Government Banks 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 government banks. Theoretically, the effect of this type of policy is ambiguous: while it can increase the total amount of credit in the economy, it can also increase misallocation if government banks finance riskier firms with unproductive projects. We leverage credit registry data to document a series of empirical facts and test if the intervention alleviated inefficient underprovision of credit. We find that while the intervention led to a reduction in interest rates and to an increase in total credit from both government and private banks, government banks faced a significant increase in defaults. Loans to *ex-ante* indebted firms explain this increase in default for government banks. Moreover, neither the increase in total credit nor the reduction in interest rates had any observable effects on output or employment. Our results suggest that the intervention increased credit misallocation, and that adverse selection did not play a significant role in the allocation of credit in Brazil.

Keywords: Credit Market Interventions, Credit Misallocation, Government Banks

JEL Classification: E44, E65, G21, L44

1. Introduction

Credit markets are prone to government intervention, and one of the tools used to intervene in these markets are government banks.[1] These interventions can address problems caused by adverse selection or excessive market power by private banks, which can lead to inefficient credit rationing. However, interventions that lead to a larger role of the state in financial markets often have harmful effects such as credit misallocation.[2] Despite government ownership of banks being common in many countries, little is known about the effects of a large-scale increase in credit provision by government banks or the underlying mechanisms driving these effects, in particular outside of crisis episodes.[3] In this paper, we ask whether a large-scale increase in lending by government banks alleviates inefficient underprovision of loans, whether such an increase exacerbates credit misallocation, and how do private banks respond to an increase in lending by state-owned banks.

We address these questions in a novel setting that exploits an unexpected large-scale credit market intervention in Brazil. In March 2012, the Brazilian government announced the use two of its largest public banks — *Banco do Brasil* and *Caixa Economica Federal* to increase lending at low interest rates. Together, these two government banks were responsible for 32% of the outstanding credit in Brazil before the intervention. The objective of the intervention was to increase credit at low interest rates, pursuing a reduction in private banks' interest rates and an increase credit access. The program was massive, with the total amount of outstanding credit from these two government banks increasing 27% in one year.[4] Using administrative data, we document that private banks reduce interest rates in response to the policy, but the credit expansion entailed more loans to riskier and more levered firms, which are riskier, and has no effects on employment or output growth. Our results suggest that the credit expansion had limited benefits and came at a cost of increased loan default risk and credit misallocation.

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[1] In this paper we use the expressions *state-owned banks*, *government banks* and *public banks* interchangeably. They refer to banks whose majority shareholder is a government entity. These banks allow governments to lend to households and firms directly. We refer to banks that are not government banks as *private banks*.

[2] Papers highlighting a beneficial view of credit market interventions include Stiglitz (1994), Tirole (2012) and Philippon and Skreta (2012). Papers that document a negative role for these state interventions include Bertrand, Schoar and Thesmar (2007), Acharya et al. (2019), Acharya et al. (2020) and Acharya et al. (2021).

[3] Countries with government banks include Brazil, Chile, Argentina, Spain, Germany and China.

[4] In the two weeks following the announcement of the program, *Banco do Brasil* stock fell by 7.62%. *Caixa Economica Federal* is not publicly traded.

Our setting is ideal to study the mechanisms and effects of a large-scale intervention in credit markets implemented through government banks. First, Brazil is a great laboratory in which to study credit market interventions. Bank lending represents nearly 52% of external finance in Brazil, close to the international average of 55%. Second, we can isolate the specific mechanisms that affect credit allocation and firm outcomes, given that our experiment occurs outside of a crisis episode, and thus in a setting where firms and banks are not subject to any other systematic shocks that would affect them differently. Third, we have access to rich administrative credit registry data, matched with employer-employee data, enabling us to provide robust causal evidence of the financial and real consequences of the intervention.

To understand under which conditions economic stimulus through an increase in credit supply by government banks can be beneficial, we first develop a simple theoretical framework. Although simple, our framework captures the relevant channels to understand the mechanisms and potential effects of the intervention and guides our empirical analysis. Our starting point is a scenario where firms with productive and unproductive projects obtain credit from banks to finance their investment projects. We incorporate government banks in this context by allowing the government to provide credit at low interest rates, but subject to a capacity constraint, which implies that not all borrowers who want to borrow from the government are able to do so. We then incorporate two mechanisms that have different implications for welfare: adverse selection and zombie lending. Specifically, in the presence of adverse selection, an increase in public credit is welfare improving, as it allows for more firms with productive projects to obtain financing in equilibrium. However, absent any form of selection, the effects of an increase in credit from government banks depend on the average quality of firms borrowing from these banks. In particular, if we allow for the credit expansion to increase the riskiness of firms that borrow from government banks, then an increase in public credit is welfare decreasing.

Having illustrated our theoretical framework, we begin our empirical analysis by focusing on the effects of the intervention on interest rates and volume of credit by both government and private banks. Throughout the paper, we focus mainly on working capital loans, which are term loans that can be used for any purpose and represent one of the main sources of funding for firms in the Brazilian economy. First, government banks lent at lower interest rates both before and after the intervention, and the policy was not characterized by large

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reductions in the interest rates of working capital loans made by government banks. Instead, the main effect of the intervention was a sudden increase in the supply of credit by government banks, which grew by more than three times after the policy was announced. Second, we turn to the response of private banks, relying 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 when the policy was implemented. While private banks' interest rates were falling at a faster pace than government banks' interest rates prior to the beginning of the policy, there was a large drop in the difference between interest rates of private and government banks after the policy. In other words, private banks respond to the increase in the supply of public credit by reducing loan interest rates, with the difference between interest rates of public and private banks falling about five percentage points, a reduction of a third of the difference prior to the intervention.

The second step in our empirical analysis is to compare the riskiness of borrowers from private and government banks. The fact that government banks charged lower interest rates relative to private banks in similar loans to comparable firms gives us an unique opportunity to test if the credit market we analyze was characterized by adverse selection. For instance, we can test if different firm willingness to pay correlates with unobserved default risk. In the presence of adverse selection an increase in the provision of public credit is beneficial since it allows for more productive firms to obtain funding for their projects. Alternatively, government banks can subsidize levered borrowers, as in zombie lending situations, in which case government banks would be financing unproductive firms that would default more often on their loans. These different channels connected to borrower risk have different implications for the desirability of the policy, as illustrated by our model.[5]

The trajectory of private and government banks loan risk reveals two important patterns. First, delinquency rates prior to the intervention were very similar for both types of banks. Second, the policy was associated with a diminishing quality of government banks' borrowers relative to private banks'. After the policy, the average probability that a firm borrowing

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[5]Another possibility is that lower interest rates riskier borrowers, such as in advantageous selection models (De Meza and Webb (1987), 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 government banks' borrowers (Boyd and De Nicoló (2005), Martinez-Miera and Repullo (2010)). Finally, government banks might have lower screening standards and attract riskier borrowers even in the absence of selection (Jiménez et al. (2019)). Our empirical evidence rules out these alternative mechanisms as well.

from a government bank became delinquent is about 100 basis points higher than the probability of a firm borrowing from private banks becoming delinquent, which corresponds to a 20% higher probability of delinquency for firms borrowing from government banks in comparison to firms borrowing from private banks. The fact that government banks extended credit to firms with similar default risk before the intervention and riskier firms after the intervention casts doubt on the idea that adverse selection drives borrower riskiness in our context. Our results are consistent with government banks allocating loans to unproductive and indebted firms, as in zombie lending contexts.[6] Nevertheless, the observed differences in average borrower riskiness between private and government banks are also consistent with lower screening standards by government banks during the policy.

To uncover the exact mechanism that explains the differences in loan risk between government and private banks, we compare loans made to *ex-ante* levered and unlevered firms. We document that while private banks charged lower interest rates when lending to borrowers with no outstanding debt, government banks charged lower interest rates when lending to older, more levered borrowers. However, when we restrict our sample to new clients only, public and private banks have comparable risk both before *and* after the intervention, contradicting the idea of uniformly lower screening standards by government banks. Risk differences for public and private banks arise from loans to levered firms, with the difference between loan risk for public and private banks increasing monotonically in firm leverage. Moreover, firms borrowing from government banks had higher debt outstanding and became more levered after the intervention.[7] These results indicate that government banks extended credit to more indebted firms as part of the policy, allowing such firms to become more levered and riskier, which increased loan default for government banks.

A final exercise to test if the policy ameliorates inefficient underprovision of credit is to assess if the increase in credit led to output and employment growth. If government banks lend to unproductive levered firms, then we should see no difference in output between

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[6]While it is challenging to precisely characterize zombie lending, the literature suggests zombies can be identified when banks issue subsidized loans to unproductive firms (Caballero, Hoshi and Kashyap (2008)). In our context, lower interest rates for highly levered firms, combined with *ex-post* higher delinquency rates, are consistent with the zombie lending view.

[7]We also perform one additional test to rule out the possibility that selection is driving our results by comparing old and new firms. We find that, conditional on having no outstanding debt, old and new borrowers have similar risk, which contradicts the hypothesis that new borrowers, who would be attracted by lower interest rates, are safer/riskier, as in adverse/advantageous selection models.

areas more and less exposed to government banks. Alternatively, locations with more exposure to government banks would have larger economic growth if credit was used to finance productive projects. We answer this question by comparing municipalities with only public or private bank branches. Areas with branches exclusively from government banks face larger credit growth after the intervention compared to locations with branches exclusively from private banks. However, municipalities with branches exclusively from government banks do not experience larger output growth. We also test for differences in employment of firms who borrow from government and private banks, since the latter group benefits from larger interest rate reductions after the intervention. However, we find that both types of firms have comparable employment dynamics. In summary, we cannot reject the hypothesis that, despite causing a reduction in the interest rates of private banks, the policy led to an increase in loans to less productive firms, decreased loan quality through an increase in firm leverage, and had limited positive effects.

The remainder of the paper is as follows: Section 2 reviews the related literature. Section 3 presents the data and relevant institutional details of the Brazilian economy. Section 4 presents the illustrative theoretical framework. 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[8]. 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. By exploring an unique setting in which a large intervention occurs outside a financial crisis episode, we are able to isolate the mechanisms affecting private banks' behavior, borrower risk and output and employment outcomes. We add to the literature by showing that public led credit expansions outside economic downturns have limited benefits despite increased costs due to higher loan default, and cannot rule out the idea that the policy led to credit misallocation.

The paper is also related to studies of asymmetric information in credit markets. Theoretical papers predict that the effectiveness of interventions in credit markets depends on the existence of adverse or advantageous selection (Stiglitz and Weiss (1981), De Meza and Webb (1987), Tirole (2012), Philippon and Skreta (2012), Mahoney and Weyl (2017) and Biswas and Koufopoulos (2019)). Empirical studies usually rely on measures of exogenous variation in borrowers' propensity to borrow/insure to test if such propensity is correlated with unobserved borrower risk, as in Chiappori and Salanié (2000). This is the case in Gupta and Hansman (2021), who study the importance of adverse selection and moral hazard in household mortgage exploring variation induced by interest rate indices used in different contracts, and Defusco, Tang and Yannelis (2021), who estimate welfare losses from asymmetric information in the market for online consumer credit. Alternatively, Crawford, Pavanini and Schivardi (2018) isolate the unobserved variation in demand for credit and the unobserved variation in risk to test for adverse selection, also showing that market power can alleviate the negative effects of increased adverse selection. We take a different approach by exploring the different interest rates charged by public and private banks, which would attract borrowers with different willingness to borrow. That allows us to test if the variations in borrower risk not explained by observables is in line with the predictions of selection models. This adds to the literature by providing a reduced form way to explore implications of asymmetric information models by testing if the predictions of these models hold in equilibrium.

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[8]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

This paper is also related to the literature that studies the Brazilian banking sector.[9] Several papers study the use of these institutions during the Great Recession to prevent a credit crunch, such as Coleman and Feler (2015) and Cortes, Silva and Van Doornik (2019). Ponticelli and Alencar (2016) shows how the Brazilian bankruptcy reform had heterogeneous local effects reflecting differences in court enforcement. Additionally, two papers focus on the same policy explored by our project. First, Garber et al. (2021), shows that the expansion led to an increase in household debt that ultimately led to smaller consumption during the economic downturn in 2014-2016. Additionally, Schmitz (2020) documents differences in ex-ante risk between public, foreign and private national banks at the regional level. Our project complements these studies by showing that the expansion led to a reduction in private banks' loan interest rates, connecting the increase in credit supply to a worsening of public banks' borrower quality and showing that this worsening of default probabilities is associated with loans to levered firms. Importantly, despite focusing on different loan types, both our study and Garber et al. (2021) convey the idea that public bank credit expansions have drawbacks linked to increased borrower leverage.

Finally, our project adds to the literature studying state owned banks. Many studies connect misallocation to the existence of public banks, such as La Porta, Lopez-De-Silanes and Shleifer (2002), which studies cross country differences in government ownership and connects it to financial development. Similarly, Dinç (2005) documents how credit provided by state owned banks is influenced by political cycles. Focusing on Italy, Sapienza (2004) shows that public banks provide cheaper credit than private banks, and connects the cheaper loans by government banks to political factors. More recently, Carvalho (2014) shows that political capture can lead to misallocation problems connected to the misuse of the a large Brazilian development bank. On the other hand, some projects show that government banks have less procyclical, as argued by Bertay, Demirgüç-Kunt and Huizinga (2015), which can be beneficial during financial crises.[10] Our paper complements this literature by documenting a response of private banks by lowering interest rates, which is consistent with the view that these banks compete against public banks. This contrasts with Coelho, De Mello and Rezende (2013), who suggests that private banks do not compete with public banks, and

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[9]Many papers explore different aspects of the Brazilian banking sector, such as Bustos, Garber and Ponticelli (2020), Lazzarini et al. (2015) and Coelho, De Mello and Funchal (2012).

