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Edited by Research Department (Depep) – E-mail: workingpaper@bcb.gov.br

Editor: Benjamin Miranda Tabak – E-mail: benjamin.tabak@bcb.gov.br
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Financial Stability and Monetary Policy - The case of Brazil

Benjamin M. Tabak* Marcela T. Laiz† Daniel O. Cajueiro‡

Abstract

This paper investigates the effects of monetary policy over banks' loans growth and non-performing loans for the recent period in Brazil. We contribute to the literature on bank lending and risk taking channel by showing that during periods of loosening/tightening monetary policy, banks increase/decrease their loans. Moreover, our results illustrate that large, well-capitalized and liquid banks absorb better the effects of monetary policy shocks. We also find that low interest rates lead to an increase in credit risk exposure, supporting the existence of a risk-taking channel. Finally, we show that the impact of monetary policy differs across state-owned, foreign and private domestic banks. These results are important for developing and conducting monetary policy.

Key Words: Monetary policy; Loan growth; Non-performing loans; Ownership control.

JEL Classification: E52, E58, G21, G28, G32

*Banco Central do Brasil.

†UNB

‡UNB, INCT

1 Introduction

In 2008, a series of large financial institutions around the world collapsed or failed, resulting in the need for government intervention. The crisis has shown that banking system losses can lead to tightening credit conditions among with economic costs. The financial crisis halted global credit markets, jeopardizing the financial stability of the economy worldwide. Brazil was no exception. However, even though affected by the crisis, Brazil reacted more effectively than other countries because it had less financial vulnerability and counted with proactive regulation and supervision of its financial market. The monetary policy was crucial for the good development of Brazil during the financial crisis. Furthermore, the role of central banks in conducting monetary policy to help equalize the adverse consequences of financial instability on the real sector of the economy was intensified. In this context, this paper intends to discuss the role of monetary policy in creating an environment of financial stability, defined by Schinasi [2004] in terms of its ability to facilitate and enhance economic processes, manage risks, and absorb shocks.

There are two main important views of the relationship between monetary policy and financial stability. The first one affirms that there are synergies in this relationship [Schwart, 1995, Bernanke and Gertler, 1999]. Stable prices create an environment of predictable interest rates, conducting to a lower risk of interest rate mismatches, which reduces, in the long-term, the inflation risk premium and contributes to financial stability [Schwart, 1995]. Therefore, monetary policy should be used to enhance price stability and financial stability [Herrero and Lopez, 2003]. Padoa-Schioppa [2002] and Haugland and Vikoren [2006] agree that there are synergies between price stability and financial stability, but only in the longer term, suggesting that there is no guarantee that monetary policy will be sufficient to prevent financial instability. In this case, a situation of low inflation may conduct to a negative effect on bank's balance sheets [Fisher, 1933, Graeve et al., 2008]. On the other hand, the other view sustains the idea of a trade-off between monetary policy and financial stability [Mishkin, 1997, Graeve et al., 2008]. Graeve et al. [2008] show that an unexpected tightening of monetary policy increases the probability of bank distress. In particular, the effect of monetary policy shocks on financial stability is larger in banks with low capitalization.

Understanding the transmission channels that exist between the financial

and the real sectors of the economy is crucial when analyzing financial stability. This paper brings out the discussion of two channels in Brazil, the bank lending channel and the risk taking channel. It is quite an agreement that the bank lending channel acts through the impact of monetary policy over deposits. According to **?** monetary policy tightening leads to a fall in deposits which induces banks to substitute towards more expensive forms of market funding, contracting loan supply. This happens when banks face frictions in issuing uninsured liabilities to replace the shortfall in deposits. In accordance, after studying more than 600 banks from 32 countries, Nier and Zicchino [2008] verified that tightening/loosing monetary policy is associated with loan decrease/increase. Disyatat [2010], on the other hand, argues that the emphasis on policy-induced changes in deposits is misplaced. A reformulation of the bank lending channel is proposed, in which monetary policy impacts primarily banks' balance sheet strength and risk perception.

Recently, monetary policy and financial stability issues have become very intertwined, which has encouraged studies concerning the bank lending channel. In their pioneering work, Kashyap and Stein [1995] use US banks to attest that under monetary policy tightening, smaller banks reduce a larger amount of loans compared to larger banks. Gambacorta [2005], in contrast, shows in a study of Italy that bank size seems to be irrelevant; small banks are not more sensitive to monetary policy shocks than large banks. Moreover, Kashyap and Stein [2000] and Bayoumi and Melander [2008] affirm that bank's balance sheets have a significant effect on credit availability. Banks with less liquid balance sheet, that is, banks with lower ratios of securities to assets, suffer a stronger impact on lending from monetary policy. **?** studied the US banks and found that during periods of monetary policy tightening banks with less capital reduce loans. In theory, the only banks that raise loan rates substantially in response to an increase in the federal funds are the ones that present a high proportion of relationship loans that are close to a loan-to-core deposit ratio of one [Black et al., 2007].

Altunbas et al. [2002], Francis and Osborne [2009a] and Gambacorta and Mistrulli [2004] found that better capitalized banks experience less pronounced impacts on their lending. This might happen because well-capitalized banks have easier access to non-deposit fund-raising [Gambacorta and Mistrulli, 2004] or because with capital adjustment costs, higher capital requirements reduce a bank's optimal loan growth [Francis and Osborne, 2009a]. The use of securitization also protects bank's loan supply from the effects of monetary policy and additionally increases the grant of loans [Altunbas

et al., 2009a]. However, attention is needed when increasing the lending standards, since it can cause negative effect on lending and on economic activity [Berrospide and Edge, 2008]. Altunbas et al. [2009b] found out that banks with a lower expected default frequency not only can offer a higher amount of credit but also can protect better their loan supply from monetary policy changes.

The financial crisis arose the discussion concerning the existence of a risk taking channel, characterized by changes in banks' risk tolerance due to expansive monetary policy. During the crisis, many central banks reduced interest rates in order to avoid recession. Brazil's interest rates were reduced to historical levels. Altunbas et al. [2009c] show in their work that unusually low interest rates lead to an increase in banks' risk taking. In particular, this effect is more pronounced in the medium term due to higher collateral value and the search for yield [Jimenez et al., 2007]. Moreover, Ioannidou et al. [2009] analyze Bolivia between 1999 and 2003 in the context of a quasi-natural experiment and found that during periods of low interest rates, banks not only increase risky loans but also reduce the rates charged to riskier borrowers. In addition, larger banks, with less capital and more liquid assets take on more risk when interest rates are lower. In a further work, **?** show the effect of deposit insurance on risk-taking, revealing that banks present a higher probability of initiating riskier loans in the post-deposit insurance period. Nevertheless, the raise in risk-taking is a result of the decrease in market discipline from large depositors. In light of these recent developments, the liquidity channel is important for determining banks' ability to extend credit. The literature attests that the propagation of funding liquidity shocks to bank lending is due to high leverage ratios, large maturity mismatches in banks balance sheet [Brunnermeier and Pedersen, 2007] and mark-to-market accounting [Cifuentes et al., 2005].

However, there is a scarce number of studies relating to developing countries. This paper intends to contribute to the literature by analyzing the case of Brazil, a developing economy. In this concern, Francis and Osborne [2009b] have shown that emerging market authorities have retained significant monetary control after the recent liberalization of financial markets. However, local monetary policy does not have a significant effect on emerging stock markets. In particular, Gunji and Yuan [2010] studied the case of China, suggesting that larger banks, banks with lower levels of liquidity and profitable banks suffer a less pronounced effect of monetary policy over their lending activity.

