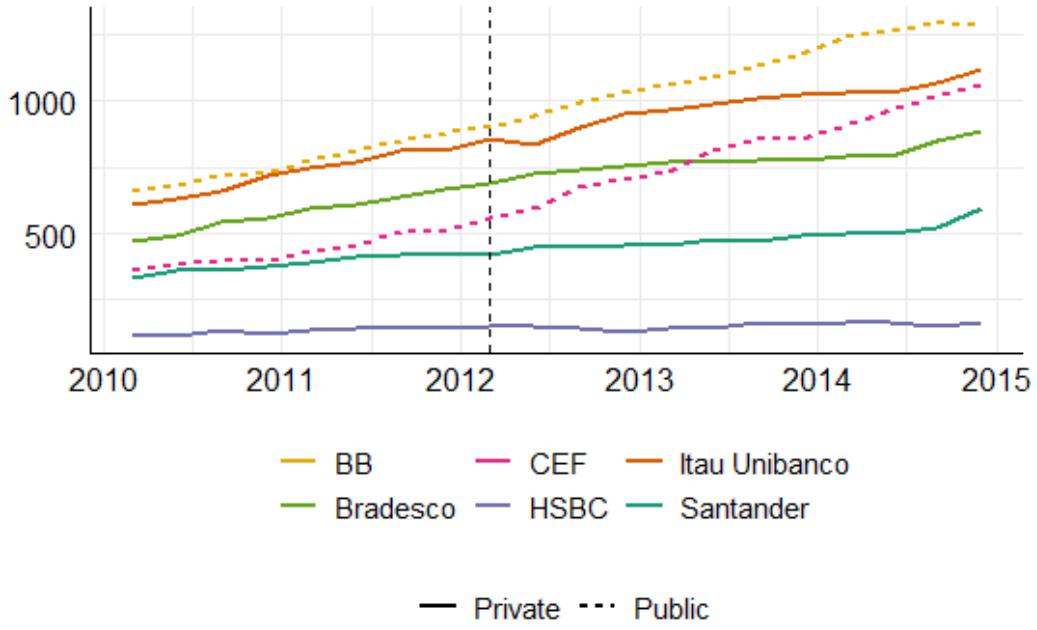
We use employment headcount to construct our firm size measures. In particular, we follow the classification by SEBRAE. In particular, we define:

- *Micro Firms*: Firms with less than 10 employees in the service/commerce sectors, or less than 20 employees in industry sectors.
- *Small Firms*: Firms with more than 10 and less than 50 employees in the service/commerce sectors, or more than 20 and less than 100 employees in industry sectors.
- *Medium Firms*: Firms with more than 50 and less than 100 employees in the service/commerce sectors, or more than 100 and less than 500 employees in industry sectors.
- *Large Firms*: Firms with more than 100 employees in the service/commerce sectors, or more than 500 employees in industry sectors.

The monthly employment panel is constructed using hiring and termination dates for each employee in the RAIS dataset. We aggregate such information at the firm-month level.