[10]Other papers that study government ownership of banks include Iannotta, Nocera and Sironi (2013), Assuncao, Mityakov and Townsend (2012) and Ru (2018)

[Sanches, Silva Junior and Srisuma](2018), who shows that public banks generate positive spillovers to private banks. Additionally, we show that the reduction in the interest rates of private banks in response to more credit by public banks is *larger* for smaller firms and for firms without previous relationships with public or private banks.[11]

3. Data and Institutional Setup

3.1. Data

Our main sources of data comes from two sources: (i) Confidential credit registry data from the Brazilian Central Bank *SCR* database;[12] (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 specific threshold, allowing us to observe the near universe of loans to firms in Brazil.[13] 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.[14] 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.

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[11]This is in line with the literature studying the how competition in the banking sector benefits small firms ([Rice and Strahan](2010) and [Ryan, O'Toole and McCann](2014)), and empirical studies of relationship lending ([Degryse and Ongena](2005), [Ioannidou and Ongena](2010)), suggesting that lending relationships allow banks to extract rents from smaller firms.

[12]Several papers studying the Brazilian economy use the SCR as their main source of data. Examples include [Fonseca and Van Doornik](2021), [Joaquim, Gustavo; Van Doornik](2019) and [Cortes, Silva and Van Doornik](2019)

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

[14]Some information available to us is not available to banks. For example, banks do not observe interest rates negotiated between clients and other 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 delinquency information is comprehensive despite the constraints. Additionally, it allow us to identify firms with a bad credit history at the moment in which they originate a loan.[15]

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.[16]

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

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[15]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.

[16]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.

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.

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.[17] 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:

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[17]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,

3.2. Economic Context

The inflation stabilization process in 1994 (Plano Real) hit hard some banks that relied on the revenues coming from hyperinflation. This started several waves of bank restructuring and MA, including privatization of regional state banks, leading to a oligopolistic structure in the Brazilian banking sector. 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 to address insolvency cases that resulted from inflation stabilization measures adopted during Plano Real (Cysne and da Costa (1997)). 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 expand their presence in Brazilian credit markets, with Santander, ABN Amro and HSBC engaging in important acquisitions during the period. Additionally, many distressed banks, including private institutions, were acquired by national private banks (e.g. *Nacional*, which was acquired by *Unibanco*) and foreign banks that were attempting to expand their operations in Brazil (e.g., *Bamerindus*, acquired by HSBC, and *Real*, acquired by ABN). Bank consolidation would further advance in the late 2000s, with the merger of Itau and Unibanco, and the sale of ABN Amro's operations in the country to the Spanish conglomerate Santander.[18]

Despite the large scale consolidation process described above, which included the pri-

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[18]We distinguish between public, private national and private foreign banks using Central Bank's UNICAD database.

vatization of several regional public banks, 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.[19]

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.

3.3. The Intervention

After the early years of the Great Recession, the Brazilian economy experienced fast economic recovery, with the Brazilian GDP growing 7.5% in 2010 and 4.3% in 2011. Importantly, in 2011 former president Dilma Rousseff began her presidential mandate, which increased the number of policies geared towards fostering economic growth. In particular, in August 2011, the government announced the *Plano Brasil Maior*, an economic plan which was geared towards increasing the competitiveness of the Brazilian economy. The plan included tax incentives for investments and exports of specific sectors, along with other eco-

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[19]These government owned commercial banks were nevertheless profitable, with their ROA above the average of OECD countries between 2010 and 2012, as can be seen in Appendix F Figure F.4.

nomic measures.[20] These policies were implemented as the government became worried about a potential economic slowdown. 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 were particularly high even when compare to other developing countries. The bank lending deposit spread in 2011 was 32.9% in Brazil, compared to 3.4% in Argentina and 3.7% in Mexico, for example.[21] Consequently, the Brazilian government increased the number of interventions in the Brazilian banking sector, which included capital injections and regulatory changes in loans to households (Torres (2016)). Furthermore, 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. These actions were part of two governmental programs, *"Bom pra todos"*, which was implemented by *BB*, and *"Caixa Melhor Credito"*, implemented by CEF.[22] 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 policymakers in Brazil, who held the belief that lower interest rates were necessary for sustainable economic growth and would prevent a slowdown of economic activity.[23]

While the policy was widely advertised after its announcement, specific details about its implementation, coverage and duration were not disclosed. 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,

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[20]For more on the plan, see https://www.forbes.com/sites/ricardogeromel/2011/08/03/bigger-brazil-plan-16-bilion-in-taxes-breaks-to-fight-against-cheap-imports-from-china-and-surging-real/?sh=1673094a29e6 and Zanatta (2012)

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

[22]The two programs were funded through a combination of equity and deposits, with total growing by about 10% for BB and 23% for CEF between 2012 and 2013, as can be seen in Appendix F Figure F.3.

[23]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 2012 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".*

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.

4. Theoretical Framework

In this section, we present our theoretical framework, which is developed to encompass key features of the intervention we study. The nature of the intervention was such that government banks were charging lower interest rates than private banks for similar products, despite having a lower market share before the intervention. Given that the sudden increase in the amount of credit originated by government banks right at the beginning of the intervention was not accompanied by a decrease in average loan interest rates, this suggests government banks operated with a fixed supply of credit and rationed some of their applicants. Moreover, our model takes into account that the intervention was large, and thus changes in the credit supply by government banks endogenously affect the pool of borrowers of private banks.

We incorporate two opposing channels through which government banks can affect credit allocation and welfare in the economy. First, through an increase in public credit, governments can address problems related to inefficient provision of credit due to adverse selection problems. Second, we consider the case where government banks extend loans, at lower rates, to riskier and less productive firms (zombie lending). In this case, a positive credit supply shock can be detrimental for welfare.

Setting. The economy consists of two types of firms that want to finance investments: good and bad firms. Firms borrow to finance an investment opportunity with unit cost. If successful, good firms obtain a return Y_i, and bad firms obtain a return Y_B, which is fixed for all bad firms. We assume that $Y_B \geq Y_i$, $\forall i$. While bad firms have greater return if they succeed, their probability of success is lower. In particular, we use p^B and p^G to denote the probability of failure of bad and good firms, respectively, and assume that $p^B > p^G$.

Adverse Selection. Each firm knows its type, but a firm's type is unknown to all banks in the economy. There is a fraction γ of bad firms in the economy, which is public knowledge. We assume that $p_G Y_i \geq c > p_B Y_B$ for all i, where c is the marginal cost of funds for all banks.

In other words, good projects have positive NPV and should be financed, while bad projects have negative NPV and should not be financed.

Notice that our assumption that bad firms have a higher return to their investment opportunities means bad firms will always obtain financing if credit is greater than zero in equilibrium. In other words, markets are characterized by *adverse selection*, with good borrowers having a lower propensity to borrow. In this economy, more credit will always be welfare improving, since more credit increases the proportion of good borrowers which are able to finance their projects.

Our model has two stages. In the first stage, a government bank sets interest rates R_G and quantity $\bar{q}$. The demand faced by the government bank is given by:

$$\gamma + (1-\gamma)\mathbb{P}(Y_i \geq R_G) \tag{1}$$

We assume that the demand for loans from government banks is larger than $\bar{q}$. In other words, government banks will have to ration their applicants. We assume that government banks randomly select firms to have their applications accepted, until their capacity is met. Therefore, the probability of a firm having their application accepted conditional on applying is given by:

$$\pi_G(\bar{q}) \equiv \frac{\bar{q}}{\gamma + (1-\gamma)P(Y_i \geq R_G)} \tag{2}$$

In the second stage, private banks provide credit for the remaining firms which did not obtain credit from government banks. Their residual demand for a given interest rate R is given by the share of bad, good and levered firms which are not able to obtain public funding *and* are willing to pay interest rates R. In particular, we have the following (all proofs are in Appendix B):

- Bad firms: For a given interest rate $R \geq R_G$, the residual demand of bad firms is given by $\gamma(1 - \pi_G(\bar{q}))$ if $Y_B \geq R$.

- Good firms: For a given interest rate $R \geq R_G$, the residual demand of good firms is given by $(1-\gamma)(1 - \pi_G(\bar{q}))\mathbb{P}(Y_i \geq R)$

Private banks face a cost fixed c when providing credit. Let $P(R) \equiv \frac{\gamma p_B + (1-\gamma)p_G \mathbb{P}(Y_i \geq R)}{\gamma + (1-\gamma)\mathbb{P}(Y_i \geq R)}$ denote the average probability of default faced by private banks when they charge interest

R. One can easily show that $\frac{\partial P}{\partial R} > 0$, that is, the average probability of default faced by private banks is *increasing* in the interest rate R. This formalizes the adverse selection mechanism, whereby safer borrowers are attracted by lower interest rates. In this case, one can show the following result:

Lemma 1. *If government banks randomly select firms to have their applications approved, then R, the equilibrium interest rate charged by government banks, is insensitive to $\bar{q}$.*

The optimal R *does not* depend on $\bar{q}$ in this case, which means an increase in public quantities would not affect private banks' interest rates. Intuitively, since an increase in $\bar{q}$ does not change the distribution of borrowers willing to pay a certain interest rate R, the interest rate that maximizes private banks' profit remains the same. Importantly, despite the fact that interest rates are not sensitive to $\bar{q}$, an increase in $\bar{q}$ would still lead to an increase in welfare. In particular, we can show the following result:

Lemma 2. *In the presence of adverse selection an increase in $\bar{q}$ increases the fraction of good firms which are able to obtain funding in equilibrium. In other words, an increase in $\bar{q}$ is welfare increasing.*

This lemma illustrates that, in markets characterized by adverse selection, government interventions that lead to an increase in total credit are welfare improving since they allow more firms with positive NPV projects to finance themselves. In this context, total credit increases since the crowding out effect of an increase in $\bar{q}$ is smaller than the increase in $\bar{q}$ itself. Thus, there is an increase in total credit, which expands the amount of funding obtained by productive firms, allowing for more NPV positive projects to be financed. Importantly, this result hinges on the idea that markets are characterized by a severe adverse selection problem, with the very riskiest firms always being financed whenever a good firm is financed. We now show that, if we relax this assumption then the welfare implications of an increase in public credit become sensitive to the average quality of firms borrowing from government banks in equilibrium.

No Adverse Selection. In models with adverse selection government actions that allow for a larger number of firms to obtain credit are welfare increasing because the less productive firms always obtain credit in equilibrium. That way, an increase in the provision of credit

will increase the amount of resources available for productive firms to finance their project, thereby increasing surplus. However, absent adverse selection, the implications for surplus are no longer straightforward.

Suppose that bad borrowers have the same distribution of returns as good borrowers. Mathematically, let Y_i^G and Y_j^B denote the returns of good and bad firms, respectively. With no adverse selection, we have that $\mathbb{P}(Y_i^G \geq R) = \mathbb{P}(Y_j^B \geq R)$ for all R. In other words, for any interest rate R charged by private banks, the fraction of good and bad firms that obtains funding for their projects remains constant. Therefore the average probability of default faced by private banks is constant and given by $p \equiv \gamma p_B + (1 - \gamma)p_G$.

We continue to assume that the government bank will intervene in the market by increasing $\bar{q}$, that is, the provision of public credit, and keep interest rates R_G constant. As before, one can show that, in response to a change in $\bar{q}$, the interest rate charged by private banks remains constant. However, such an increase no longer necessarily leads to an increase in welfare. In particular, letting $F(i)$ denote the CDF of the returns of good and bad firms, we can show the following result:

Lemma 3. *Absent adverse selection, an increase in $\bar{q}$ is welfare increasing if and only if*

$$\mathcal{W}_{NoAdS} \equiv \int_{i(R_G)}^{i(R)} (p_B \gamma Y_i^B + p_G(1 - \gamma)Y_i^G - c)dF(i) > 0 \tag{3}$$

Moreover, for a sufficiently large $\gamma \in (0, 1)$, the intervention is welfare decreasing.

Lemma 3 shows that when there is no selection, the effect of an increase in public credit depends on the sign of $\mathcal{W}_{NoAdS}$, that is, the average net present value of the firms who apply for government banks only. Moreover, if the fraction of bad firms is sufficiently large, then the average net present value of firms applying to government credit only is negative.[24] Finally, the model also predicts that, in the case of adverse selection, government banks will finance comparatively *safer* firms, whereas without selection public and private banks finance firms which have similar risk. This is because the share of government credit that is used to finance good firms is larger than the share of private credit used to finance good firms when there is adverse selection. Thus, average probability of default faced by the gov-

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[24]Importantly, the lower the interest rate, the smaller the average NPV of firms who finance their projects with public credit, since the return of firms with a lower propensity to borrow is smaller.

ernment bank is smaller. This is a testable implication that we investigate in our empirical analysis that follows.

## 5. The Effects of the Intervention on Equilibrium Credit

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.

5.1. Aggregate Loan Amounts and Average Interest Rates

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 government banks successfully increased 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 government 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 government banks lend per month.