We report banks's specific characteristics and ownership control in order to verify if there is a bank lending and risk taking channel operating in Brazil. **?** affirm that for a good comprehension of Latin American banks performance it is necessary to evaluate the degree of capitalization and the banks' size. Those characteristics were included in our study, along with liquidity. Additionally, we show that monetary policy has different effects on banks with different ownership. This may be due to the fact that state-owned, foreign and private domestic banks have different goals and strategies and may have different funding sources, either domestically or abroad. Recent research has found that banks with different ownership may have different bank technology and efficiency [Staub et al., 2010]. Therefore, the empirical evidence presented in this paper is in line with a different impact to monetary policy for state-owned, foreign and private domestic banks.

Our sample consists of a high frequency panel data, with 5183 observations for the period 2003-2009. The main results of our study are as follows. First, we show the existence of a bank lending channel by showing that during periods of monetary tightening/loosing, banks have their loans decreased/increased. Moreover, larger, well capitalized and liquid banks expand more their loan portfolio. We show that the financial crisis has had a large impact on lending activity. We find that state-owned banks seem to respond more to monetary policy changes than foreign and private banks. Second, by analyzing the impacts of monetary policy over non-performing loans, we find that during periods of interest rates increase/decrease, banks present a higher/lower growth rate of NPL, which may aggravate/alleviate their performance. In addition, state-owned banks have a different lending profile, since they present a lower amount of non-performing loans. Finally, our results also support the existence of a risk taking channel, in which lower monetary policy rates increase the banks' risk-taking. During periods of low interest rates, large and liquid banks increase their credit risk exposure.

These findings should be taken into account when managing monetary policy. Policymakers must be aware of the possible implication of their actions on banks' incentives. And, more precisely, attention should be paid during periods of unusually low interest rates which may signal an increase in risk-taking. Therefore, central banks should have caution when conducting monetary policy. The benefits of the central bank independence are quite a consensus not only for aiming price stability but also for maintaining financial stability [Shiratsuka, 2001, Herrero and Lopez, 2003, Klomp and Haan, 2009, Smaghi, 2008]. However, Greenspan [2005] recommends that monetary

policy should only be used as a reactive instrument to alleviate the effects of a financial crisis and not as an instrument to prevent it.

The remainder of the paper is structured as follows. Section 2 describes the empirical methodology adopted. Section 3 presents the data. Section 4 describes the empirical results. Finally, section 5 concludes our work.

2 A Brief Review of the Brazilian Banking System

The Brazilian banking system consists of state-owned, foreign and private domestic banks. However, there are several differences among asset structures of the various banking segments. State-owned banks, with the exception of the National Bank of Economic and Social Development (BNDES), had the lowest proportion of assets invested in loan operations in 2007. Meanwhile, these banks also had the largest volume of Stocks and Securities (TVMs). Since 2004, investments of state-owned banks were in a certain way concentrated in TVM, particularly in papers held to maturity. This is due to high interest rates and large profits that stem from these operations with low risk. Private banks, on the other hand, are characterized by presenting the largest volume of interbank liquidity investments, accompanying the tendency of making greater use of funding through repo operations and permanent assets, due to investments in stockholding positions. Foreign institutions, in the recent period, presented a greater use of other common assets, particularly derivatives. This could be due to hedging purposes as some of these institutions are specialized in intermediating external funding operations for domestic clients in Brazil.

In 2008 state-owned banks had the highest margin requirements compared to other institutions. In the first semester of 2008, the Required Base Capital (PRE) of private domestic banks and foreign banks were, respectively, 15.2% and 11.7%, while state-owned banks led the way with 18.2%. Compared to private banks, the difference in the pace of growth of state-owned banks is illustrated mainly by the reduction in the representativeness of state-owned banks in Total Consolidated Assets, which dropped to 33.9% in 2008 [§].

The credit expansion has made the monitoring of default and capitalization levels of financial institutions become more important. The level of

[§]Brazilian Central Bank Financial Stability Report - 2008, 2009

default dropped from 6.9% in 2003 to 3.2% in 2007. Despite the reduction in leverage, state-owned banks continued making intensive use of third-party capital, especially through subordinate debt. Credit assigns[¶] have been another important source of financing, particularly to smaller scale banks. In the recent period, private banks have hold the largest volume of liabilities for repo operations. Foreign banks have made greater utilization of time deposits and liabilities for loans and on lending operations, as state-owned banks have become known for saving deposits.

Since 2003, the participation in credit operations by state-owned banks has been increasing. In December of 2003, the participation of state-owned banks grew on 9%, while the participation of national private banks and foreign banks grew on 6.6% and 4%, respectively. In 2010, state-owned banks were ahead of private banks in lending activity, representing 41.7% of total credit in the financial system. Private banks were responsible for 40.5%, due to an increase in non-earmarked lending to individuals and corporations, while foreign banks represented 17.8% of the financial system. Moreover, state-owned banks led the way in credit with earmarked resources; these banks have increased 52.9% in credit to housing and 32.4% in credit to individuals compared to the same period in 2009.

The Brazilian economy was negatively affected by the worsening of the world economic crisis since September 2008, after the failure of Lehmam Brothers. Financing conditions for firms and banks deteriorated and only began to improve in the second semester of 2009. The government implemented monetary, fiscal and credit stimuli through 2009 to help accelerate the recovery of the economy. In particular, a quantitative easing was undertaken by the central bank due to a cool off of inflation pressures in light of the large contraction of domestic demand. This quantitative easing has helped to normalize credit conditions.

With the disorder triggered by the mortgage market crisis, national financial market indicators presented some kind of resilience. As a result, investors were favorable on bringing their money to Brazil, a distinguished emerging economy. However, domestic indicators became more volatile, especially in what concerns interest rates and stock markets. The growing dynamics of domestic demand presented significant increases in investment levels and in expanding household consumption. Although credit supply (% GDP) has

[¶]joint liabilities assumed in assigns, securitization of credit or negotiation of certificates or bank credit to corporate financial entities and individuals.

reached high historical levels in the recent past, it is still relatively low if compared to other countries. The considerable confidence of consumers and Brazilian businessmen in the market led to an increasing in the average maturity of loans, which can be used as a proxy for measuring risk. Consequently, credit growth in Brazil has in no way jeopardized financial system solidity. As a matter of fact, at the end of 2008, there was a continuous credit expansion, with low default level and a consistently greater level of provisions than any expected losses.

The Brazilian Central Bank (BCB) has adopted some measures in order to avoid the crisis and solve the liquidity problem. During the second semester of 2008, there have been several auctions of dollars with the attempt to buy it back in the future, as well as auctions of loan reserve and currency swap contracts. Those sells represent signs of liquidity supply in the short-term. Additionally, the resources allow banks to finance Brazilian exports. The BCB not only released R$ 13,2 billions to the financial market as additional compulsory as well as changed several rules of the compulsory reserve. The measures were applied to preserve the national financial system from the liquidity restriction effects that have been observed in the international financial system. By the end of October, there was a currency trade agreement between BCB and FED in the value of US$ 30 billions. In order to assure liquidity in the national market, BCB released compulsory reserves, changed several rules in rediscount operations and in the Credit Guarantee Fund (FGC). By the end of 2008, the credit rules were softened and there was a reduction of the tax on financial transactions (IOF). In order to maintain credit expansion, in the beginning of 2009 it was implemented an employment guarantee, a housing plan and a tax waiver package in the attempt of preventing Brazil from falling into recession. Those measures made it possible to alleviate the liquidity problem as well as enhanced the credit activity.

We test for the impacts of monetary policy over state-owned, foreign and private domestic banks. Since they present different characteristics and different strategies, we expect to find different reactions to interest rates changes from each bank segment in what concerns lending and credit risk exposure. These results are important to assess the different impacts of monetary policy on the banking system.

3 Methodology

The empirical specification is designed to test the relationship between monetary policy and financial stability. We search for evidences that suggest the existence of a bank lending channel and a risk taking channel in Brazil. We also shed light on the different impacts of monetary policy over state-owned, foreign and private banks. To do so, we test the impact of monetary policy over loan growth, NPL and a credit risk exposure measure. We employ the Feasible Generalized Least Squares (FGLS) estimation to test our hypothesis, in which there is first-order correlation within units as well as correlation and heteroscedasticity across units. The Modified Wald test is presented in order to attest if the model is well specified, as proposes **?**.