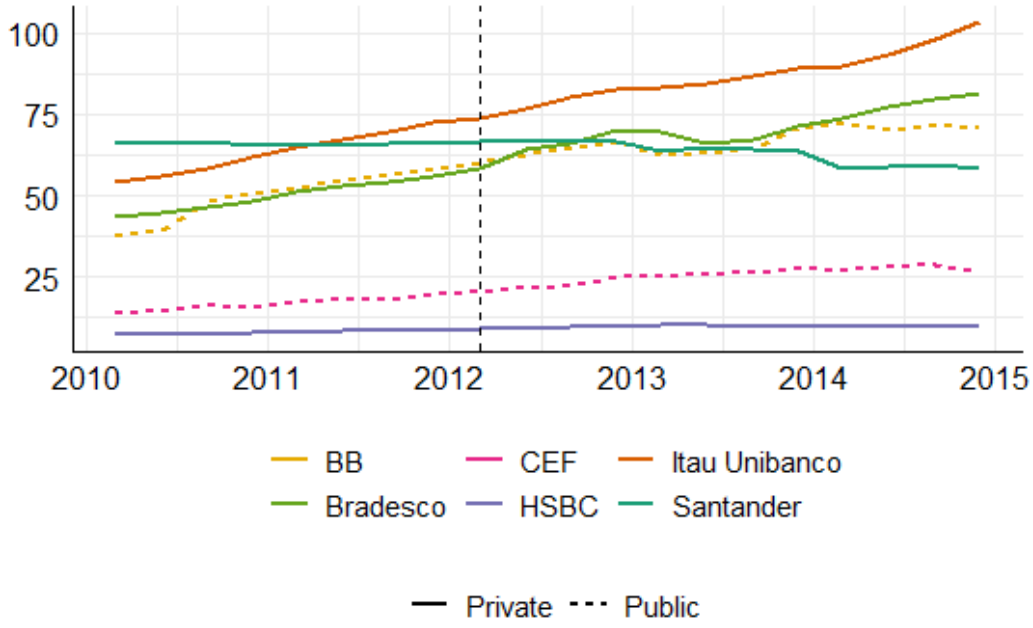
D. Bank Level Analysis

Figure D.1: Total Assets



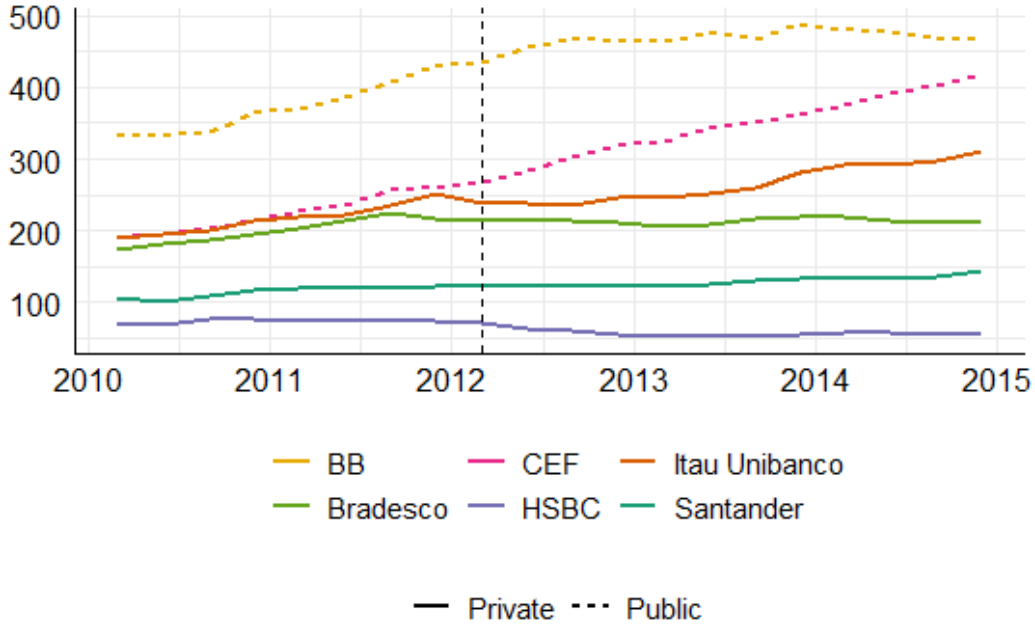
Notes: Total Bank Assets, including loan portfolio, securities, repo and others. Source: IF Data, available at https://www3.bcb.gov.br/ifdata/

Figure D.2: Equity



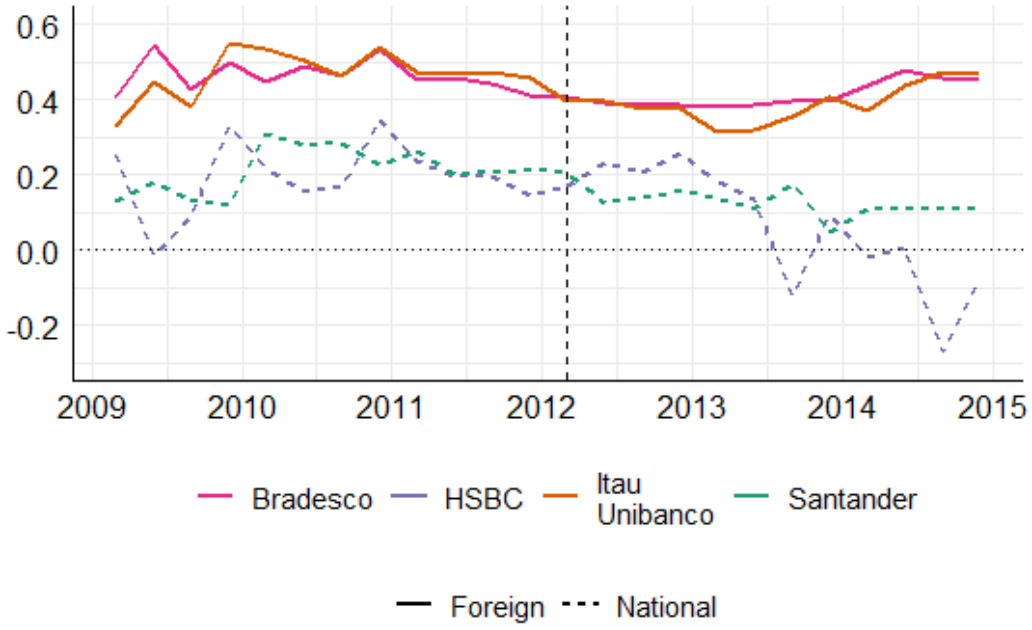
Notes: Total Bank Equity. Source: IF Data, available at https://www3.bcb.gov.br/ifdata/