The striking feature of Figure 1 is that, despite a sudden and large increase in government banks' lending right after the intervention, this change did not trigger an immediate reduction in the amount of loans originated by private banks, which was stable throughout most of 2012. Despite the fact that government banks had small market share prior to the intervention, they were 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 E Table E.1 shows that in response to a 1% increase in government banks' credit at the municipality level, private banks' credit fell by 0.02%. This translates into a 4% crowding out of private credit in response to the increase in supply of government banks during

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Figure 1: Total Amount of Working Capital Loans (New Originations)
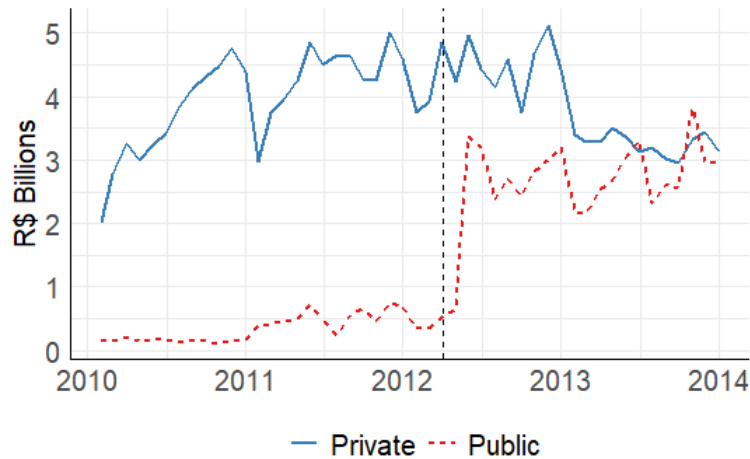
Note: This figure shows the total amount of working capital loans originated
by private and government banks each month. Source: SCR Database.

the intervention. Moreover, despite the increase in the availability of cheaper credit, very
few firms switched from private to government banks.[25] This is in line with the idea that
lending relationships are sticky and characterized by hold up issues (Petersen and Rajan
(1994)).

Our evidence is consistent with the hypothesis that government banks are subject to a
fixed credit supply (that increased during the intervention), which would explain how these
banks were able to suddenly increase their loan originations. Additionally, to the extent
that government banks can also internalize social benefits of lending, they can charge lower
interest rates than private banks, thus facing larger demand for loans. This can help explain
why borrowers who were potentially being rationed by government banks would not have
obtained loans from private banks before the intervention.[26]

The lack of effects of the policy in the amount of private credit new originations 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 mean-
ingful differences between government and private banks in terms of pricing, we analyze
average loan interest rates. The behavior of interest rates is relevant not only because it can

[25]Conditional on borrowing from private banks before the intervention, less than 10% of the firms borrow
from government banks exclusively after the policy.
[26]In terms of size distribution, firms borrowing from both private and government banks are usually micro
and small firms, as can be seen in Appendix D Figure D.2.

provide additional evidence of credit rationing by government 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, government 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.

Figure 2: Average Loan Interest Rates (Working Capital Loans, New Originations)
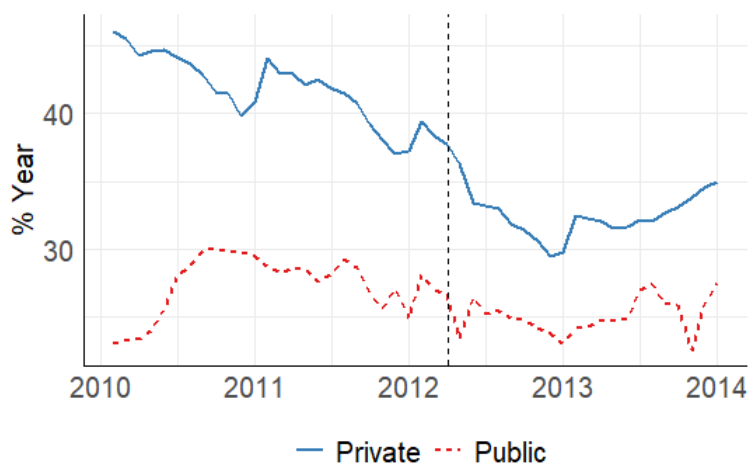
Note: This figure shows the average yearly interest rates of uncollateralized working capital loans originated by private and government banks. Source: SCR Database.

The notion that government banks are able to provide loans at lower interest rates is evident in Figure 2. We can see that government banks provided 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 banks. Despite such reduction, the difference in interest rates of private and government banks remained large after the intervention, with private loans on average 12.8 percentage points more expensive before the intervention, and 7.4 percentage points more expensive after the policy.[27] One possibility is that private banks were 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 could also have extended smaller loans to their borrowers,

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[27]That difference is more pronounced in loans for small and micro firms, as can be seen in Appendix D Figure D.3.

which would limit the extent to which the policy benefits firms who previously borrowed from private banks. Figure D.7 and Figure D.6 show that there were 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 that private banks adjusted in response to the policy were loan 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 government banks, firms have to provide collateral, or other guarantees which are might not be available for smaller firms. Finally, government 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. These aggregate differences can reflect borrower or loan characteristics among which private and government 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 government 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 difference-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 government banks during such episodes, which could also explain observed changes in the difference between interest rates. Therefore our identification assumption is that, given the absence any systematic shocks that differently hit private and government banks, changes in the difference between private and government banks' interest rates are caused by the intervention. Formally, we estimate Equation 4 at the loan-level:

$$i_{jtmbfs} = \alpha_{tms} + \alpha_b + \alpha_{t,j(maturity)} + \alpha_{t,f(size)} + \sum_{\tau \neq -1} \delta_\tau \, Private_b + \varepsilon_{jtmbfs} \tag{4}$$

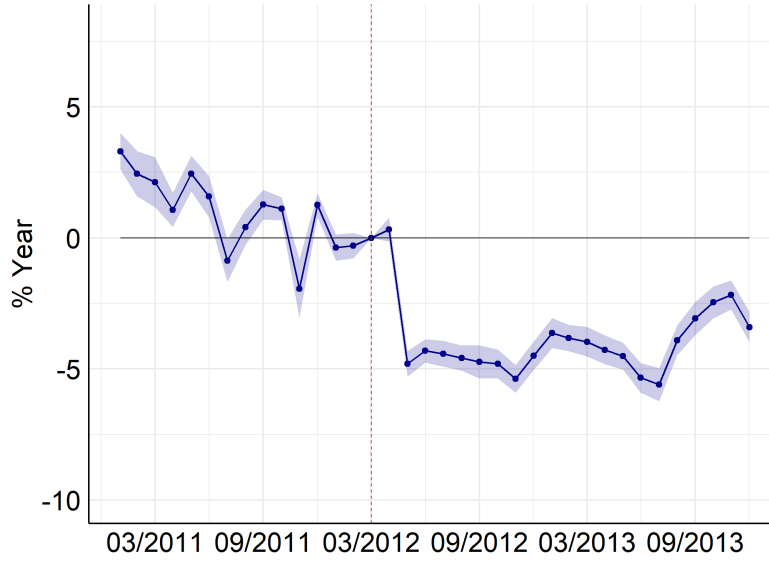where i_{jtmbfs} denotes the interest rate of a loan j, issued in month t, municipality m, by bank b to firm f in industry s. $Private_b$ is a dummy equal to 1 if bank b is a private bank, α_{tms} are time-municipality-industry fixed effects, α_b are bank fixed effects, $\alpha_{t,j(maturity)}$ are time-maturity fixed effects and $\alpha_{t,f(size)}$ are time-firm size fixed effects. For maturity and firm size, we bin the underlying continuous in several different categories. For details, see Appendix C. The coefficients of interest are δ_τ, the differential change on interest rates charged by private banks. 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. In summary, this specification guarantees our results are also not capturing portfolio rebalancing changes in response to the policy.[28] The results are in Figure 3.

The results in Figure 3 indicate that, despite a linear trend prior to the intervention, interest rates of private banks fell sharply relative to the interest rates of government banks after

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[28]Since there were very few operations in 2010 for uncollateralized loans originated by government banks, 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.

Figure 3: Differential Interest Rate Response: Government vs Private Banks

Note: Regression estimates for δ_τ from Equation 4 at the loan level, with March 2012 as the reference month, weighted by loan amount. We run: $i_{jtmbfs} = \alpha_{tms} + \alpha_b + \alpha_{t,j(maturity)} + \alpha_{t,f(size)} + \sum_{\tau \neq -1} \delta_\tau\ Private_b + \varepsilon_{jtmbfs}$, where i_{jtmbfs} denotes the interest rate of a loan j, issued in month t, municipality m, by bank b to firm f in industry s. $Private_b$ is a dummy equal to 1 if bank b is a private bank, α_{tms} are time-municipality-industry fixed effects, α_b are bank fixed effects, $\alpha_{t,j(maturity)}$ are time-maturity fixed effects and $\alpha_{t,f(size)}$ are time-firm size fixed effects. For maturity and firm size, we bin the underlying continuous in several different categories. For details, see Appendix C. Standard errors clustered at bank-municipality level. Coefficients include 95% confidence interval.

the policy.[29] Figure E.2 shows that the spread between public and private banks' interest rates falls around 5 percentage points, a reduction of about 33% of the pre-policy interest rate spread between private and public interest rates. The results are also robust to the inclusion of a private bank specific linear trend, as shown in Figure D.9, and indicate that the competition shock caused by the increase in supply by government banks *caused* a reduction in private banks' interest rates.[30]

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

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[29]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 Figure D.8 we show that if one adds time, municipality and industry fixed effects *separately* in Equation 4, the coefficient associated with November 2011 falls by half, without any meaningful changes in our coefficients of interest after March 2012.

[30]Table E.4 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.

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, government 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 government 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 government 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 showed that private banks charge higher interest rates than government 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 government 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 government banks used 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 government banks once the policy ends. Alternatively, worse borrower quality for government banks can also be a consequence of these banks banks being less efficient in their screening process than private banks. Consequently, expanding 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 government 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 government 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 government banks to have different risk. 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. We say a firm that 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.[31] For example, if a firm obtains a loan in May 2012, we track that firm's delinquency until May 2013. If such a firm fails to pay its loan installments for at least 90 days, we define such firm as a delinquent for loans it contracted in May 2012.

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

$$I^D_{tmbfs} = \alpha_{ms} + \alpha_b + \alpha_{f(size)} + \sum_{\tau \neq -1} \gamma_\tau + \varepsilon_{tmbfs} \tag{5}$$
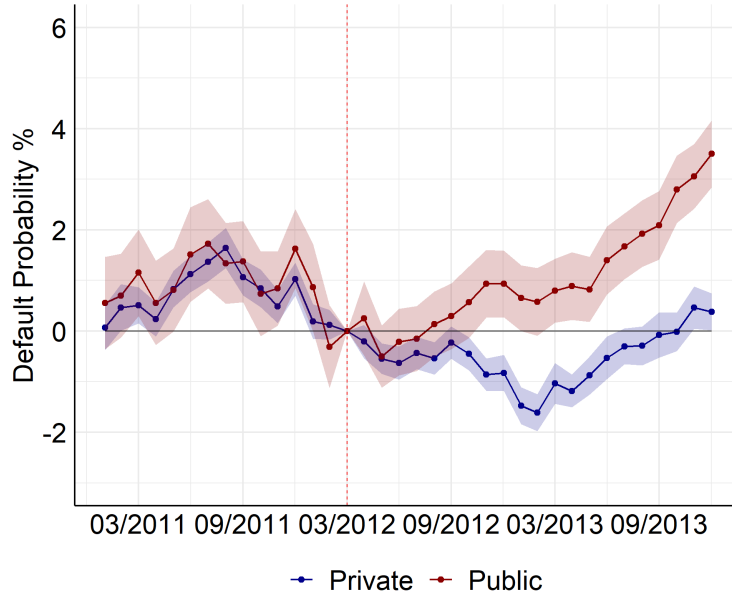
where I^D_{tmbfs} is a dummy equal to 1 if a loan originated on month t, municipality m, bank b, firm f and industry s becomes delinquent within one year after origination, α_{ms} are municipality-industry fixed effects, α_b are bank fixed effects, $\alpha_{f(size)}$ are firm size fixed effects, and γ_τ are time dummies. Each γ_τ indicates the average delinquency probability

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

relative to March 2012, our baseline date. We estimate equation 5 for public and private banks separately, and show the specific time coefficients γ_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 government banks experience a deterioration of their loan portfolio, while private banks' borrower quality remains mostly stable.[32]

Figure 4: Differences in Average Borrower Delinquency

Notes: Results for the γ_τ from the estimation of Equation 5 for public and private banks separately. We run: $I^D_{tmbfs} = \alpha_{ms} + \alpha_b + \alpha_{f(size)} + \sum_{\tau \neq -1} \gamma_\tau + \varepsilon_{tmbfs}$, where I^D_{tmbfs} is a dummy equal to 1 if a loan originated on month t, municipality m, bank b, firm f and industry s becomes delinquent within one year after origination, α_{ms} are municipality-industry fixed effects, α_b are bank fixed effects, $\alpha_{f(size)}$ are firm size fixed effects, and γ_τ are time dummies. Each γ_τ indicates the average delinquency probability relative to March 2012, our baseline date. Coefficients include 95% confidence interval. Standard errors are clustered at the bank-municipality level.