It is worth mentioning that most of our regressions are based on dynamic panel data model specifications. We also know that dynamical panels with small time dimension estimated using FGLS may be severely biased. However, since both the number of banks and the size of the sample are long, in our case, this bias may be neglected [**?**]. Avoiding the usual procedure based on difference and system generalized method of moments (some variation of the Arellano and Bond [1991] estimator), we also circumvent the problem of too many instruments [**?**] that could arise in our study due to the large sample period.

It is difficult to separate and distinguish supply from demand factors using aggregate data. Empirically, it is not clear to attest whether the effects of banks conditions are affecting the demand or the supply side. In order to solve this identification problem we include in our specification the industrial production to control for aggregate loan demand, as suggests Nier and Zicchino [2008]. This variable enables to account for differences in the time profile of loan demand as well as relieve identification of bank loan supply. Considering the supply side, Kashyap and Stein [2000] propose to examine lending behavior at the individual bank level. That is why we have incorporated variables for bank-specific characteristics, such as size, capitalization and liquidity.

3.1 Bank Lending Channel

The bank lending channel acts through the impact of monetary policy over deposits, and therefore lending. During monetary tightening deposits fall, forcing banks to opt for more expensive forms of market funding, contracting

loan supply [Disyatat, 2010]. Changes in deposits are seen to drive bank loans. The opposite is also valid, when interest rates decrease, both deposits and lending increase [Altunbas et al., 2009c].

We test if there is a bank lending channel in Brazil by analyzing the relationship between monetary policy changes and loan growth. **?** sustain that there are two bank's specific factors that are particularly important in explaining Latin American banks performance: the degree of capitalization and banks' size. We include these variables in our specification, along with liquidity. Moreover, we test interactions of loans with bank's specific characteristics (Size, Capitalization and Liquidity) in order to verify if they are in accordance with the bank lending channel literature. In addition, we test the different reactions of state-owned, foreign and private domestic banks to interest rates (Selic) changes. In order to verify this relation we include two dummies: $State - Owned$ and $Foreign$. They represent, respectively, state-owned banks and foreign banks. We expected to find different effects. State-owned and foreign banks differ in several ways. Staub et al. [2010] show that foreign banks have improved their performance in what concerns the establishment of new affiliates and the acquisition of local banks. On the other hand, despite having improved cost efficiency, state-owned banks are profit inefficient.

We take into consideration in our empirical analysis the impact of the 2008 financial crisis. The Brazilian economy was negatively affected by the worsening of the world economic crisis since September 2008, after the failure of Lehmam Brothers. In order to capture this effect we introduce a dummy crisis, $Crisis$. Moreover, we test if the the bank lending channel is more pronounced during the crisis period by adding some interactions with $Crisis$.

The benchmark equation is presented as follows:

$$\begin{aligned}
\Delta Loans_{it} &= \alpha \Delta Loans_{i,t-1} + \beta Size_{i,t-1} + \gamma Cap_{i,t-1} + \delta Liq_{t-1} \\
&+ \psi \Delta IP_{t-1} + \varphi \Delta Selic_{t-1} + \tau Ownership_{i,t} \\
&+ \rho \Delta Selic_{t-1} * Ownership_{i,t} + \varrho Size_{i,t-1} * \Delta Selic_{t-1} \\
&+ \upsilon Cap_{i,t-1} * \Delta Selic_{t-1} + \varsigma Liq_{i,t-1} * \Delta Selic_{t-1} \\
&+ \zeta Size_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} \\
&+ \chi Cap_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} \\
&+ \vartheta Liq_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} + \kappa Crisis_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{1}$$

where $\Delta Loans$ is the variation of bank's loan growth of bank i, $Size$ is the

log of the total assets of bank i at time $t-1$, *Cap* stands for capitalization, measured by the equity ratio over assets, *Liq* represents liquidity and is measured by deposits over loans, $\Delta Selic$ is the Banco Central do Brasil's overnight lending yoy (year over year), $DummyOwnership$ represents the dummies for $State - Owned$ and $Foreign$ banks, $Crisis_{i,t}$ is the dummy for crisis period that starts in September of 2008, and $\varepsilon_{i,t}$ is the error. All variables are presented in natural logarithm.

We also estimate the growth rate of loans in periods of monetary contraction and expansion using two dummies Up and $Down$. They represent, respectively, upward and downward movements in the Selic interest rates. We interact these dummies with banks' characteristics (size, capitalization and liquidity), ownership control, and the dummy for crisis. We verify wether the loan growth supply differs for these banks for different periods in the monetary cycle. The specification to be tested is given by:

$$\begin{aligned}
\Delta Loans_{it} &= \alpha \Delta Loans_{i,t-1} + \beta Size_{i,t-1} + \gamma Cap_{i,t-1} + \delta Liq_{t-1} \\
&+ \psi \Delta IP_{t-1} + \varphi Dummy_{t-1} + \tau Ownership_{i,t} \\
&+ \rho Dummy_{t-1} * Ownership_{i,t} + \varrho Size_{i,t-1} * Dummy_{t-1} \\
&+ \upsilon Cap_{i,t-1} * Dummy_{t-1} + \varsigma Liq_{i,t-1} * Dummy_{t-1} \\
&+ \zeta Size_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} \\
&+ \chi Cap_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} \\
&+ \vartheta Liq_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} + \kappa Crisis_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{2}$$

where *Dummy* represents the monetary policy dummies. We expect the Up coefficient to be negative, i.e., when interest rates increase, banks reduce their lending activity. On the other hand, the *Down* coefficient is expected to be positive, i.e., decreases in the interest rates lead to increases in bank's lending activity. Furthermore, we expect the coefficients for Size, Capitalization and Liquidity to be positive, in accordance with the bank lending channel literature.

In order to verify the consistence of our results, we test the same regression of Equation (1) and (2) but now using the mean of the independent variables for each year. Therefore we can analyze the effects of monetary policy over the year and compare with the results for each month observation.

3.2 Risk-Taking Channel

3.2.1 Non-Performing Loans

We also analyze the effects of monetary policy on non-performing loans (NPL). Ideally, we would like to employ market-risk based indicators for banks risk. However, such database is not available for a long time period and a large sample of banks. Therefore, we employ accounting-based risk measures. A few authors [Altunbas et al., 2009b,c,a] have used the EDF as a measure of risk-taking. An underlying assumption in the use of this variable is that changes in EDF reflect a change in the bank risk taking, which may not hold. Specially in crisis periods. If a major global shock hits the economy we should expect these EDF measures to reflect an increase in risk-taking in accordance to investors expectations which may or may not reflect the true banks risk taking. In Brazil, traditionally banks invest in safe fixed income securities (TVM) with low risk such as government bonds, which pay a high interest rate and perform credit operations. An increase in their risk-taking can be capture by measuring the higher proportion of loans of total assets they hold. Therefore, we believe that this variable may capture better the Brazilian banks risk taking.

We also used the ownership control in order to test whether the effects of monetary policy differs for these banks. We include the $State - Owned$ and $Foreign$ dummies in order to verify which bank has a higher credit exposure. Again, we expect the effects not to be the same due to different strategies that these banks present. Once more, the bank's specific characteristics were included as well as the dummy for $Crisis$. The benchmark equation is presented as follows:

$$\begin{aligned}
\Delta NPL_{it} &= \alpha \Delta NPL_{i,t-1} + \beta Size_{i,t-1} + \gamma Cap_{i,t-1} + \delta Liq_{t-1} \\
&+ \psi \Delta IP_{t-1} + \varphi \Delta Selic_{t-1} + \tau Ownership_{i,t} \\
&+ \rho \Delta Selic_{t-1} * Ownership_{i,t} + \varrho Size_{i,t-1} * \Delta Selic_{t-1} \\
&+ \upsilon Cap_{i,t-1} * \Delta Selic_{t-1} + \varsigma Liq_{i,t-1} * \Delta Selic_{t-1} \\
&+ \zeta Size_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} \\
&+ \chi Cap_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} \\
&+ \vartheta Liq_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} + \kappa Crisis_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{3}$$

where ΔNPL is the variation of bank's Non-performing loans divided by Loans of bank i at time t.