Figure D.3: Total Deposits



Notes: Total Deposits include Savings, Demand and Time Deposits. Source: IF Data, available at https://www3.bcb.gov.br/ifdata/

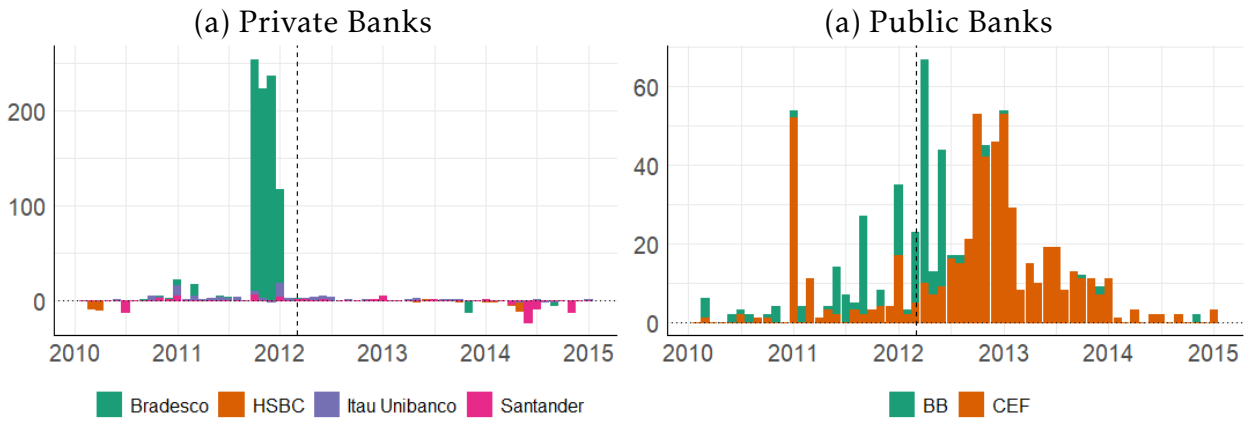
Figure D.4: Return Over Assets - Private Banks



Notes: Return Over Assets Defined as Net Income divided by Total Assets. Source: IF Data, available at https://www3.bcb.gov.br/ifdata/