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

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[32]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 government banks.

specification at the firm-bank level:

$$I^D_{tmbfs} = \alpha_{tms} + \alpha_b + \alpha_{t,f(size)} + \sum_{\tau \neq -1} \delta_\tau Public_b + \varepsilon_{tmbfs} \tag{6}$$

Relative to Equation 5, we now focus on the differences in delinquency for different types of banks within a period. 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 similar industry, in the same month.[33] The results are in Figure 5:

Figure 5: Diff-in-Diff in Average Borrower Delinquency: Government vs Private Banks
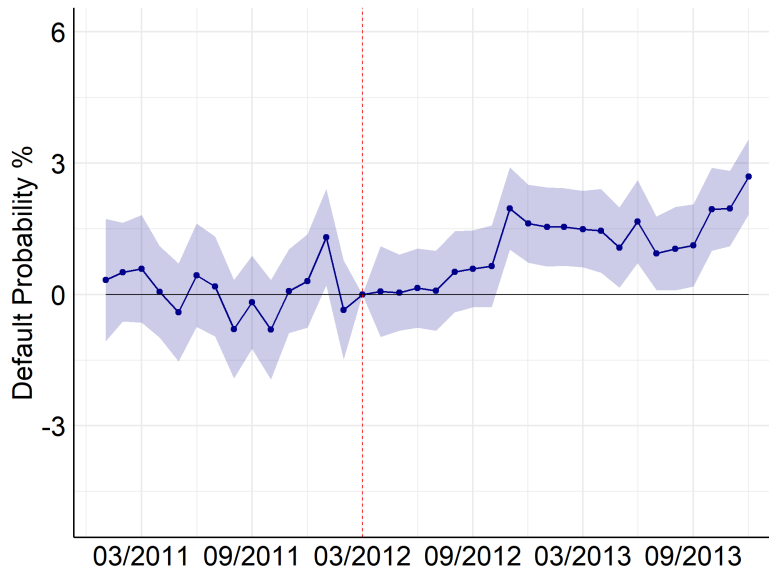
Notes: Results for the δ_τ from the estimation of Equation 6. Dependent variable I^D_{tmbfs} is a dummy equal to 1 if a loan originated by firm f located in municipality m in sector s in month t borrowed from bank b becomes delinquent within one year after origination. Coefficients include 95% confidence interval. Standard errors are clustered at the bank-municipality level.

Relative to private banks, government banks experience *higher* delinquency rates after the intervention, despite the fact that private banks charge substantially larger interest rates across all years in the sample. In particular, after the policy, loans originated by government

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[33]One implication of the use of these controls is that our results are not explained, for example, by the fact that government banks entered many new locations during the policy.

banks had between 70 and 130 basis points higher probability of becoming delinquent relative to loans originated by private banks, as shown in Table E.3.

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 attracted 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. This result is similar to the evidence from Jiménez et al. (2019). Studying a similar policy implemented in Spain, Jiménez et al. (2019) find that government banks accepted applications from borrowers with a lower credit score than did private banks.

6. Intervention Driven Increases in Risk

The results so far are consistent with the idea that government 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 for firms who borrow from government banks is lower than the average propensity to borrow for firms who borrow from private banks, the trajectory of borrower risk observed after the intervention is hard to reconcile with adverse selection, since government banks lend to worse borrowers despite charging lower interest rates.

However, it is not clear whether or not government 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 government 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, the possibility remains that loan markets in Brazil are still

characterized by adverse selection, but with government banks less effective at screening and ultimately attracting riskier applicants. To rule out these alternative explanations we exploit the richness 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 E.3 suggest that debt plays a significant role in explaining delinquency. Thus, we start by dividing firms between levered and unlevered, and investigate whether or not banks price discriminate between these different types of firms. We define a firm as a levered firm if that firm has positive debt outstanding at the beginning of the month in which it borrows.[34] The division between levered and unlevered firms allows us to draw connections to the literature that studies zombie lending, where zombies are defined as inefficient, less productive firms which borrow at subsidized interest rates, such as in Acharya et al. (2020). In our context, if government 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 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. Moreover, Ornelas, Soares Da Silva and Van Doornik (2020) show evidence that Brazilian private banks behave in this way, while government banks less so, which can worsen this bias. 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. Since firms can be more or less levered, we also compare, within the subset of levered firms, the interest rates paid by more levered firms relative to

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[34]This definition incorporates the notion that the vast majority of Brazilian firms, including firms in our sample, does not have access to capital markets to finance themselves.

less levered firms. Finally, we also analyze differences between firms with bad credit history and other firms. Formally, we estimate at the loan-level the following regression separately for public and private banks to investigate if the intervention is associated with different pricing strategies for these institutions:

$$i_{jtmbfs} = \alpha_{tms} + \alpha_b + \alpha_{t,j(maturity)} + \alpha_{t,f(size)}$$
$$+ \beta_0 \times Type + \beta_1 Post_t \times Type + \Gamma\mathbf{X}_{jtmbf} + \varepsilon_{jtmbfs} \qquad (7)$$

where $Type$ is one of two dummies: first with positive outstanding Debt ($Debt_f > 0$) and firms with outstanding debt at any previous moment in time (Old_f), and $\mathbf{X}_{jtmbf}$ are firm and loan controls: loan rating, firm ownership, log of number of employees, and log of estimated revenue. We estimate the regression in equation 7 for public and private banks separately. We include a series of time-varying loan and firm specific controls to isolate the differences in pricing due to the individual characteristics we are testing. The results are in Table 2.

Table 2: Interest Rate Sensitivity - Private Banks

	Private Banks		Public Banks	
	(1)	(2)	(3)	(4)
Debt	0.511***		0.0354	
	(0.0838)		(0.139)	
Post × Debt	1.246***		0.00558	
	(0.0663)		(0.148)	
Old		-0.621		0.162
		(0.350)		(0.825)
Post × Old		1.541***		-0.768
		(0.371)		(0.924)
Firm Group	All	Unlevered	All	Unlevered
Time × Ind × Mun FE	✓	✓	✓	✓
Bank FE	✓	✓	✓	✓
R^2	0.581	0.627	0.514	0.680
Observations	1725178	330369	787623	38880

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table shows the results of the estimation of Equation 7 including loans issued by private banks only. Controls $\mathbf{X}_{tm}$ include: rating, firm ownership dummies, log of number of employees, and log of estimated revenue. Standard errors are clustered at the bank-municipality level.

Column (1) in Table 2 shows that the reduction in interest rates of private banks caused by the policy is 1.2 percentage points larger for unlevered firms after the intervention. Unlevered firms pay *smaller* interest rates than levered firms when borrowing from private banks after the policy. Column (2) shows that firms with pre-existing relationships with private banks experienced smaller reduction in their loan interest rates 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. The results are different for loans issued by government banks. Columns (3) and (4) indicate that government banks do not price discriminate between firms with positive debt outstanding and unlevered firms, or firms with existing relationships and new firms.

While the results in Table 2 suggest levered firms would benefit from comparatively lower interest rates when borrowing from government banks due to the lack of discrimination between levered and unlevered firms in loans issued by government institutions, we can further explore how differences in leverage are priced by these banks. We do so by dividing our sample into quintiles of our leverage proxy, the ratio of total outstanding debt to payroll costs. We then estimate the following regression at the loan-level:

$$i_{jtmbfs} = \alpha_{tms} + \alpha_b + \alpha_{t,j(maturity)} + \alpha_{t,f(size)} + \sum_l \beta_l \times Ind_f^l + \Gamma \mathbf{X}_{jtmbf} + \varepsilon_{jtmbfs} \qquad (8)$$

where Ind_f^l are dummy variables equal to 1 if firm f belongs to the $l \in \{2, 3, 4, 5\}$ quintile — among firms that borrow before or after the policy — in terms of leverage in the baseline. The coefficient β_l in Equation 8 captures the average difference in the interest rates between firms in the bottom quintile of the leverage proxy distribution and firms in the l quintile of the same distribution. We estimate the specification above separately for private and government banks, and both before and after the intervention, to capture potential changes that were caused by the policy. We add firm and loan level controls to minimize the possibility that we capture variation related to a different variable. The results are in Figure 6.

A related question is whether or not the subsidies provided by government banks to levered firms leads to an increase in average firm leverage after the intervention. To answer this

Figure 6: Interest Rate Differences - Leverage

(a) Pre-Intervention	(b) Post Intervention
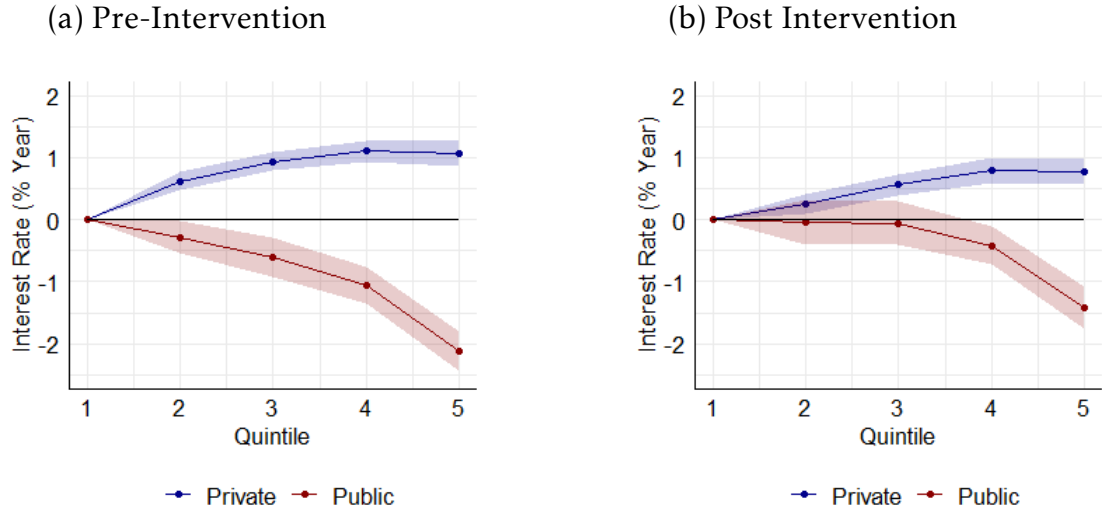
Notes: Results for the β_l from the estimation of Equation 8 for public and private banks separately. Controls $\mathbf{X}_{tmbf}$ include: Maturity categories, rating, firm ownership dummies, log of number of employees, log of estimated revenue. Standard errors are clustered at the bank-municipality level.

first question, we use a leverage proxy, given by total debt outstanding divided by total payroll costs. If physical capital and labor are, to some extent, complementary, firms with more assets are more likely to have more payroll costs, and our measure should capture changes in leverage over time. While this measure can underestimate formal leverage if firms with more labor costs choose smaller leverage (Favilukis, Lin and Zhao (2020)), it should nevertheless capture how large firm debt is relative to overall firm *size*. Figure 7 Panel (a) shows the ratio of debt outstanding over payroll costs for public and private banks.

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 government banks' loan portfolio after the beginning of the policy. Firms borrowing from government banks have a debt over payroll costs ratio 7% larger after the intervention relative to prior to the intervention. Another possibility is that the policy also led to a change in the composition of government banks' loan portfolio towards levered firms. Panel (b) of Figure 7 indicates that government 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 Panel (b) of Figure 7. These results are consistent with the idea that government banks prioritized more levered firms after the policy.

Figure 7: Loan Portfolio Changes - Public and Private Banks

(a) Debt Over Payroll Costs   (b) Total Debt Outstanding
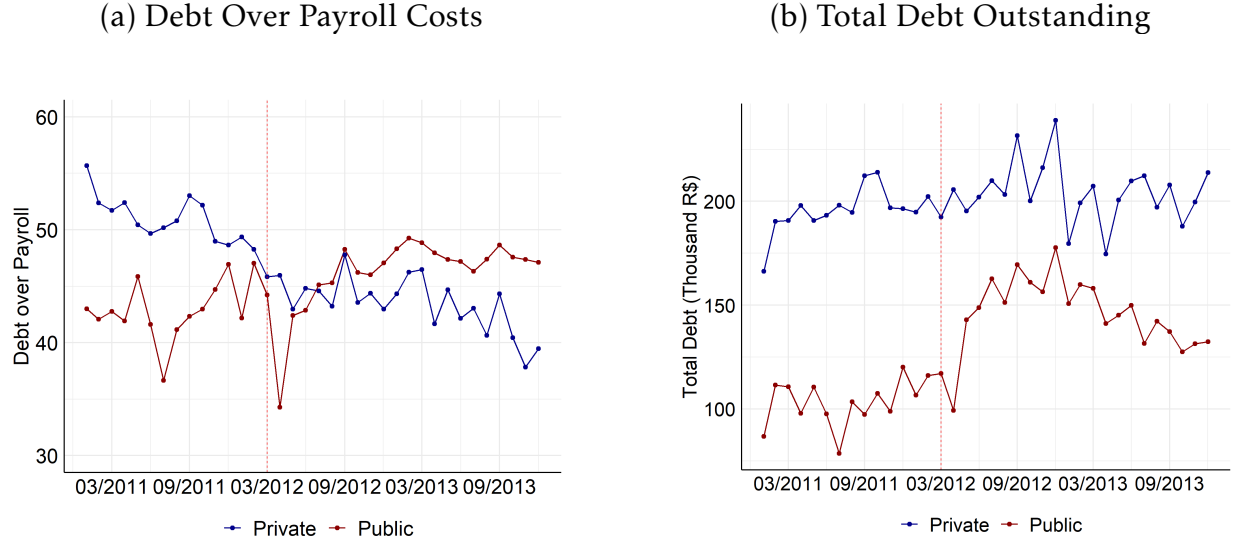
Note: Panel (a) shows the average total amount of debt outstanding over total payroll costs for firms that borrow from public and private banks. Panel (b) shows the total amount of debt outstanding in other types of credit for firms borrowing from private and government banks over time. Source: SCR Dataset and RAIS Dataset.