We test how monetary policy changes affect the non-performing loans (NPL) by introducing monetary policy dummies (Up and $Down$). We want to check if banks increase/decrease their exposure in accordance with the direction of monetary policy. The equation is represented as follows:

$$\begin{aligned}
\Delta NPL_{it} &= \alpha \Delta NPL_{i,t-1} + \beta Size_{i,t-1} + \gamma Cap_{i,t-1} + \delta Liq_{t-1} \\
&+ \psi \Delta IP_{t-1} + \varphi Dummy_{t-1} + \tau Ownership_{i,t} \\
&+ \rho Dummy_{t-1} * Ownership_{i,t} + \varrho Size_{i,t-1} * Dummy_{t-1} \\
&+ \upsilon Cap_{i,t-1} * Dummy_{t-1} + \varsigma Liq_{i,t-1} * Dummy_{t-1} \\
&+ \zeta Size_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} \\
&+ \chi Cap_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} \\
&+ \vartheta Liq_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} + \kappa Crisis_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{4}$$

We expect to find a positive coefficient for the Up dummy, suggesting that when interest rate increase non-performing loans increase. In contrast, we expect to find a negative sign for the $Down$ coefficient, suggesting that when interest rate decrease non-performing loans decrease.

In order to verify the consistence of our results, we test the same regression of Equation (3) and (4) but now using the mean of the independent variables for each year. Therefore we can analyze the effects of monetary policy over the year and compare with the results for each month observation.

3.2.2 Credit Risk Exposure

During the financial crisis, Brazil's interest rates reached low historical values. Altunbas et al. [2009c] show in their work that unusually low interest rates leads to an increase in banks' risk taking. Moreover, this effect is more pronounced in medium term due to higher collateral value and the search for yield [Jimenez et al., 2007]. This period of low interest rates may encourage banks to soften their lending standards and increase the participation of risky new loans [Jimenez et al., 2007]. Ioannidou et al. [2009] shows that during periods of low interest rates, banks not only increase risky loans but also reduce the rates charged to riskier borrowers. In addition, larger banks, with less capital and more liquid assets take on more risk when interest rates are lower. Our paper brings more discussion to this issue by including the interaction between Size and Selic in order to test whether small or large

banks are the ones that present a higher credit risk exposure. In addition, we reveal the role of the ownership control. Although the participation of foreign banks has been increasing, the share of state-owned banks is high [Staub et al., 2010]. The benchmark equation is presented as follows:

$$\begin{aligned}
\Delta Risk_{it} &= \alpha \Delta Risk_{i,t-1} + \beta Size_{i,t-1} + \gamma Cap_{i,t-1} + \delta Liq_{t-1} \\
&+ \psi \Delta IP_{t-1} + \varphi \Delta Selic_{t-1} + \tau Ownership_{i,t} \\
&+ \rho \Delta Selic_{t-1} * Ownership_{i,t} + \varrho Size_{i,t-1} * \Delta Selic_{t-1} \\
&+ \upsilon Cap_{i,t-1} * \Delta Selic_{t-1} + \varsigma Liq_{i,t-1} * \Delta Selic_{t-1} \\
&+ \zeta Size_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} \\
&+ \chi Cap_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} \\
&+ \vartheta Liq_{i,t-1} * \Delta Selic_{t-1} * Crisis_{i,t} + \kappa Crisis_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{5}$$

where $\Delta Risk$ is the ratio between total Loans and total Assets of bank i at time t.

We want to test the effects of monetary policy changes on credit risk exposure, in order to analyze if there is a risk taking channel acting in Brazil's economy. If there is a risk taking channel, low interest rates will induce to a higher risk exposure, increasing loans. To test our hypothesis we include the monetary policy dummies (Up and $Down$). The equation is determined as:

$$\begin{aligned}
\Delta Risk_{it} &= \alpha \Delta Risk_{i,t-1} + \beta Size_{i,t-1} + \gamma Cap_{i,t-1} + \delta Liq_{t-1} \\
&+ \psi \Delta IP_{t-1} + \varphi Dummy_{t-1} + \tau Ownership_{i,t} \\
&+ \rho Dummy_{t-1} * Ownership_{i,t} + \varrho Size_{i,t-1} * Dummy_{t-1} \\
&+ \upsilon Cap_{i,t-1} * Dummy_{t-1} + \varsigma Liq_{i,t-1} * Dummy_{t-1} \\
&+ \zeta Size_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} \\
&+ \chi Cap_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} \\
&+ \vartheta Liq_{i,t-1} * Dummy_{t-1} * Crisis_{i,t} + \kappa Crisis_{i,t} + \varepsilon_{i,t}
\end{aligned} \tag{6}$$

We expect the ψ coefficient to be positive when the dummy $Down$ is included, since it implies that decreases in interest rates increase credit risk exposure. In addition, we expect to find a significant coefficient of the interactions between Selic and banks' specific characteristics.

Finally, we introduce another measure of bank risk, the Z-score, which has been widely used in the recent literature [**???**]. We constructed the Z-score

as the sum of the mean of return on assets and the mean of equity-ratio divided by the standard deviation of the return on assets. We apply the natural logarithm to the Z-score, since it is highly skewed. This measure represents the number of standard deviations that a banks rate of return of assets has to fall for the bank to become insolvent [**?**]. In other words, the Z-score measures the distance from insolvency [**?**]. Therefore, the Z-score is represented as the inverse of the probability of insolvency. A higher Z-score suggests a lower probability of bank insolvency.

The specification is presented as follows:

$$\begin{aligned} \textit{Z-score}_{it} &= \alpha \Delta \textit{Z-score}_{i,t-1} + \beta \textit{Size}_{i,t-1} + \gamma \textit{Cap}_{i,t-1} + \delta \textit{Liq}_{t-1} \\ &+ \psi \Delta \textit{IP}_{t-1} + \varphi \Delta \textit{Selic}_{t-1} + \tau \textit{Ownership}_{i,t} \\ &+ \rho \Delta \textit{Selic}_{t-1} * \textit{Ownership}_{i,t} + \varrho \textit{Size}_{i,t-1} * \Delta \textit{Selic}_{t-1} \\ &+ \upsilon \textit{Cap}_{i,t-1} * \Delta \textit{Selic}_{t-1} + \varsigma \textit{Liq}_{i,t-1} * \Delta \textit{Selic}_{t-1} \\ &+ \zeta \textit{Size}_{i,t-1} * \Delta \textit{Selic}_{t-1} * \textit{Crisis}_{i,t} \\ &+ \chi \textit{Cap}_{i,t-1} * \Delta \textit{Selic}_{t-1} * \textit{Crisis}_{i,t} \\ &+ \vartheta \textit{Liq}_{i,t-1} * \Delta \textit{Selic}_{t-1} * \textit{Crisis}_{i,t} + \kappa \textit{Crisis}_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{7}$$

where $\Delta z\text{-}score$ is the natural logarithm of the z-score measure of bank i at time t.