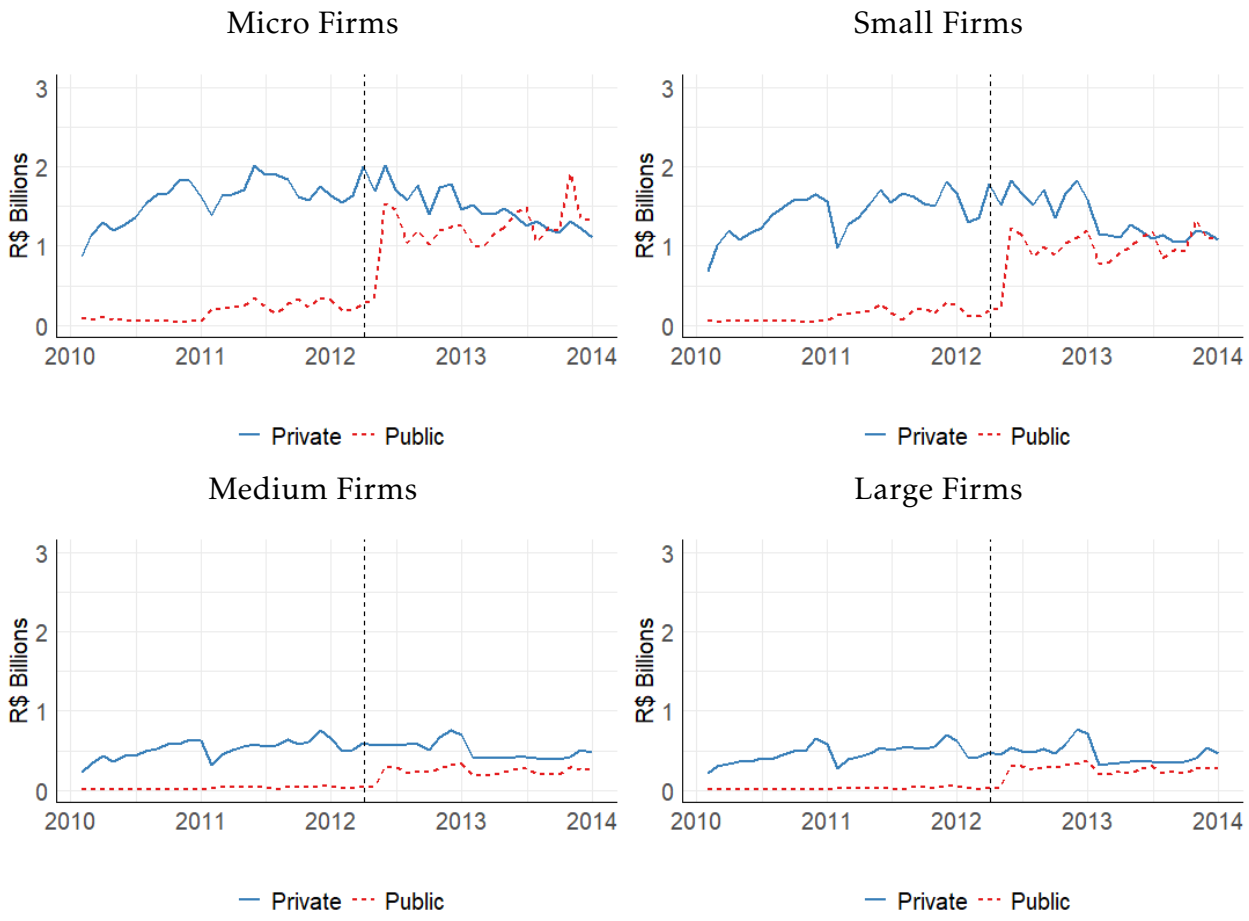
E. Additional Figures

Figure E.1: Bank Entry



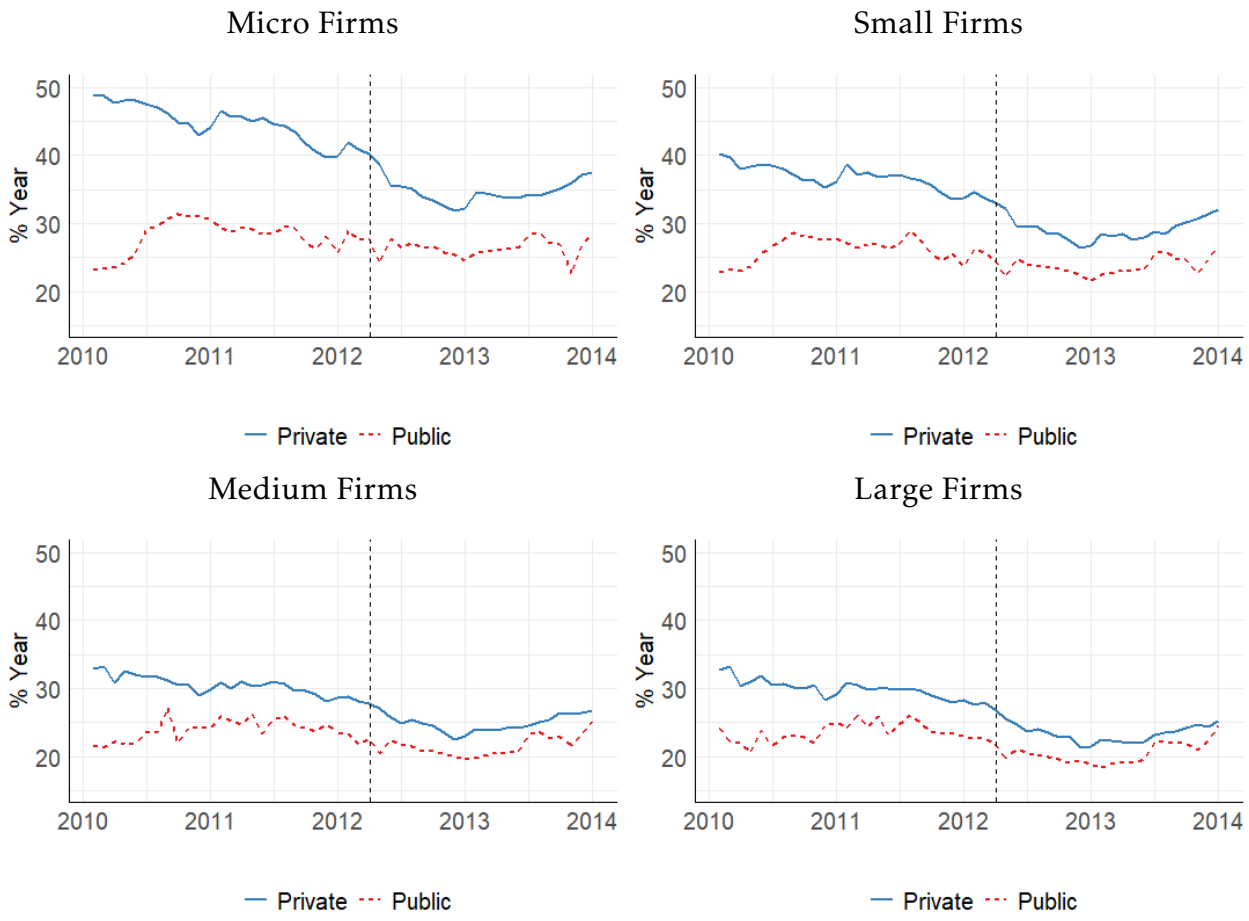
Notes: Entry is defined by a bank opening a branch in location where it had no previous presence. Source: ESTBAN Dataset, available at https://www4.bcb.gov.br/fis/cosif/estban.asp?frame=1