Overall, the evidence is consistent with government 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 government 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 government 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 5 for each group separately. The estimates for the coefficients δ_τ and the respective standard errors are in Figure 8.

Figure 8: Delinquency Averages By Borrower Type
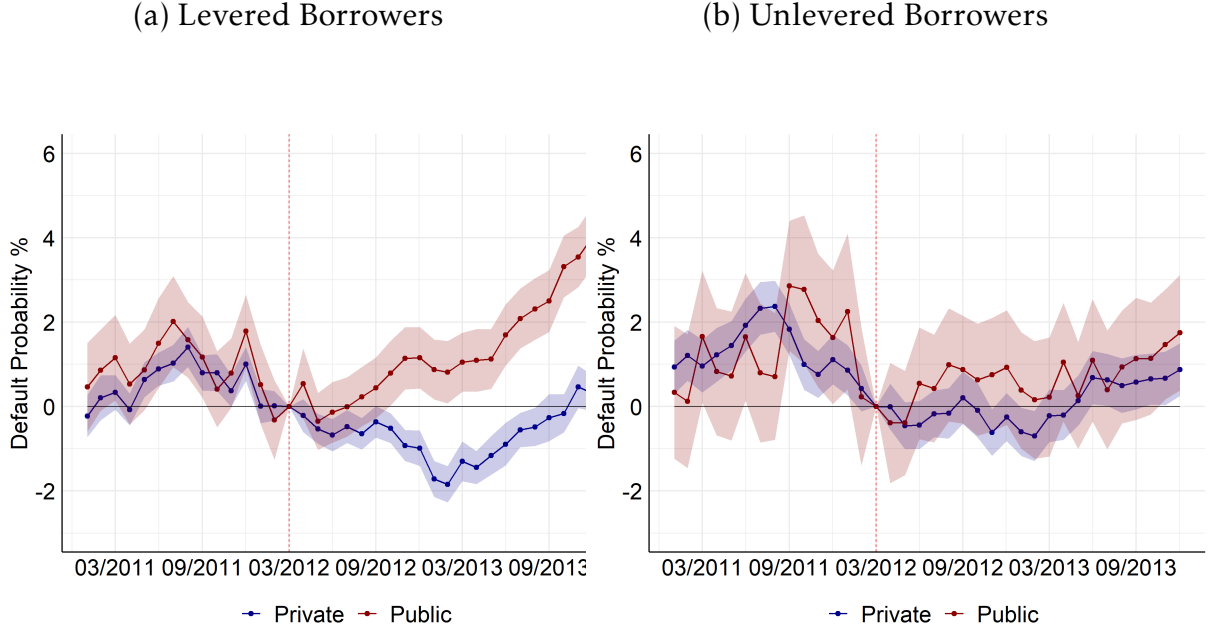
(a) Levered Borrowers   (b) Unlevered Borrowers

Notes: Results for the δ_τ from the estimation of Equation 5 for public and private banks separately. Each panel estimates the regression for levered and unlevered borrowers separately. Dependent variable I^D_{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. Coefficients include 95% confident interval. Standard errors are clustered at the bank-municipality level.

Figure 8 Panel (a) shows that levered borrowers of government 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.

Our working hypothesis is that by providing loans to firms with positive debt outstanding, government banks exposed themselves to more borrower delinquency risk. This view incorporates the notion that more levered firms are more likely to become delinquent. To understand whether or not this is indeed the case, we test if our leverage is correlated with delinquency. In particular, we divide firms in 5 bins according to their position in the dis-

tribution of leverage, and estimate the following regression at the firm-level:

$$I^D_{tmbfs} = \alpha_{mts} + \alpha_b + \alpha_{t,f(size)} + \sum_l \beta_l \times Ind^l_f + \varepsilon_{tmbfs} \tag{9}$$

The coefficients β_l in equation 9 capture the average delinquency difference between firms in the bottom quintile of the leverage proxy distribution and firms in the upper quintiles of the same distribution. Importantly, we restrict this analysis to firms with positive leverage, so our results are not contaminated by differences in riskiness of levered and unlevered firms, and focus only on the post intervention period. The results are shown in Figure 9. We can see that delinquency increases monotonically in leverage quintiles, indicating that firms with more leverage are more likely to become delinquent, with the difference being economically significant. In particular, firms in the bottom quintile of leverage are 8.5 percentage points more likely to become delinquent that firms in the bottom quintile. Furthermore, this effect is larger for government banks than for private banks, which indicates that leverage plays a central role in explaining the relative differences between public and private banks' borrower default risk.

Finally, 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 2 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:

$$I^D_{tmbfs} = \alpha_{mts} + \alpha_b + \alpha_{t,f(size)} + \beta_0 Old_f + \varepsilon_{tmbfs} \tag{10}$$

The results are in Table 3. Importantly, there are no meaningful differences in the risk of new and old borrowers. To the extent that old and new borrowers have different propensities to borrow since they face exogenously different interest rates, this indicates that borrowers with different propensities to borrow do not have different unobserved risk, going against the idea that adverse or advantageous selection can explain differences between riskiness of

Figure 9: Delinquency Differences - Leverage
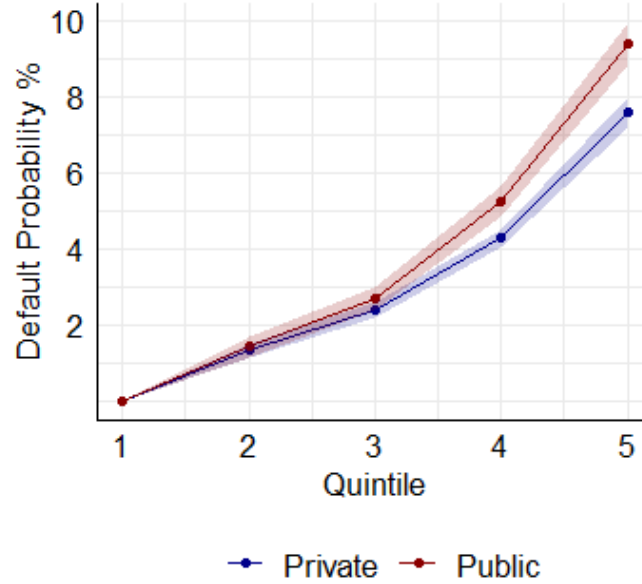
Note: This figure shows the β_l on Equation 9. Dependent variable I_{tmbf}^D is a dummy equal to 1 if a loan originated by firm f located in municipality m in month t borrowed from bank b becomes delinquent within one year after origination. The leverage proxy is calculated using firm outstanding debt at the beginning of month t divided by the firms' total payroll cost in that month. Coefficients include 95% confidence interval. Standard errors are clustered at the bank-municipality level.

public and private banks.

Table 3: 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 10. Dependent variable I_{tmbf}^D 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. Coefficients include 95% confidence interval. Standard errors are clustered at the bank-municipality level.

Overall, our results indicate that by subsidizing loans to levered firms, government banks increased the riskness of their loan portfolio, which led to a deterioration of their credit quality over time. This is consistent with the idea that government banks, when facing a relaxation of their capacity constraints, provided more loans to unproductive indebted firms, which became more levered and, consequently, more likely to default on their debt obligations. Importantly, our results are also consistent with the hypothesis that state owned banks engaged in zombie lending during the policy.

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. We test for the real effects of the policy in two settings. First, we consider the aggregate effects at the regional level. That encompasses all regional effects of the policy (credit and interest rates), including any reallocation of labor and capital across firms. Second, we consider the employment effects of the reduction in interest rates at the firm level.

7.1. Regional Effects

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 government banks. In particular, one cannot simply regress municipality GDP on public credit, for example, since government banks might be targeting municipalities where growth prospects are particu-

larly 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 sector. Specifically, we leverage on the fact that most municipalities that had only private or only government 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:

$$\Delta \ln(credit)_{tmr} = \alpha_m + \alpha_{tr} + \sum_{\tau \neq -1} \delta_\tau Public_m + \varepsilon_{tmr} \tag{11}$$

where $\Delta \ln(credit)_{tmr}$ denotes log of total working capital loans originated in municipality m, quarter t and micro-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.[35] We limit our analysis to municipalities that have branches of only one bank – either a government bank, or a private bank. Equation 11 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 10.

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. The magnitude of the change is consistent with the overall change in credit following the policy (a 27% increase in credit from public banks). This indicates that we can compare municipalities with only private or government banks to evaluate whether the increase in credit associated with the policy has real effects. We do so by estimating a version of Equation 11 using local GDP and its individual components as the dependent variables.

$$\Delta y_{tmr} = \alpha_m + \alpha_{tr} + \sum_{\tau \neq -1}^{m} \delta_\tau Public_m + \varepsilon_{tmr} \tag{12}$$

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[35]Brazil has over 5,500 municipalities, aggregated across 558 microregions. For a more detailed analysis of micro-regions, see Joaquim, Gustavo; Van Doornik (2019).

Figure 10: Public and Private Monopolies - Credit
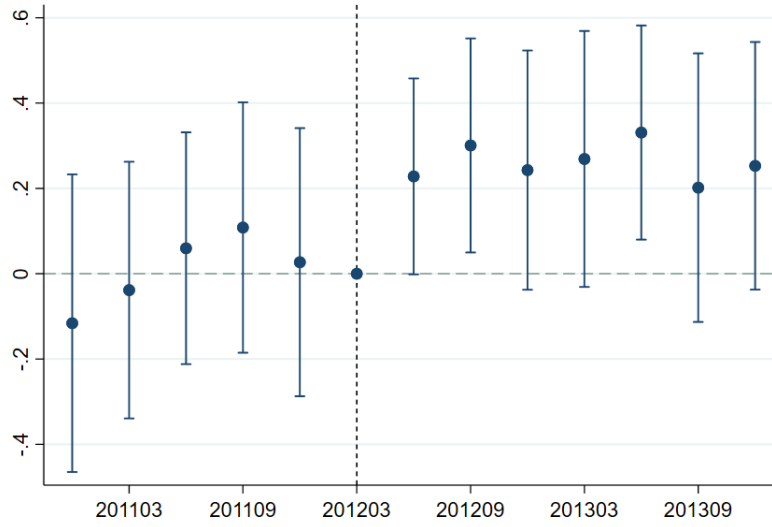
Notes: Results from the estimation of Equation 11. Dependent variable $\Delta \ln(credit)_{tmr}$ denotes log of total working capital loans originated in municipality m, quarter t and micro-region r. Coefficients include 95% standard errors. Standard errors are clustered at the municipality level.

where Δy_{tmr} denotes local GDP growth in municipality m, year t and micro 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 11.

The results show in Figure 11 show that, despite the large difference in credit in municipalities with only government banks, there is no difference in GDP growth between these locations and cities with only private banks after the policy.[36] The evidence suggests that that the extensive margin of credit — the increase the total amount of credit — does not lead to larger GDP growth, which is in line with the idea that government banks were not financing productive projects in these municipalities. In conclusion, we cannot reject the hypothesis that credit provided by state owned banks was mainly used to finance unproductive zombie firms.

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[36]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 government bank branches, and to the extent that this intensive margin of credit supply can also have real effects, our coefficients would be downward biased.

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Figure 11: Regional Effects: GDP
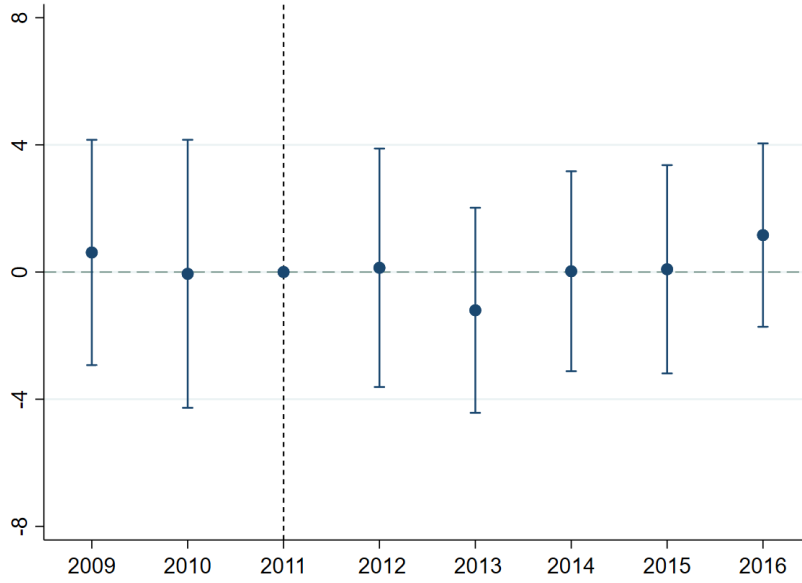
Note: This figure shows the results from regression 12. Dependent variable Δy_{tmr} denotes local GDP growth in municipality m, year t and micro region r, α_m and α_{tr} are municipality and micro region-time fixed effects.. Standard errors clustered at municipality level. Coefficients include 95% confidence intervals. Source: IBGE municipality data and ESTBAN dataset.

7.2. Firm-Level Interest Rate Effect

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 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 allow 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 government 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 government 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 government

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 (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 government 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 by estimating Equation 13

$$Log(emp)_{tmbfs} = \alpha_{tms} + \alpha_b + \alpha_{t,j(size)} + \sum_{\tau \neq -1} \delta_\tau Private_b + \varepsilon_{tmbfs} \tag{13}$$

where $Log(emp)_{tmbfs}$ is the log of employment at time t, on market m, bank b, firm f and sector s. The coefficients of interest δ_τ capture the employment differences between firms borrowing from private and government banks in month τ. The results are in Figure 12

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 government banks stemming from the policy. Since the subset of firms is kept constant — namely, firms with exclusive relationships with either private or government banks, that had access to working capital loans prior to the intervention — our lack of results implies that 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.