We estimate the regression using monetary policy dummies for additional results. We want to verify whether the effect of monetary policy changes, represented by the dummies Up and $Down$, are statistically significant and whether the coefficient is positive or negative. The specification to be tested is:

$$\begin{aligned} \textit{Z-score}_{it} &= \alpha \Delta \textit{Z-score}_{i,t-1} + \beta \textit{Size}_{i,t-1} + \gamma \textit{Cap}_{i,t-1} + \delta \textit{Liq}_{t-1} \\ &+ \psi \Delta \textit{IP}_{t-1} + \varphi \textit{Dummy}_{t-1} + \tau \textit{Ownership}_{i,t} \\ &+ \rho \textit{Dummy}_{t-1} * \textit{Ownership}_{i,t} + \varrho \textit{Size}_{i,t-1} * \textit{Dummy}_{t-1} \\ &+ \upsilon \textit{Cap}_{i,t-1} * \textit{Dummy}_{t-1} + \varsigma \textit{Liq}_{i,t-1} * \textit{Dummy}_{t-1} \\ &+ \zeta \textit{Size}_{i,t-1} * \textit{Dummy}_{t-1} * \textit{Crisis}_{i,t} \\ &+ \chi \textit{Cap}_{i,t-1} * \textit{Dummy}_{t-1} * \textit{Crisis}_{i,t} \\ &+ \vartheta \textit{Liq}_{i,t-1} * \textit{Dummy}_{t-1} * \textit{Crisis}_{i,t} + \kappa \textit{Crisis}_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{8}$$

We expect the coefficient of dummy Up to be negative, indicating that the effect of monetary policy tightening on bank risk taking is positive. On the

other hand, we expect the result to be inverse when considering the dummy *Down*.

4 Data

We collect data from monthly reports that banks have to present to the Central Bank of Brazil, which provides information on financial statements for financial institutions. We use a sample consisting of an unbalanced panel with 5183 observations. We identify 99 banks for which income statements and balance sheets detailed data are provided from January 2003 to February 2009. We focus on commercial banks that engage in loan operations.

We use data from bank consolidated accounts (bank conglomerates) and from unconsolidated accounts for individual banks. If banks merge or are acquired we use consolidated data for the acquiring bank and the acquired bank is not included in the data after that. The bank ownership information is obtained from the Brazilian Central Bank database.

Table 1 presents the summary statistics for the variables used in the analysis. Loans correspond to the annual growth rate of lending in Brazilian banks. Non Performing Loans are loans that are in default or close to being in default [‖]. NPL are the ratio between the Non Performing Loans and total loans, measured in percentage. Total Assets will be used as a proxy for the size of the banks. Equity over assets ratio will be used as a control variable in the regressions. Selic is the Banco Central do Brasil's overnight lending. We also employ the Z-score, the sum of the mean of return on assets and the mean of equity-ratio divided by the standard deviation of the return on assets.

< Place Table 1 About Here >

The financial crisis of 2008/2009 had a significant impact over Brazilian credit and external accounts. Companies that speculated in the exchange rate derivatives market presented losses, even though, there was no capital flight. The Brazilian economy was able to partially contain the effects of the crisis due to the high international reserves. In addition, the Central Bank was also able to reduce interest rates. However, the damage caused by the turbulence

[‖]They are defined as loans that are past due for 90 days or more, but have not been completely written off

in the Brazilian economy appeared in October, 2008. Companies promoted collective vacations, postponed investments and held off from undertakings. Figure 1 shows Brazilian' credit growth for different financial institutions, revealing that state-owned banks were more sensitive to changes in credit during the financial crisis.

< Place Fig.1 About Here >

In the recent period, Brazilian banks increased their provisions of non-performing loans in order to prevent against the possible effects of the crisis in the US subprime market. Figure 2 presents the non performing loans for state-owned, private and foreign banks. From this figure we can see that the dynamics of NPLs is heterogenous across bank type.

< Place Fig.2 About Here >

5 Empirical Results

This section presents empirical results for the impacts of monetary policy changes on lending activity in order to sustain the existence of a bank lending channel. Subsequently, we present evidence suggesting that low interest rates increase banks' risk-taking.

5.1 Bank Lending Channel

The results of Equation (1) are summarized in Table 2. The size, the capitalization and the liquidity effect are positive, suggesting that large, well-capitalized and liquid banks in Brazil are more tempted to expand their loan portfolio. We also test the effect of monetary policy changes on loan growth. The response of bank lending to a monetary policy shock is negative. When Selic increases, banks reduce their lending activity. This happens mainly because during monetary tightening banks opt to lend to the government, who pays more, rather than lend to consumers. The higher the Selic, the more expansive is the credit offered to consumers, since there is less money available in the economy. Industrial Production (IP) affects positively loans. A higher level of industrial production increases the loan growth. The interaction between Size/Cap and monetary policy (Selic) have positive sign.

Larger and well-capitalized banks are better able to buffer their lending during monetary policy shocks, which is in line with the bank lending channel literature. Larger banks and well-capitalized banks can mitigate the effect of shocks as they can have access to other funding sources such as interbank lending/borrowing or retail/wholesale funding. Moreover, the effects of these interactions are more pronounced during the crisis period, characterized by the failure of Lehman Brothers.

Column (3) also shows that monetary policy has different effects over state-owned, foreign and private domestic banks. State-owned banks are the ones more affected by monetary policy changes. One explanation could be that, during the observed period, state-owned banks have increased their payroll loans to state-owned employees. The payroll loans, characterized by personal loans with interests payments directly deducted from the borrowers' payroll check, brings benefits to both borrowers and lenders. It is safer for lenders since the payment is automatic and the responsibility belongs to the union. Thus, it brings benefits to the borrowers since it reduces their work to go to the bank or do the job manually. State-owned banks presented a strong credit growth recorded in payroll and mortgages in 2009. The payroll loans were favored by downward movements in the interest rates and by regulatory changes that increased the margin of retirees and pensioners of the National Institute of Social Security (INSS). In turn, concerning the mortgages, there was an increase in resources of the savings account and in the Guarantee Fund for Length Service (FGTS) **.

< Place Table 2 About Here >

We also test for the effects of monetary policy over lending. Table 3 presents the results of how changes in the interest rates affect the credit growth, regarding the estimation of Equation (2). During periods of tightening monetary policy, banks reduce their loans. In contrast, during periods of loosening monetary policy, banks increase their loans. Those results of tightening and loosing monetary policy are in accordance with Nier and Zicchino [2008] and Kashyap and Stein [2000]. However, our results show that the effects of tightening and loosing policy are not of similar magnitude. Dummy Down, representing decreases in the interest rates, presents a stronger effect over loan growth. The two effects are statistically different from each other

**Financial Stability Report - October of 2009

in absolute terms, which suggests evidence for asymmetric effects. Which is expected since we used monthly observations.

This finding clarifies the existence of a bank lending channel, which is a particular case of the broad credit channel [Kashyap and Stein, 1994] due to its emphasis on just one source of external financing, the supply of bank loans, in the monetary policy transmission. During expansionary monetary policy, the interest rate decreases leading to an increase in the supply of credit [Bernanke, 1993]. [Disyatat, 2010] adds to this discussion by attesting that tight monetary policy is assumed to drain deposits from the system and, therefore, reduce lending if banks face frictions in issuing uninsured liabilities to replace the shortfall in deposits. Additionally, much of the driving force behind bank lending is attributed to policy-induced quantitative changes on the liability structure of bank balance sheets.

Furthermore, Table 3 shows how monetary policy affect loan growth in a different way depending on banks' size, capitalization and liquidity. During monetary policy tightening larger banks expand their lending activity. Again, in line with the result that larger banks are better able to buffer their lending during monetary policy shocks. This effect is more pronounced during the financial crisis for capitalized and liquid banks. State-owned banks rise their lending in periods where the interest rates increase. Therefore, state-owned banks are more sensitive to monetary policy changes in the period analyzed. Policymakers must take this into account when formulating monetary policy. On the other hand, in periods of crisis when interest rates decrease, well-capitalized banks decrease their lending activity.