Figure E.2: Total Loan Amount by Firm Size



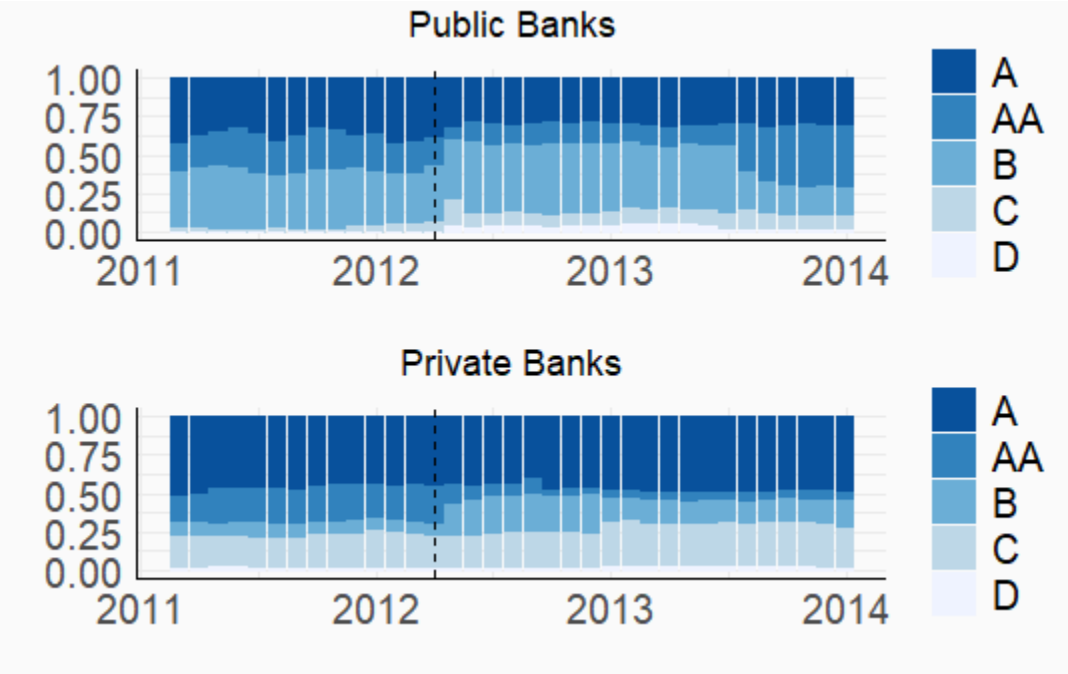
Notes: Total loan amount for public and private banks for firms of different size. Source SCR dataset and RAIS dataset.