The fact that most loans originated by government banks during the policy went to indebted firms begs the question of whether there was an insufficient number of new borrowers demanding credit or if government banks rationed new applicants. While answering this question is beyond the scope of our project, the stylized facts we have uncovered sug-

Figure 12: Firm-Level Interest Rate Effect
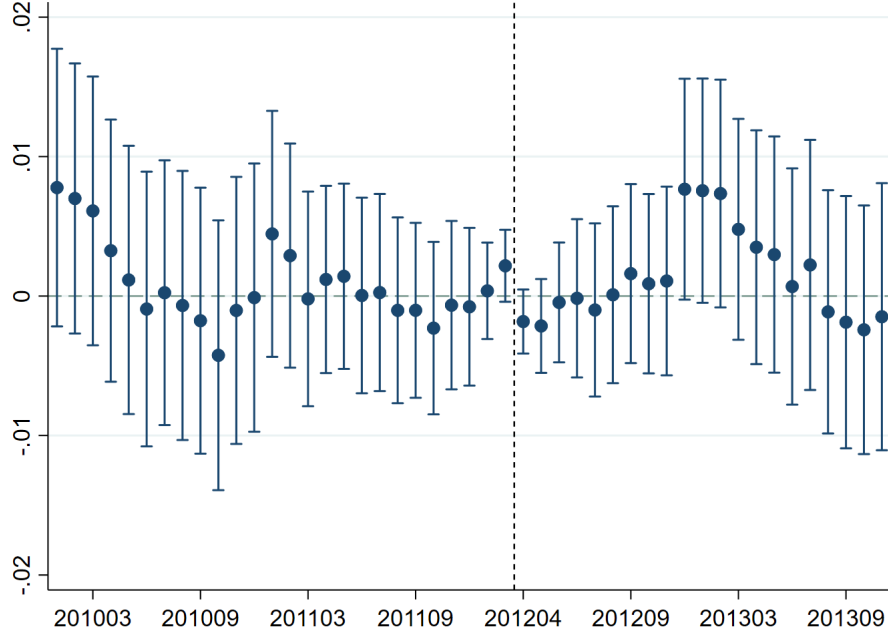
Note: This figure shows the coefficients δ_τ from regression 13. Standard errors clustered at municipality level. Coefficients include 95% confidence intervals. Source: SCR Dataset and RAIS Dataset.

gest government banks might have faced operating capacity constraints to process working capital loans. If banks face operating capacity constraints, these institutions would provide more refinancing credit at the expense of new credit, as shown by Choi, Choi and Kim (2021). In our context, government banks had a small market share of working capital loans, and rapidly expand credit at the onset of the intervention. If loan officers faced operating constraints, it is possible that they would favor firms with existing relationships, allowing banks to expand credit faster. Importantly, regardless of the exact force behind the increase in government bank loans to levered firms during the policy, our results indicate that public led credit expansions outside crisis episodes can lead to increased loan default and potential credit misallocation, while providing limited benefits stemming from reduced interest rates.

8. Conclusion

In this paper we study a credit market intervention implemented by the Brazilian government using public commercial banks. The intervention is characterized by a large increase

in the supply of credit to firms at subsidized interest rates. We document that while the policy was effective in inducing private banks to reduce interest rates, it was also associated with a deterioration in credit quality that led to credit misallocation. Loans issued by government banks during the intervention were around 1 percentage point 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.

We find that the policy had government banks subsidizing loans to firms with positive debt outstanding and with whom they had previous relationships. Moreover, we show that lending to more levered firms caused a deterioration of borrower quality for government banks, and that such effect is not observed in loans to new borrowers. We thus rule out alternative explanations as to why the intervention is characterized by the worsening in credit quality, such as selection or poor screening by government banks. These findings have important implications for papers highlighting the role of asymmetric information mechanisms linked to interest rates (e.g., Stiglitz and Weiss (1981)). Our analysis suggests that asymmetric information channels are not relevant in our setting.

Finally, we rule out the hypothesis that the increase in credit was used to finance productive projects. Despite a large relative increase in credit in regions with government banks only versus those with private banks only, locations with government banks do not have better economic growth in the years following the policy. Moreover, the reduction in interest rates of private banks is also not able to generate variations in employment at the firm-level, casting doubt on the idea that the policy was effective at addressing inefficient credit rationing problems. Our results are consistent with zombie lending, where government banks provided loans to unproductive firms and thus increase misallocation.

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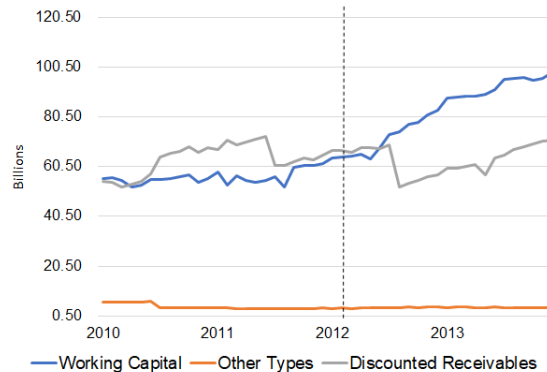
Note: This figure shows the total amount outstanding for different types of loans for public banks. Source: SCR Dataset.

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. Lemma 1

Proof. We can write private banks' profit when charging interest R as:

$$Q_P(R, \bar{q})[R(1 - P(R)) - c] \tag{14}$$

Where $Q_P(R, \bar{q}) \equiv (1 - \pi_G(\bar{q}))[\gamma + (1 - \gamma)Prob(Y_i \geq R)]$ is private banks' residual demand. First order conditions for R are:

$$Q'_P(R, \bar{q})[R(1 - P(R)) - c] + Q_P(R)(1 - P(R)) - Q_P(R)RP'(R) = 0 \tag{15}$$

Importantly, since $Q_P = (1 - \pi_G(\bar{q}))[\gamma + (1 - \gamma)Prob(Y_i \geq R)]$, then $Q'_P(R, \bar{q}) = (1 - \pi_G(\bar{q}))(1 - \gamma)\frac{\partial Prob(Y_i \geq R)}{\partial R}$, and we can write the first order condition as:

$$Q'_P(R, \bar{q})[R(1 - P(R)) - c] + Q_P(R)(1 - P(R)) - Q_P(R)RP'(R) = 0$$

$$\iff (1 - \pi_G(\bar{q}))\left[(1 - \gamma)\frac{\partial Prob(Y_i \geq R)}{R}(R(1 - P(R) - c) + (\gamma + (1 - \gamma)Prob(Y_i \geq R)\left((1 - P(R)) - R\frac{\partial P}{\partial R}\right)\right] = 0$$

$$\iff (1 - \gamma)\frac{\partial Prob(Y_i \geq R)}{R}(R(1 - P(R) - c) + (\gamma + (1 - \gamma)Prob(Y_i \geq R)\left((1 - P(R)) - R\frac{\partial P}{\partial R}\right) = 0$$

∎

B.2. Lemma 2

Proof. First, notice that:

$$\frac{\partial Q_P}{\partial \bar{q}} = -\frac{\partial \pi_G(\bar{q})}{\partial \bar{q}}[\gamma + (1 - \gamma)Prob(Y_i \geq R)]$$

$$= -\frac{1}{[\gamma + (1 - \gamma)Prob(Y_i \geq R_G)]}[\gamma + (1 - \gamma)Prob(Y_i \geq R)]$$

$$> -1$$

Where the last inequality comes from $R_G < R$. Therefore, the effect of an increase in $\bar{q}$ in total credit $Q = Q_P + \bar{q}$ is positive. Since that bad firms always borrow if equilibrium credit is greater than zero, as their propensity to borrow is higher than all good firms, then an increase in $\bar{q}$ is welfare improving in the presence of adverse selection. To see why, notice that we can write the total function as:

$$SW(R, \bar{q}, R_G) = \gamma(p_B Y_B - c) + \int_{i(R)}^{1} (p_G Y_i - c) dF(i) + \int_{i(R_G)}^{i(R)} (p_G Y_i - c)\pi(\bar{q}) dF(i) \qquad (16)$$

Since $\pi'_G(\bar{q}) > 0$ and $\int_{i(R_G)}^{i(R)} (p_G Y_i - c) > 0$, then $\frac{\partial SW(R, \bar{q}, R_G)}{\partial \bar{q}} > 0$, that is, social welfare is increasing in the amount of public credit.

$\blacksquare$

B.3. Lemma 3

Proof. As before, we know that an increase in $\bar{q}$ leads to an increase in total credit. Then, we can write social surplus as:

$$SW(R, \bar{q}, R_G) = \int_{i(R)}^{1} (p_B \gamma Y_i^B + p_G(1-\gamma)Y_i^G - c) dF(i) + \int_{i(R_G)}^{i(R)} (p_B \gamma Y_i^B + p_G(1-\gamma)Y_i^G - c)\pi(\bar{q}) dF(i)$$

$$(17)$$

In this case $\frac{\partial SW}{\partial \bar{q}} \lesseqgtr 0 \iff \int_{i(R_G)}^{i(R)} (p_B \gamma Y_i^B + p_G(1-\gamma)Y_i^G - c) \lesseqgtr 0$. In particular, for a sufficiently large γ, $\int_{i(R_G)}^{i(R)} (p_B \gamma Y_i^B + p_G(1-\gamma)Y_i^G - c) < 0$, meaning an increase in government credit becomes welfare decreasing.

$\blacksquare$

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.
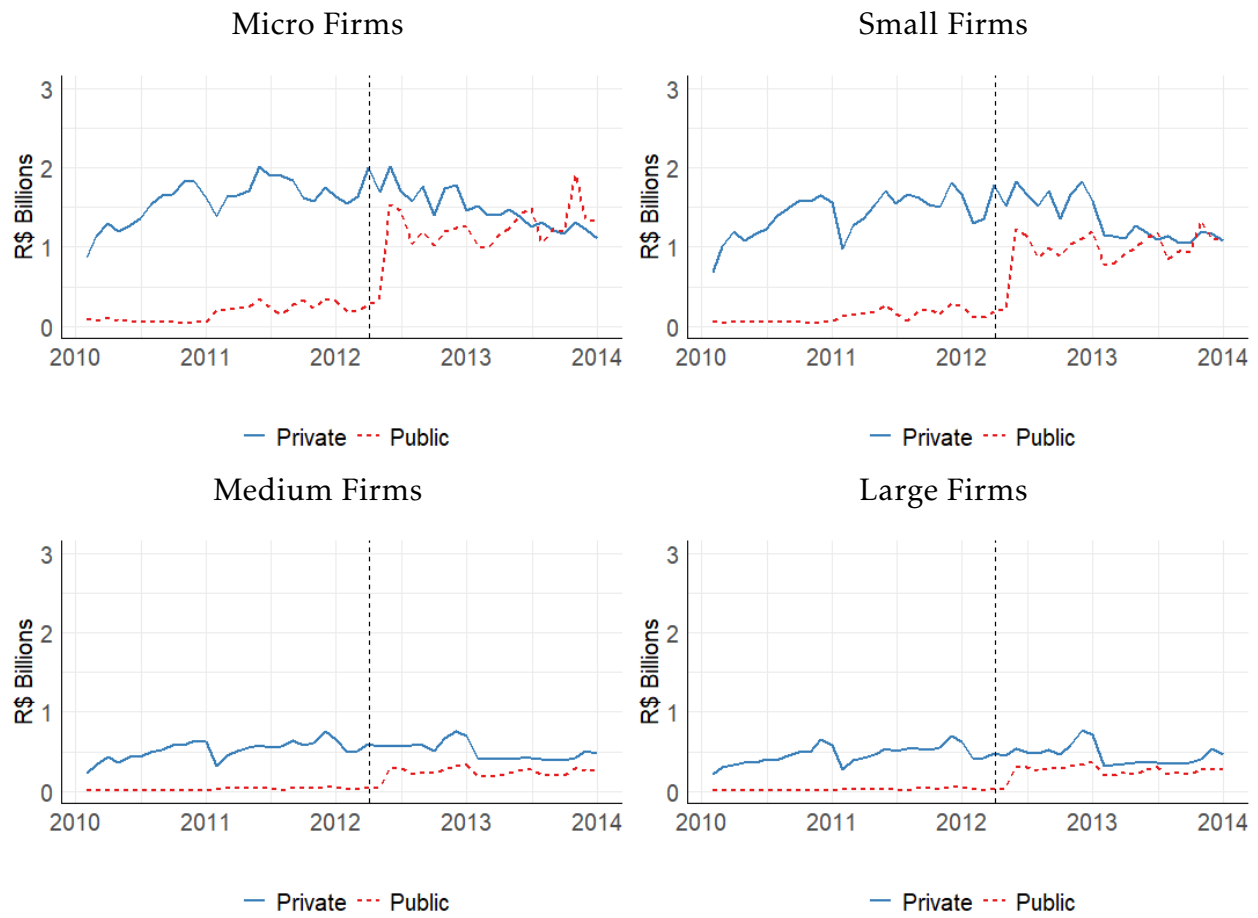
D. Additional Figures