< Place Table 3 About Here >

Table 4 reinforces the results of Table 2 presenting the determinants of loans for annual observations, i.e., the independent variables were constructed as the mean of each bank for each year. The results are similar to the ones presented before. Size, Capitalization and Liquidity influence positively loan growth. On the other hand, Selic impacts negatively loan growth, i.e., when Selic increases/decreses banks reduce/increase their lending activity. Foreign banks have a higher loan activity if compared to public and private domestic banks. However, state-owned banks are more sensitive to monetary policy shocks. The interactions of Selic with banks' specific characteristics give support to the bank lending channel. Larger and well-capitalized banks are better able to buffer their lending during monetary policy shocks. And again these impacts are more pronounced during the financial crisis.

< Place Table 4 About Here >

In Table 5, we present the results of the estimation of Equation (2) using annual data. These results show that the estimations do not change much from the ones presented with monthly observations in Table 3. Using the average of the independent variables we can verify the presence of the bank lending channel. Lending increase/decrease during periods of loosening/tightening monetary policy. Furthermore, the interactions with monetary policy dummies and banks' specific characteristics are significant, intensifying the assumption of the bank lending channel. And, even though we present annual observations, the coefficients of tightening and loosing policy are not of similar magnitude. Which brings evidence for asymmetric effects.

< Place Table 5 About Here >

In all regressions presented above, the time dummies for the period from October 2008 to February 2009 are all negative and statistically significant. They account for the absorption of the global shock that has hit the US and the rest of the world after the failure of Lehman Brothers. Our empirical results suggest that in this event the bank lending channel was important to dampen these effects.

5.2 Risk-Taking Channel

5.2.1 Non-Performing Loans

Non Performing Loans are loans that are in default or close to being in default. Table 6 presents the results of Equation (3), revealing the sensitivity of non performing loans (NPL) to monetary shocks. Empirical suggests that NPL are persistent as the coefficient on lagged NPL is statistically significant. The coefficient of the Selic interest rates presents the expected sign. Increases/decreases in interest rates imply in increases/decreases in the growth rate of NPL.

We also control for ownership in this specification and find that the ownership dummies are statistically significant, with state-owned banks having a lower NPL on average if compared to private domestic and foreign banks. In fact, if we take a look to the average NPL of public banks we will find that this financial institution presents the lower average (0.0131). Private domestic and foreign banks presents an average, respectively, of 0.0164 0.0137.

This may be due to the fact that state-owned banks have a lower exposure to credit risk if compared to their private counterparts.

Moreover, Column (2) presents the results of different reactions to monetary policy shocks depending on banks' specific characteristics. Larger and well-capitalized are more affected by changes in the Selic. When Selic increases larger and well-capitalized banks reduce the growth rate of NPL. Likewise, these effects were more pronounced during the financial crisis, since the crisis affects positively the NPL.

< Place Table 6 About Here >

Table 7 illustrates the effects of monetary policy on non-performing loans by estimating Equation (4). In periods in which interest rates have increased, banks increased their NPL. Monetary tightening may aggravate the situation of banks since increases their NPL participation. On the other hand, monetary loosing may contribute to banks' performance; when interest rates decrease, banks decrease their NPL. The effects of tightening and loosing policy are not of similar magnitude. The dummy for decreases in interest rates have a stronger effect, suggesting that there is asymmetry in these effects.

The results point to different reactions of the NPL depending on banks' specific characteristics. Liquid banks decrease the growth rate of NPL during monetary tightening. In contrast, during monetary loosing, large banks increase the growth rate of NPL. Furthermore, during the financial crisis, when the interest rates have increased, well-capitalized and liquid banks increase their growth rate of NPL, while larger banks decrease this rate. Again, crisis plays an important role in determining the growth rate of NPL.

< Place Table 7 About Here >

We use the mean of the variables for each year in order to analyze the effects of monetary policy over the year and compare with the results for each month observation. Table 8 shows these results for NPL. We find consistency in our results. Selic presents a positive significant sign. State-owned banks have a lower NPL if compared to other banks. And finally, our results point to different reactions to monetary policy shocks depending on banks' specific characteristics.

< Place Table 8 About Here >

By including the dummies of monetary policy we can verify very similar effects for annual observations. During periods of monetary policy tightening/loosing, NPL increases/decreases. State-owned banks are more sensitive to monetary policy changes, since its coefficient is significant. In addition, we find significant interactions of monetary policy dummies with banks' specific characteristics. Including new variables in each column does not change much the results of the earlier variables, which justifies robust results. This results can be seen in Table 9.

< Place Table 9 About Here >

5.2.2 Credit Risk Exposure

The financial crisis arose the discussion concerning the existence of a risk taking channel, characterized by changes in banks' risk tolerance due to expansive monetary policy. There are three main ways in which such risk-taking channel may be operative. A first set of effects operates through the impact of interest rates on valuations, incomes and cash flows, acting like a financial accelerator. Furthermore, these effects can be applied to the widespread use of Value-at-Risk methodologies for economic and regulatory capital [Danielsson et al., 2004]. A second set of effects operates through the relationship between market rates and target rates of return, the so-called "search for yield" [Rajan, 2005]. Low interest rates may create incentives to asset managers to take on more risks, because of some behavioral features such as money illusion or bad adjustment after times of prosperity. Finally, it can operate through aspects concerning characteristics of the communication policies, such as transparency and insurance, which together with the reaction function of the central bank, may change the risk taking behavior [Diamond and Rajan, 2009].

Banks' specific characteristics are important determinants of Risk. We find that Size and Liquidity have a positive relation with Risk. Large and liquid banks presents a higher credit risk exposure. On the other hand, we find that well-capitalized banks have a lower risk exposure. Selic has a negative impact on Risk. When Selic increases, banks take less credit risk, which is expected. This result can be explained by the reduction in lending during periods of monetary tightening. The interaction term, NPL versus Selic, account for losses. Changes in the Selic affects the exposure of credit risk depending on the level of the NPL rate. The interactions with Selic

shows that monetary policy has different effects depending on banks' size, level of capitalization and liquidity.

Additionally, in the risk taking channel there are some statistical differences between banks, due to ownership. When there are changes in the Selic interest rates, state-owned banks increased their loans participation in total assets, which suggests that they have increased their share relative to private domestic banks. We found positive coefficients for this interaction.

The financial crisis exhibits a negative influence over credit risk exposure. This might be due to the incredibility that was passed on by the financial crisis. Just before the financial crisis disclosure, owners of stocks in U.S. corporations had suffered enormous losses. The financial crisis halted global credit markets, jeopardizing the financial stability of the economy worldwide. Even though governments and central banks have adopted measures to contain the crisis, what our results might suggest is that the crisis have reduced bank risk taking in this period. These results are provided in Table 10, which presents the results of the estimation of Equation (5).

< Place Table 10 About Here >

Table 11 presents the results of Equation (6). Monetary policy changes affect credit risk exposure. Higher interest rates reduce banks' credit risk exposure. On the other hand, low interest rates contribute to increase banks' risk-taking. Specifically, monetary tightening have a stronger effect over credit risk exposure. Again, we have evidences for asymmetric effects. When interest rates decrease, banks shift to more riskier operations with higher rate of return. With this finding we confirm the existence of a risk-taking channel in Brazil's economy. Unusually low interest rates during an extended period of time leads to an increase in banks' risk taking [Altunbas et al., 2009c]. Therefore, this period of low interest rates may encourage banks to soften their lending standards, as proposed by Jimenez et al. [2007], amplifying the effectiveness of the risk-taking channel.

Considering the ownership control, our results suggest that foreign banks take on more credit risk. In addition, we tested for a more detailed effect of monetary policy over banks' specific characteristics. We found that during monetary loosing, large and well-capitalized banks reduce their credit risk exposure. Furthermore, the financial crisis affected negatively the risk taking.

< Place Table 11 About Here >

Table 12 illustrates the determinants of Z-score [††] as presented in equation (7). We interpret the results very cautiously. The coefficient of Selic is negative and statistically significant, suggesting that the effect of Selic on bank risk taking is positive and significant. A higher estimated Z-score mean more stability, i.e., less risk taking. Therefore, a higher Selic should imply in higher levels of bank risk taking. In addition, our results point that larger and well-capitalized banks seems to present lower levels of bank risk taking. We also find that, during monetary policy shocks, well-capitalized banks appear to present higher levels of bank risk taking. Once again, this effect is intensified during the financial crisis. Moreover, the financial crisis actually seems to increase the levels of bank risk taking.