Figure E.3: Loan Interest Rates by Firm Size



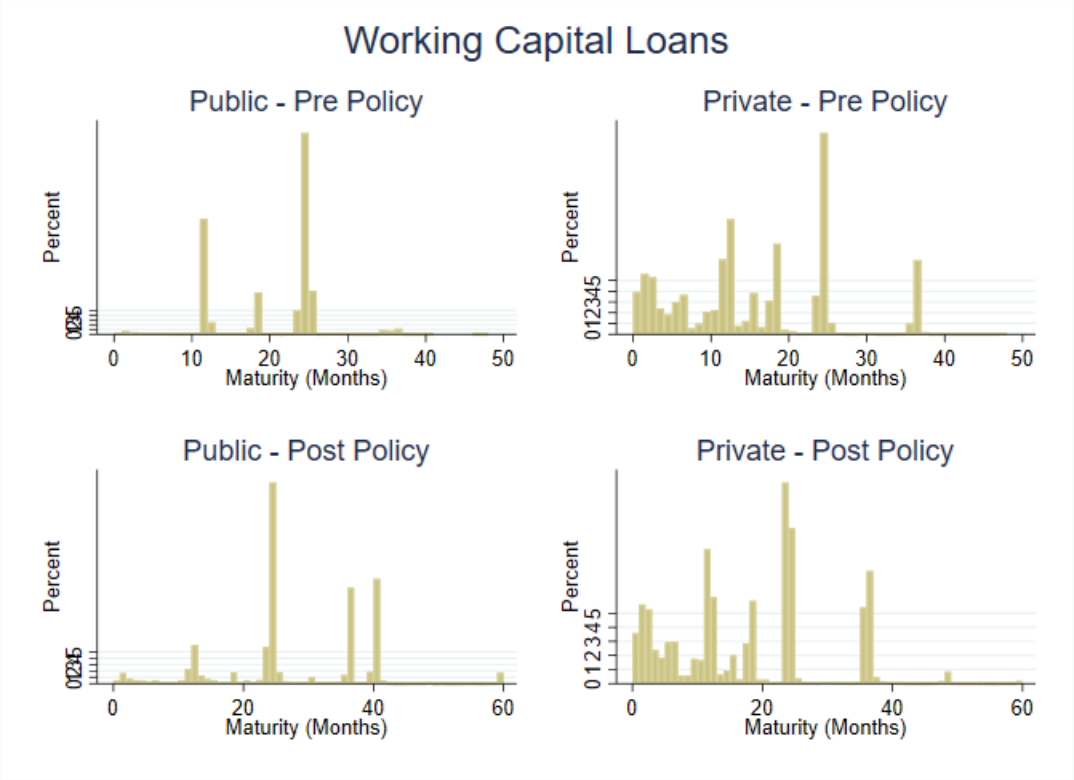
Notes: Average interest rate differences for firms of different size. Source SCR dataset and RAIS dataset.

Figure E.4: Credit Rating Distribution: Public and Private Banks



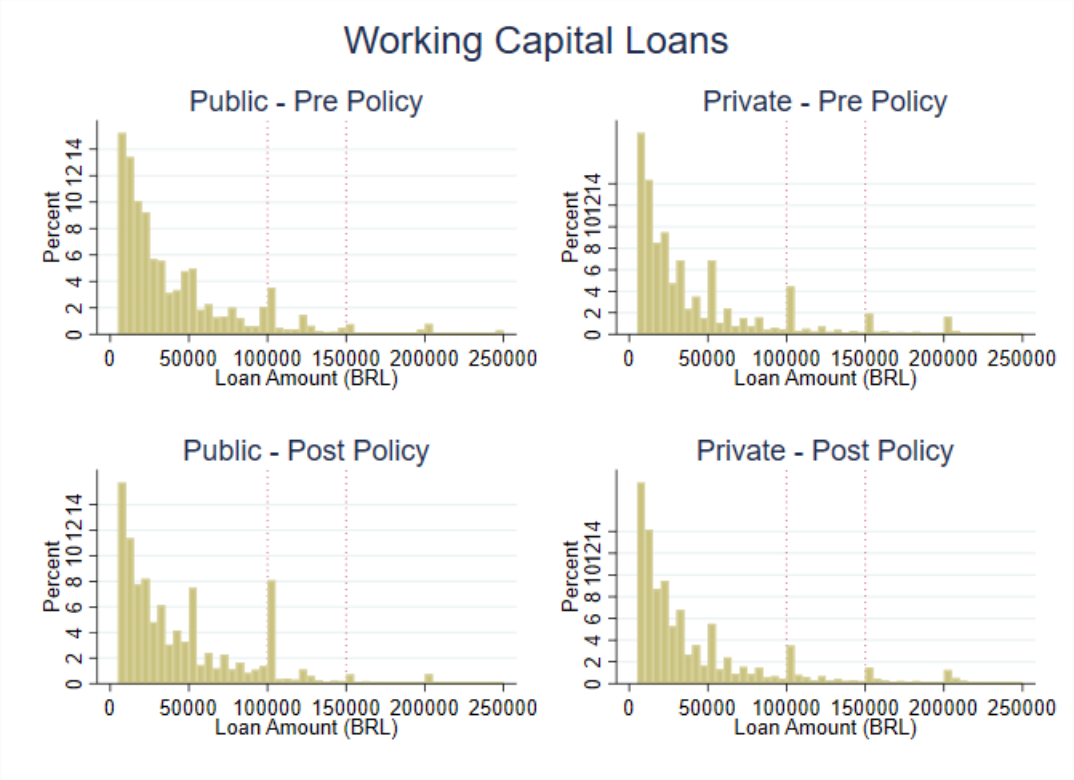
Note: This figure shows the distribution of credit rating for loans originated by public and private banks. Source: SCR Dataset.