Figure D.1: Bank Entry

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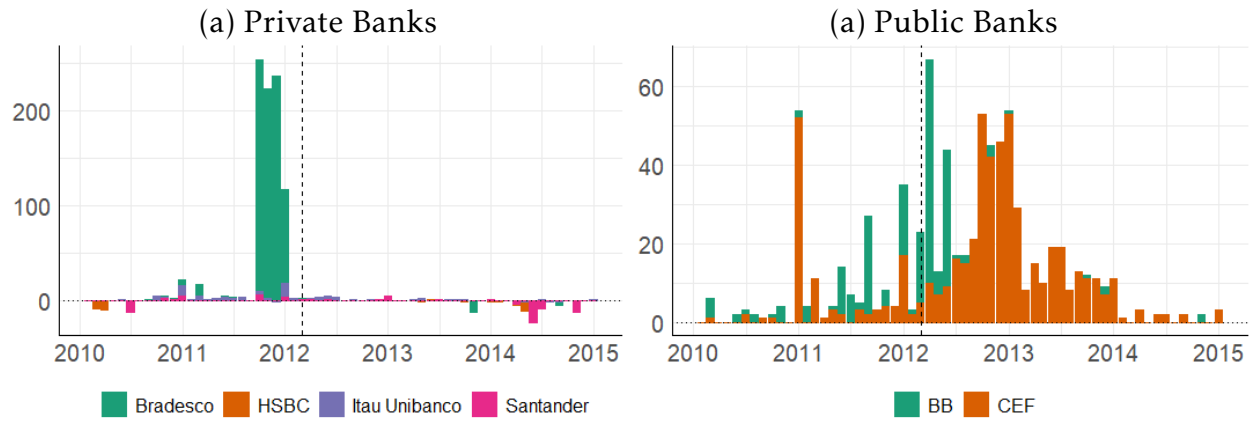
Notes: Entry is defined by a bank opening a branch in location where it had no previous presence. Source: ESTBAN Dataset, available at https://www4.bcb.gov.br/fis/cosif/estban.asp?frame=1

Figure D.2: Total Loan Amount by Firm Size

Micro Firms

Small Firms

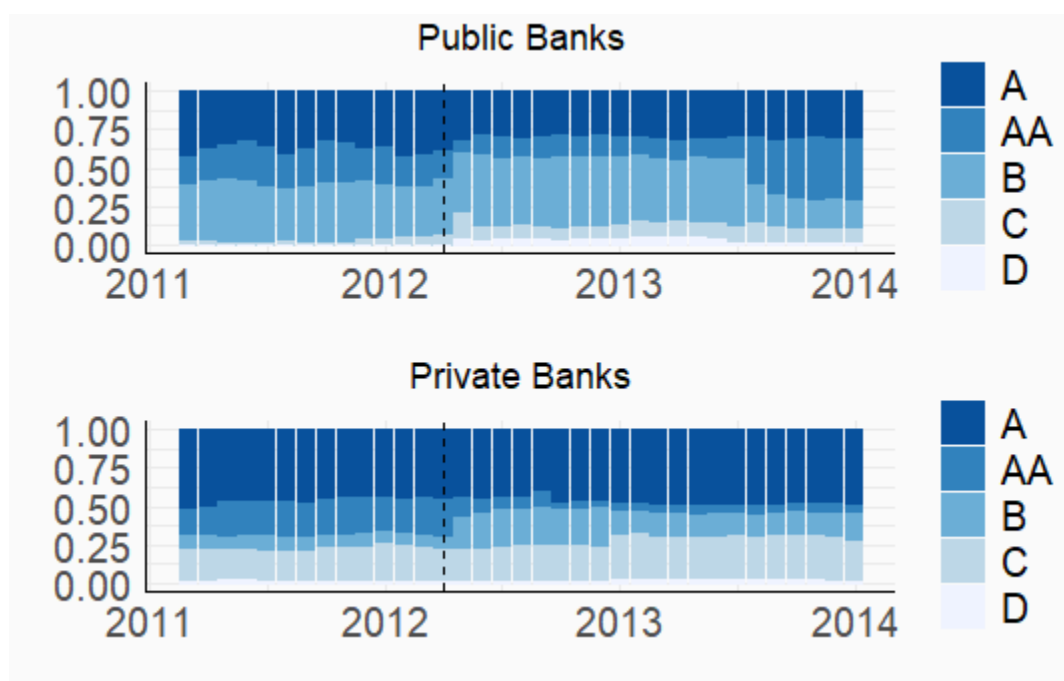### Medium Firms

Large Firms

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

## Figure D.3: Loan Interest Rates by Firm Size
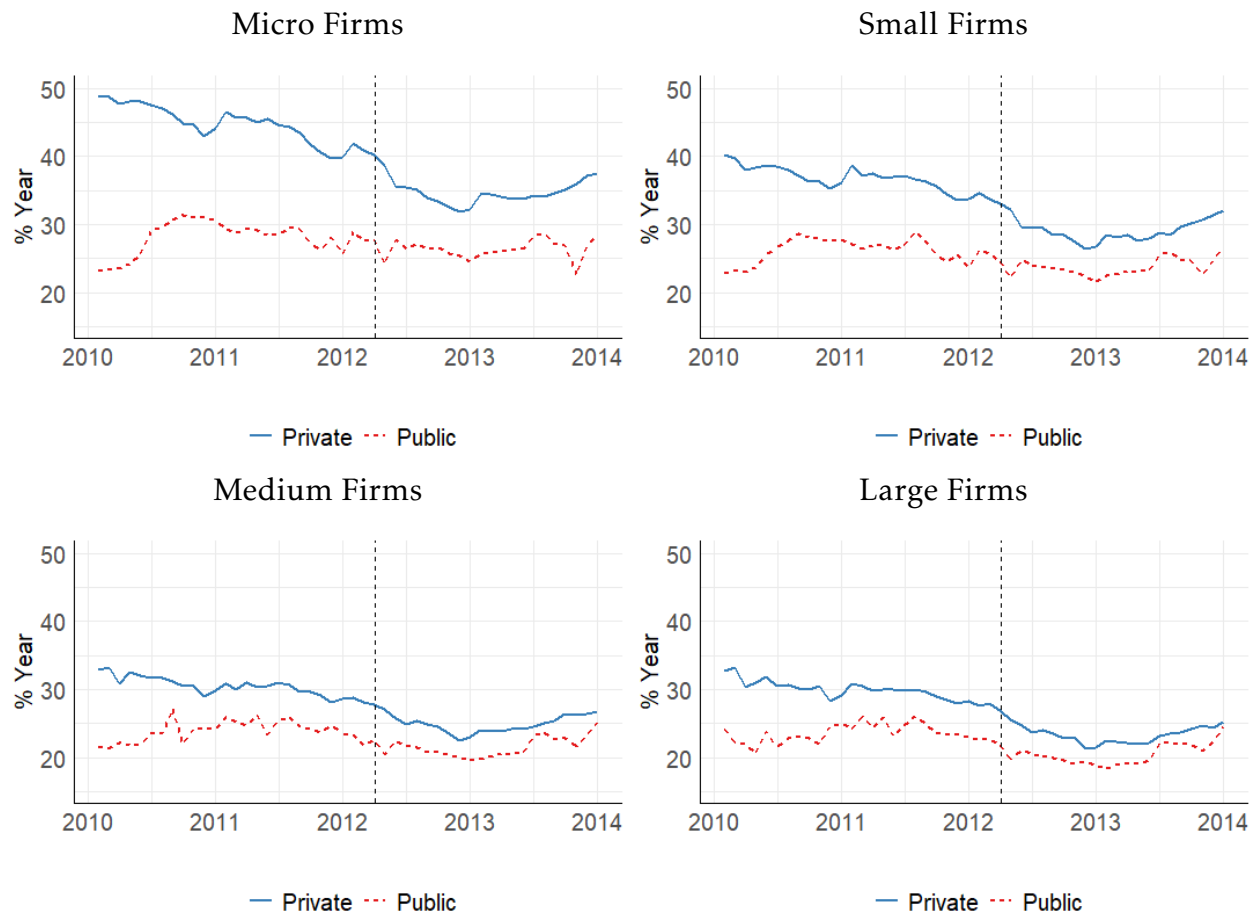
Notes: Average interest rate differences for firms of different size. Source SCR dataset and RAIS dataset.

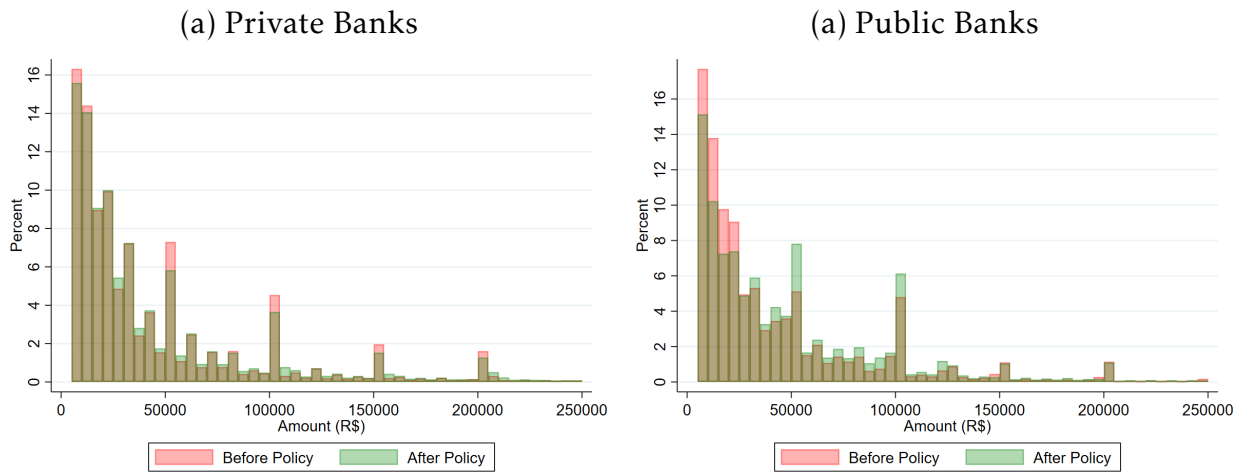Figure D.4: Credit Rating Distribution: Public and Private Banks

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

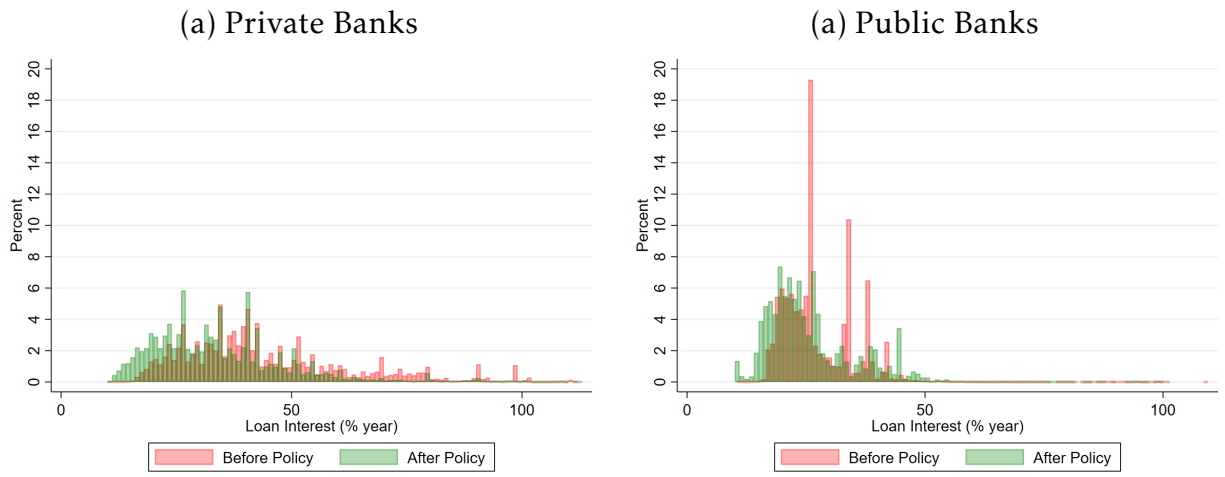# Figure D.5: Loan Maturity Distribution: Public and Private Banks

(a) Private Banks   (a) Public Banks
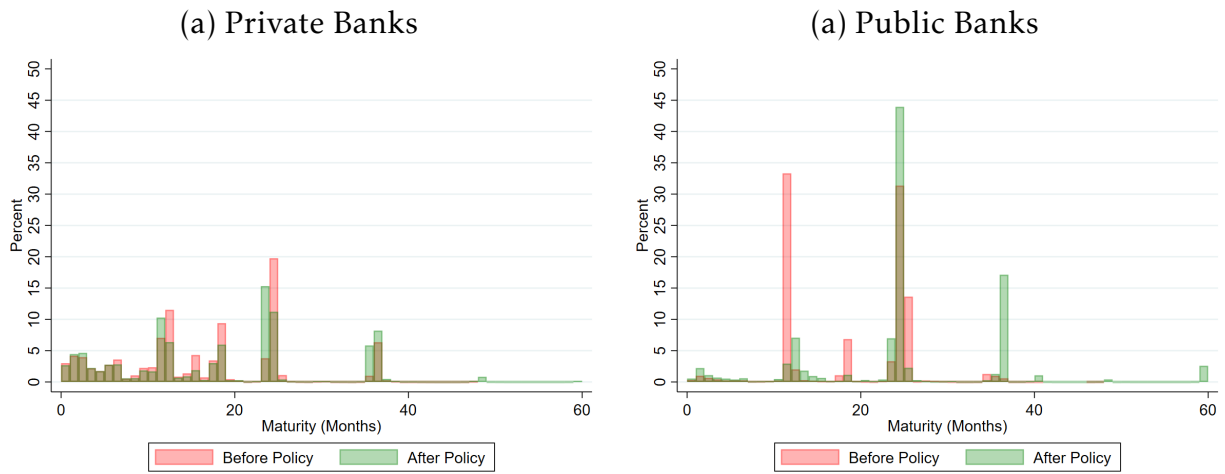
Note: This figure shows the distribution of loan maturity for loans originated by public and private banks. Source: SCR Dataset.