< Place Table 12 About Here >

Finally, Table 13 presents the results of Z-score including monetary policy dummies as presented in Equation (8). Again, we verify consistency in our results. The coefficient of monetary policy tightening is negative, suggesting that its effect on bank risk taking is positive and significant. This intensifies the assumption earlier presented that a higher estimated Z-score mean more stability, i.e., less risk taking. The result is inverse when considering the dummy for monetary policy loosing. Several interactions with monetary policy dummies and banks' specific characteristics are presented. The financial crisis seems to increase the levels of bank risk taking.

< Place Table 13 About Here >

5.3 Robustness Check

Overall, the empirical results imply that both the bank lending and risk-taking channels are operational in Brazil. These results are robust to periods of distress as the one we have witnessed recently after the recent global crisis that was originated in the credit market of the US.

We also run all regressions using the Least Squares Dummy Variable (LSDV) with Bias Correction for Dynamic Panel (LSDVC) estimator due to **?**, which has expanded the LSDV bias approximations in **?** to unbalanced panels. Qualitative results remain the same, which suggests that the

[††]We applied the Hausman test and the result suggested the use of fixed effects

bias is small in our case as expected due to the large number of time periods and large number of banks. Furthermore, as tested, our regressions are heteroscedastic. Therefore, FGLS is adequate in our case.

An additional problem that could affect our results is that the bank control variables could be endogenous in our specifications. We also run these regressions without the control variables and find similar results but small changes in the coefficients, which may suggest omitted variable bias. Therefore, we present the results with these control variables.

6 Final Considerations

The current credit crisis has shown the important role of monetary policy in assuring financial stability. We analyze the role of monetary policy by accessing a detailed database of Brazil during the period of 2003-2009. As expected, high interest rates reduce lending, and low interest rates increase lending. This finding clarifies the existence of a bank lending channel. Moreover, banks change their lending strategy in accordance with the direction of monetary policy.

It is interesting to notice how different banks react to monetary policy changes. State-owned banks seem to respond more than foreign and private banks to increases and decreases in interest rates. This might be due to the strong credit growth recorded in payroll loans and mortgages, or the influence that politics plays in the lending decisions of state-owned banks. Studies have shown that state-owned banks have increased their lending during elections. As a result, several state-owned banks have increased their loan portfolio over the years. This suggests that attention should be paid when conducting monetary policy, since state-owned banks can be more sensitive to interest rates changes.

We also study the impacts of monetary policy over non-performing loans. The results may indicate that monetary policy changes can aggravate or alleviate banks' performance. During periods of interest rates increasing, banks present a higher credit exposure, which may aggravate their performance. During periods of interest rates decreasing their relation is reversed. In addition, we shed light on the different impacts on state-owned, foreign and private domestic banks. State-owned banks present a lower amount of non-performing loans compared to other banks. Consequently, state-owned banks present a different lending profile.

Finally, our results support the idea that lower monetary policy rates increase the banks' risk-taking. Banking supervisors should be very careful during periods of extremely low interest rates, in order to mitigate possible lending shocks. Controlling for bank's characteristics, we found that banks react differently when interest rates change depending on the size, level of capitalization and liquidity that the bank presents. Additionally, foreign banks have increased their loans participation in total assets, which suggests that they have increased their share relative to the other banks.

The 2007-2008 financial crisis has revealed that the economy perception of risk is crucial to determine the bank access to capital. Moreover, the crisis has shown that banking losses can lead to critical credit conditions and as a result impose severe costs to the economy. Monetary policies are shown to be able to offset the consequences of financial instabilities. Therefore, we find a empirical consistent relationship between monetary policy and financial stability. Further research could explore how the market structure affects the impacts of monetary policy on bank lending.

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Table 1: Summary Statistics

Variable	Mean	Sd	Min	Max
Loans*	8150.85	23505	0.7239	242000
Non Performing Loans*	120.17	354.34	0.0000	4836.72
NPL	0.02	0.0265	0.0000	0.3577
Assets*	18955	51509	15.41	500000
Equity*	1937.98	5057.45	-1.9957	50722
Equity Ratio	0.1882	0.1267	-0.1272	0.8835
ΔSelic	-0.0742	0.2476	-0.5046	0.3594
Z-score	4.28	1.07	.6860	9.77

This table presents the summary statistics for the variables used in the analysis. Loans correspond to the annual growth rate of lending in Brazilian banks. Non Performing Loans are the loans in default or close to being in default. NPL are the ratio between the Non Performing Loans and the Loans, measured in percentage. Assets are the size of the Brazilian banks. Equity is the total assets minus total liabilities. Equity Ratio is the owner's equity divided by the total assets. Selic is the variation of Banco Central do Brasil's overnight lending year over year. Z-score is the bank's return on assets plus the equity ratio divided by the standard deviation of asset returns.

** In million of Brazilian reais*

Table 2: The Determinants of Loan Growth

Dependent Variable: $\Delta\ Loans_t$	(1) Baseline	(2) Ownership	(3) Interaction
$\Delta\ Loans_{t-1}$	0.0554***	0.0578***	0.0738***
	(0.0142)	(0.0142)	(0.0141)
$Size_{t-1}$	0.00150***	0.00144***	0.00147***
	(0.000364)	(0.000366)	(0.000352)
Cap_{t-1}	0.00668***	0.00609***	0.00634***
	(0.00156)	(0.00169)	(0.00164)
Liq_{t-1}	0.00431***	0.00533***	0.00552***
	(0.000732)	(0.000880)	(0.000907)
$\Delta\ IP_{t-1}$	0.00249**	0.00251**	0.00254**
	(0.00102)	(0.00101)	(0.00106)
$\Delta\ Selic_{t-1}$	-0.0572***	-0.0550***	-0.612***
	(0.0191)	(0.0190)	(0.174)
State-Owned		-0.00270	-0.00127
		(0.00167)	(0.00165)
Foreign		0.00249	0.00295
		(0.00203)	(0.00204)
$\Delta\ Selic_{t-1}$*State-Owned			0.194***
			(0.0445)
$\Delta\ Selic_{t-1}$*Foreign			0.0914
			(0.0565)
$Size_{t-1}$*$\Delta\ Selic_{t-1}$			0.0289***
			(0.00803)
Cap_{t-1}*$\Delta\ Selic_{t-1}$			0.0417***
			(0.0112)
Liq_{t-1}*$\Delta\ Selic_{t-1}$			0.00108
			(0.0253)
$Size_{t-1}$*$\Delta\ Selic_{t-1}$ * Crisis			-0.0248***
			(0.00425)
Cap_{t-1}*$\Delta\ Selic_{t-1}$ * Crisis			-0.241***
			(0.0361)
Liq_{t-1}*$\Delta\ Selic_{t-1}$ * Crisis			0.144*
			(0.0829)
Crisis			-0.0136***
			(0.00266)
Constant	-0.00479	-0.00418	-0.00828
	(0.00657)	(0.00653)	(0.00635)
Time Dummies	YES	YES	YES
Observations	5140	5140	5140
Number of banks	99	99	99
AR(1)	0.1537	0.1505	0.1276
Wald	138.4***	144.1***	321.6***
Modified Wald Test	$1.8 \cdot 10^5$***	$1.7 \cdot 10^5$***	$4.3 \cdot 10^5$***

This table presents the variables that affect loan growth and the results for public, foreign and private banks. We also include NPL_{t-1} in the regression but it was not statistically significant. In Column (1) we regress our baseline model. In Column (2) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (3) we add the interactions. The method used was the FGLS estimator, corrected for heteroscedasticity and autocorrelation (AR1). For heteroskedasticity we used the Modified Wald Test for groupwise heteroskedasticity. The independent variables are presented with one lag. We also add the Selic with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 3: The Effects of Monetary Policy on Loan Growth