Figure E.5: Loan Maturity Distribution: Public and Private Banks



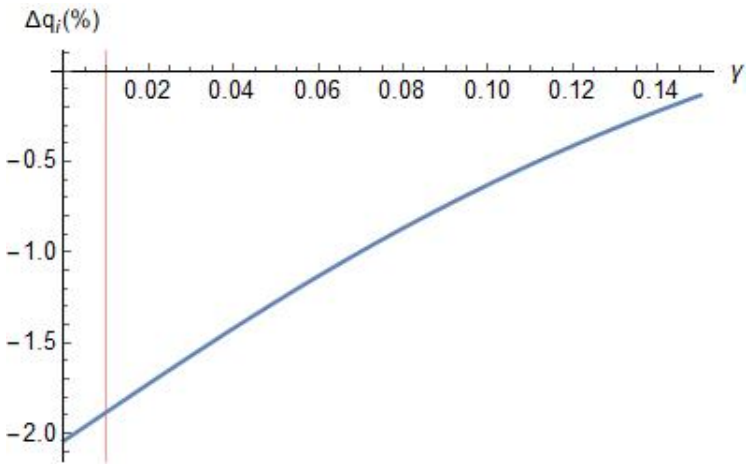
Note: This figure shows the distribution of loan maturity for loans originated by public and private banks. Source: SCR Dataset.

Figure E.6: Loan Amount Distribution: Public and Private Banks



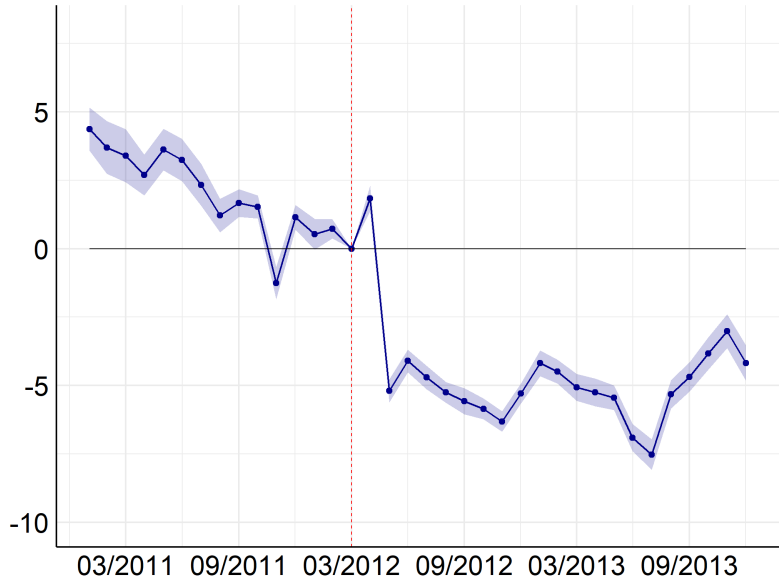
Note: This figure shows the distribution of credit rating for loans originated by public and private banks. Source: SCR Dataset.

Figure E.7: Numerical Simulation - Efficient Rationing With Advantageous Selection