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

(a) Private Banks

(a) Public Banks

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

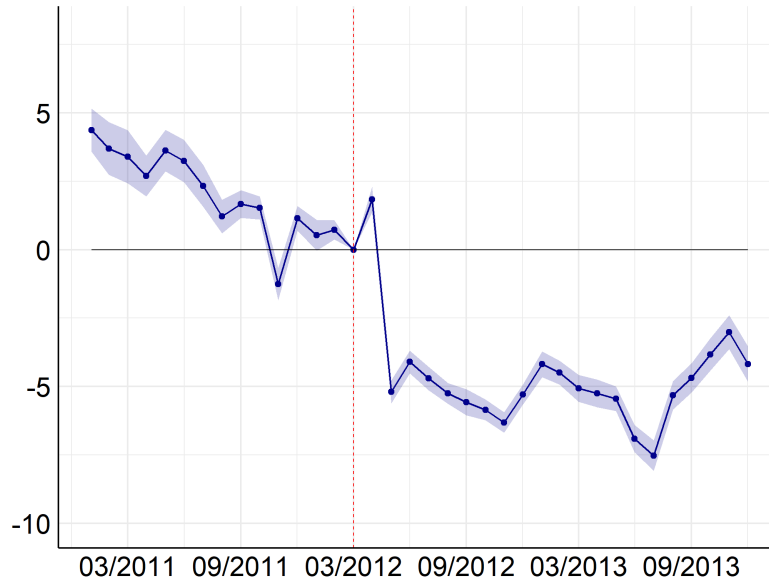# Figure D.7: Loan Interest Rates Distribution: Public and Private Banks

(a) Private Banks

(a) Public Banks

Note: This figure shows the distribution of loan interest rates for loans originated by public and private banks. Source: SCR Dataset.
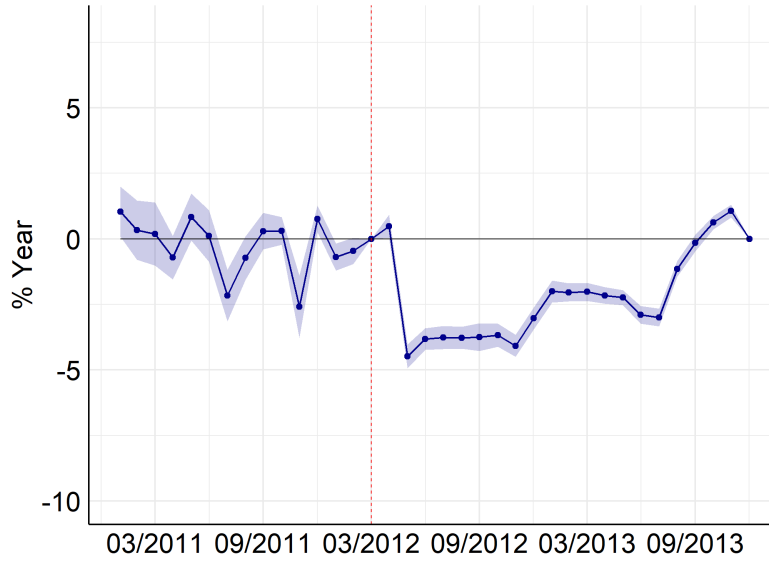
Figure D.8: Differences in Differences - Interest Rates with separated fixed effects

Note: Regression estimates from equation 4 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 D.9: Differences in Differences - Interest Rates with Private Linear Trend

Note: Regression estimates from equation 4 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.

E.   Additional Tables

Table E.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 E.2: Differences in Differences: Interest Rates

	(1)	(2)	(3)
Public	-12.80***		
	(0.186)		
Public × Post	5.131***	7.123***	5.324***
	(0.636)	(0.470)	(0.353)
Time× Ind × Mun FE	✓	✓	✓
Bank FE		✓	✓
Firm FE			✓
Adjusted R^2	0.545	0.528	0.753
Observations	3448110	2640349	2325626

Standard errors in parentheses

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

Notes: Results from a DiD regression using interest rates as the dependent variable. Standard errors clustered at bank level.

Table E.3: Differences in Differences: Borrower 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× Municipality × Industry 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 a difference in differences regression using delinquency as the dependent variable. Standard errors are clustered at the bank-municipality level.

Table E.4: 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.
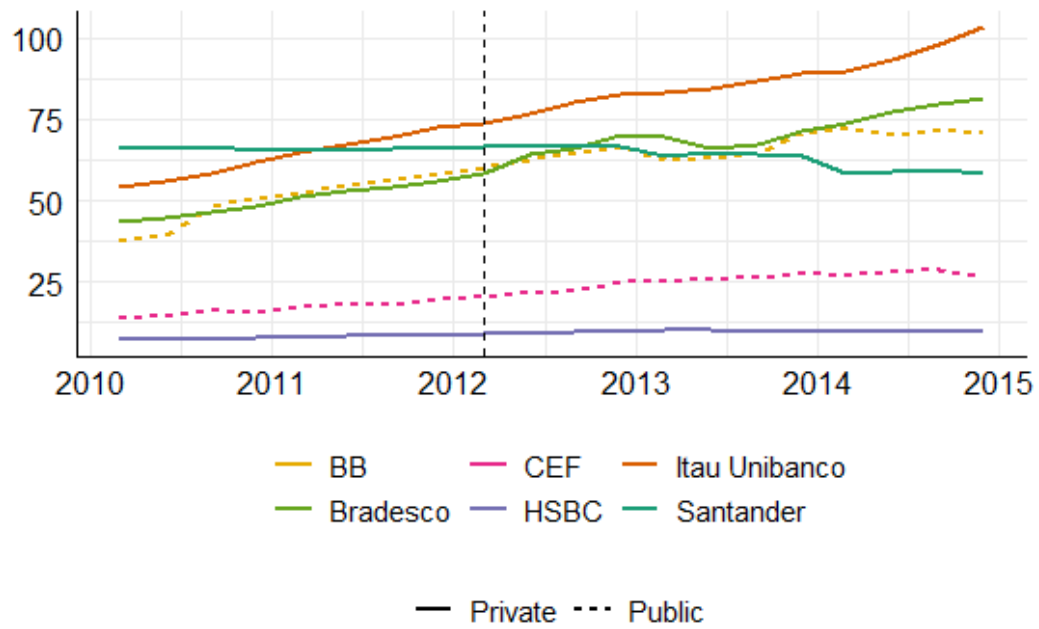
F. Bank Level Analysis

Figure F.1: Total Assets
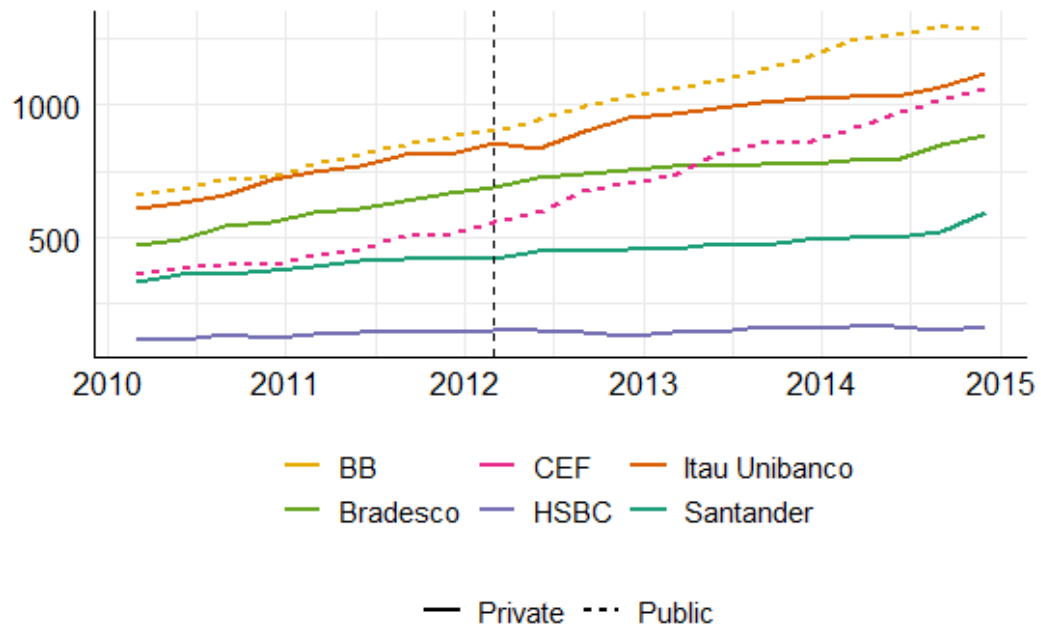
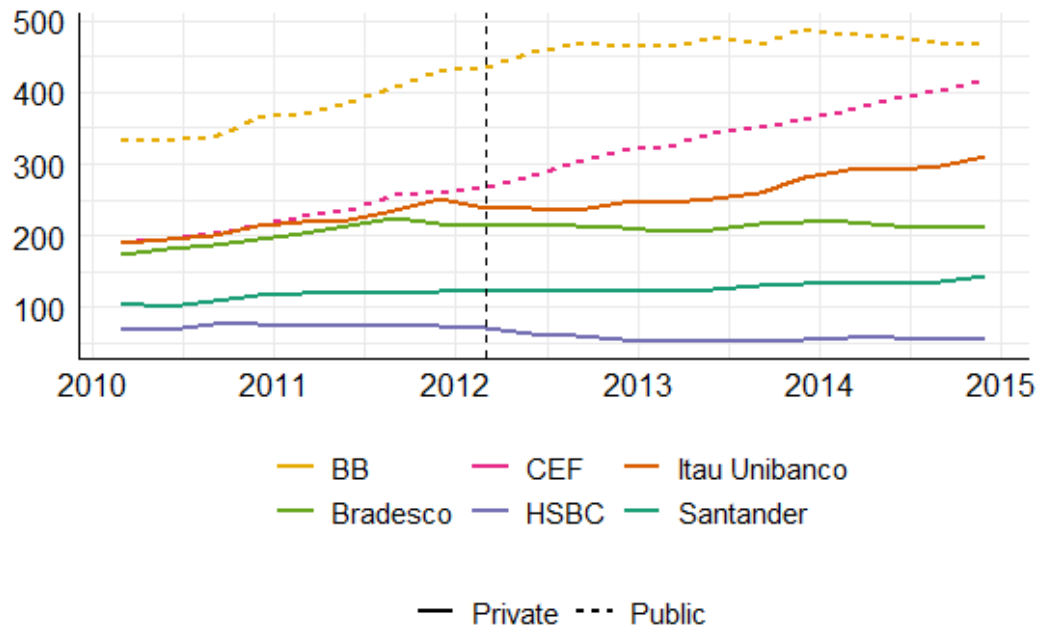**Notes**: Total Bank Assets, including loan portfolio, securities, repo and others. Source: IF Data, available at https://www3.bcb.gov.br/ifdata/

Figure F.2: Equity

Notes: Total Bank Equity. Source: IF Data, available at https://www3.bcb.gov.br/ifdata/
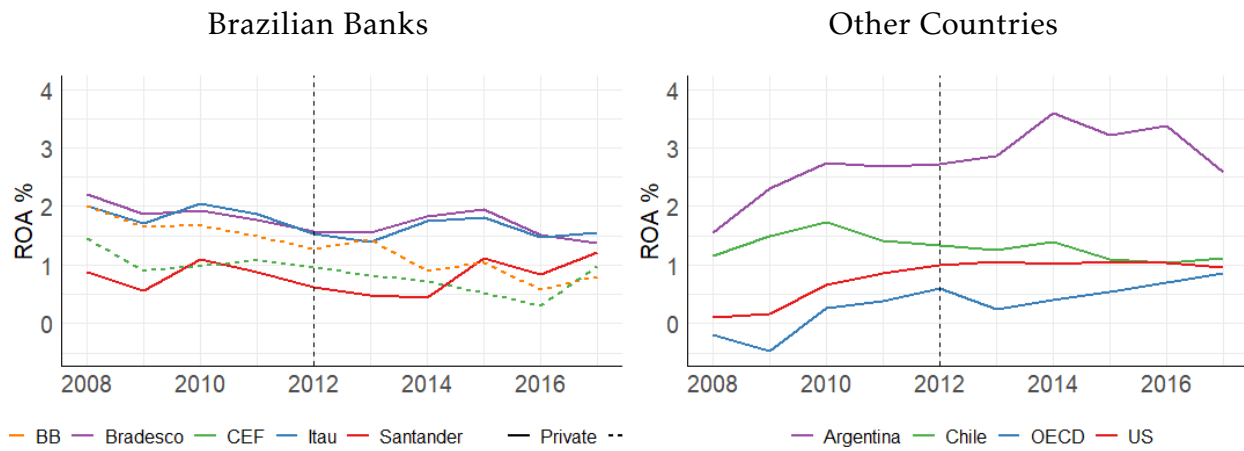
Figure F.3: Total Deposits

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

Figure F.4: Return Over Assets

Brazilian Banks

Other Countries

Notes: Return Over Assets Defined as Net Income divided by Total Assets. Data for plot (a) obtained using IF Data, available at https://www3.bcb.gov.br/ifdata// Data for plot B available at the IMF's Global Financial Development database.