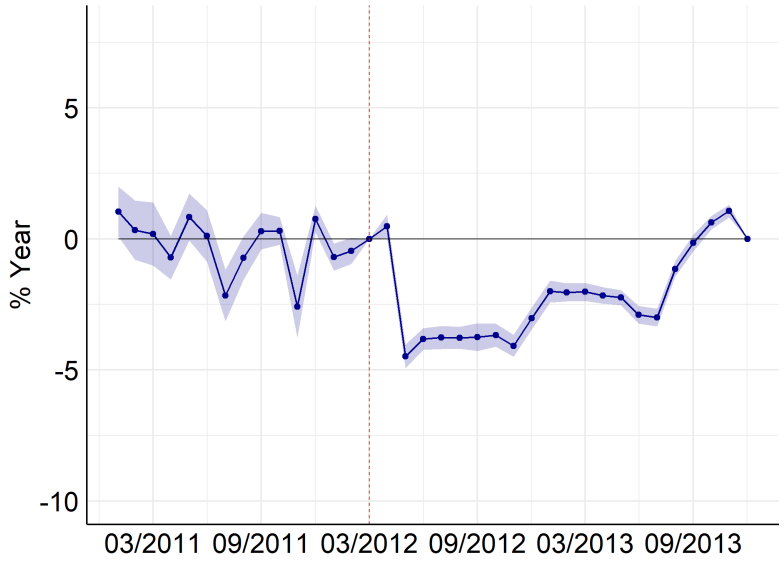
Note: This figure the illustrates Proposition 2. Parameter values: $a = 2$, $b = 1/3$, $c = 1$, $N = 3$, $\xi = 4/100$, $\bar{q}' = 12/100$, $\bar{q}'' = 24/100$. For a fixed pre-policy government interest rate R'_G and an increase in quantities $\Delta\bar{q}$, we show what would be the percent change in the quantity of each individual bank for different values of R''_g

Figure E.8: Differences in Differences - Interest Rates with separated fixed effects



Note: Regression estimates from equation 2 at the loan level weighted by loan amount, with March 2012 as the reference month, but with time-municipality-industry fixed effects *not interacted*. Dependent variable i_{jtmbf} is the interest rate of a loan j issued in municipality m, month t, from bank b to firm f. Standard errors clustered at bank-municipality level. Coefficients include 95% confidence interval.

Figure E.9: Differences in Differences - Interest Rates with Private Linear Trend



Note: Regression estimates from equation 2 at the loan level weighted by loan amount, with March 2012 as the reference month and adding a private specific linear trend. Dependent variable i_{jtmbf} is the interest rate of a loan j issued in municipality m, month t, from bank b to firm f. Standard errors clustered at bank-municipality level. Coefficients include 95% confidence interval.

F. Additional Tables

Table F.1: Crowding Out Regressions

	(1)	(2)	(3)	(4)
$\Delta Credit^{Public}(\%)$	-0.0281***	-0.0114**	-0.00858	-0.0162**
	(0.00468)	(0.00574)	(0.00728)	(0.00801)
R^2	0.00963	0.0486	0.0950	0.230
N. Munic.	3649	2755	1327	1315
Municipality Controls		✓	✓	✓
Local Branch Controls			✓	✓
Region FE				✓

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Results from a regression of private credit in public credit and controls at municipality level. Standard errors clustered at municipality level.

Table F.2: Switching Probability

	(1)	(2)	(3)
Rel Length (Private)	-0.000179***	-0.000177***	-0.000192***
	(0.00000563)	(0.00000574)	(0.00000778)
Private Monopoly		-0.0158***	-0.0143**
		(0.00474)	(0.00566)
Firm Age (Years)			0.000244***
			(0.0000776)
Number of Employees			-0.0000293***
			(0.00000674)
R^2	0.00674	0.00675	0.00734
Observations	147986	140322	119812

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Results from a linear probability model where the dependent variable is a firm's probability of switching between private and public banks. Standard errors clustered at bank level.

Table F.3: Differences in Interest Rates - Relationship Borrowers

	Private Banks			Public Banks		
	(1)	(2)	(3)	(4)	(5)	(6)
Post	-1.840***	-1.844***	-2.271***	-0.395***	-0.430***	-0.157
	(0.0857)	(0.0873)	(0.107)	(0.0776)	(0.0785)	(0.0868)
Post × Monopoly		-1.047			0.535*	
		(0.787)			(0.266)	
Small			-0.613***			0.490***
			(0.0893)			(0.0854)
Medium			-0.944***			0.527**
			(0.190)			(0.186)
Large			-0.818**			0.985**
			(0.257)			(0.321)
Post × Small			1.093***			-0.663***
			(0.0943)			(0.0789)
Post × Medium			2.034***			-0.397*
			(0.153)			(0.172)
Post × Large			1.757***			-0.986***
			(0.225)			(0.213)
Ind × Mun FE						
Bank × Firm FE	✓	✓	✓	✓	✓	✓
R^2	0.745	0.745	0.746	0.676	0.675	0.676
Observations	1622503	1586269	1622503	840496	821345	840496

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Results from the regression specification in Equation $i_{tmbf} = \alpha_{tim} + \alpha_b + \beta_0 Type + \beta_1 Post_t \times Type + \Gamma_1 \mathbf{X}_{tmbf}$ for firm credit. Controls $\mathbf{X}_{tm}$ include: Maturity Categories, Loan Amount and Rating Categories, Firm Ownership dummies, log of number of employees, log of estimated revenue. Standard errors clustered at bank level.