Dependent Variable: $\Delta\ Loans_t$	(1) Baseline	(2) Ownership	(3) Interaction	(4) Baseline	(5) Dummy	(6) Interaction
$\Delta\ Loans_{t-1}$	0.0619***	0.0638***	0.0696***	0.0629***	0.0655***	0.0603***
	(0.0142)	(0.0142)	(0.0141)	(0.0142)	(0.0142)	(0.0142)
$Size_{t-1}$	0.00137***	0.00131***	0.00116***	0.00139***	0.00133***	0.00139***
	(0.000361)	(0.000363)	(0.000370)	(0.000360)	(0.000362)	(0.000364)
Cap_{t-1}	0.00634***	0.00571***	0.00681***	0.00638***	0.00571***	0.00606***
	(0.00155)	(0.00169)	(0.00163)	(0.00155)	(0.00168)	(0.00169)
Liq_{t-1}	0.00437***	0.00539***	0.00512***	0.00436***	0.00539***	0.00539***
	(0.000731)	(0.000881)	(0.000863)	(0.000730)	(0.000880)	(0.000881)
$\Delta\ IP_{t-1}$	0.00234**	0.00237**	0.00224**	0.00236**	0.00239**	0.00258**
	(0.00102)	(0.00101)	(0.000922)	(0.00101)	(0.00100)	(0.00101)
Up_{t-1}	-0.00440***	-0.00422***	-0.0323**			
	(0.00150)	(0.00148)	(0.0132)			
State-Owned		-0.00273	-0.00406**		-0.00281*	-0.00282*
		(0.00166)	(0.00172)		(0.00166)	(0.00166)
Foreign		0.00232	0.00249		0.00235	0.00239
		(0.00203)	(0.00199)		(0.00203)	(0.00203)
Up_{t-1}*State-Owned			0.00760***			
			(0.00281)			
$Size_{t-1}$*Up_{t-1}			0.00109*			
			(0.000586)			
Crisis*Cap_{t-1}*Up_{t-1}			-0.0369***			
			(0.00902)			
Crisis*Liq_{t-1}*Up_{t-1}			0.0230***			
			(0.00809)			
Crisis			-0.0138***			-0.0536**
			(0.00511)			(0.0210)
$Down_{t-1}$				0.00312***	0.00302***	0.00353***
				(0.00113)	(0.00112)	(0.00114)
Crisis*Cap_{t-1}*$Down_{t-1}$						-0.0177*
						(0.00962)
Constant	-0.00168	-0.00113	0.00536	-0.00419	-0.00358	-0.00409
	(0.00653)	(0.00650)	(0.00671)	(0.00652)	(0.00648)	(0.00652)
Time Dummies	YES	YES	YES	YES	YES	YES
Observations	5140	5140	5140	5140	5140	5140
Number of banks	99	99	99	99	99	99
AR(1)	0.1490	0.1462	0.1398	0.1487	0.1452	0.1475
Wald	134.9***	140.3***	241.2***	133.4***	139.8***	154.4***
Modified Wald Test	$1.9 \cdot 10^5$***	$1.9 \cdot 10^5$***	$1.3 \cdot 10^6$***	$2.0 \cdot 10^5$***	$1.9 \cdot 10^5$***	$1.8 \cdot 10^5$***

This table presents the results of how changes in monetary policy affect loan growth. More precisely, we show the results of how changes in monetary policy affect loan growth in a different way depending on banks' size, capitalization and liquidity. We also include NPL_{t-1} and the dummy neutral in the regression but they were not statistically significant. In Column (1) we regress our baseline model with the dummy Up_{t-1}. In Column (2) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (3) we add the interactions. In Column (4) we regress our baseline model with the dummy $Down_{t-1}$. In Column (5) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (6) we add the interactions. The method used was the FGLS estimator, corrected for heteroscedasticity and autocorrelation (AR1). For heteroskedasticity we used the Modified Wald Test for groupwise heteroskedasticity. The independent variables are presented with one lag. We also add the dummies with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 4: The Determinants of Loan Growth - Average

Dependent Variable: $\Delta\ Loans_t$	(1) Baseline	(2) Ownership	(3) Interaction
$\Delta\ Loans_{t-1}$	0.234***	0.238***	0.118**
	(0.0502)	(0.0529)	(0.0548)
$Size_{t-1}$	0.0148***	0.0156***	0.0218***
	(0.00483)	(0.00508)	(0.00503)
Cap_{t-1}	0.0346	0.0503**	0.0792***
	(0.0225)	(0.0247)	(0.0250)
Liq_{t-1}	0.0458***	0.0565***	0.0707***
	(0.0116)	(0.0152)	(0.0185)
$\Delta\ IP_{t-1}$	0.0977***	0.103***	0.0857
	(0.0308)	(0.0315)	(0.0822)
$\Delta\ Selic_{t-1}$	-7.125***	-7.206***	-24.78***
	(0.754)	(0.774)	(4.410)
State-Owned		0.0140	0.0230
		(0.0243)	(0.0257)
Foreign		0.0479*	0.0590*
		(0.0263)	(0.0317)
$\Delta\ Selic_{t-1}$*State-Owned			4.340***
			(1.171)
$\Delta\ Selic_{t-1}$*Foreign			1.583
			(1.437)
$Size_{t-1}$*$\Delta\ Selic_{t-1}$			1.124***
			(0.248)
Cap_{t-1}*$\Delta\ Selic_{t-1}$			2.904*
			(1.576)
Liq_{t-1}*$\Delta\ Selic_{t-1}$			1.169
			(0.947)
Crisis*$Size_{t-1}$*$\Delta\ Selic_{t-1}$			-0.561***
			(0.189)
Crisis*Cap_{t-1}*$\Delta\ Selic_{t-1}$			-3.857*
			(1.980)
Crisis*Liq_{t-1}*$\Delta\ Selic_{t-1}$			-0.318
			(1.225)
Crisis			-0.0439
			(0.0414)
Constant	-0.169*	-0.168*	-0.187**
	(0.0886)	(0.0908)	(0.0950)
Time Dummies	YES	YES	YES
Observations	325	325	325
Number of banco	76	76	76
AR(1)	0.1711	0.1751	0.3900
Wald	196.5	182.4	313.0
Modified Wald Test	$2.9 \cdot 10^5$***	$1.4 \cdot 10^9$***	$5.3 \cdot 10^9$***

This table presents the average of the variables that affect loan growth and the results for public, foreign and private banks. We also include NPL_{t-1} in the regression but it was not statistically significant. In Column (1) we regress our baseline model. In Column (2) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (3) we add to the baseline model the interactions. The method used was the FGLS estimator, corrected for heteroscedasticity and autocorrelation (AR1). For heteroskedasticity we used the Modified Wald Test for groupwise heteroskedasticity. The independent variables are presented with one lag. We also add the Selic with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 5: The Effects of Monetary Policy on Loan Growth - Average

Dependent Variable: $\Delta\ Loans_t$	(1) Baseline	(2) Ownership	(3) Interaction	(4) Baseline	(5) Ownership	(6) Interaction
$\Delta\ Loans_{t-1}$	0.296***	0.248***	0.344***	0.423***	0.355***	0.357***
	(0.0514)	(0.0541)	(0.0501)	(0.0474)	(0.0534)	(0.0498)
$Size_{t-1}$	0.0163***	0.0189***	-0.00555	0.00750*	0.0103**	0.0351***
	(0.00506)	(0.00539)	(0.00682)	(0.00405)	(0.00457)	(0.00593)
Cap_{t-1}	0.0374*	0.0623**	-0.0347	-0.00203	0.0188	0.127***
	(0.0217)	(0.0242)	(0.0369)	(0.0186)	(0.0213)	(0.0290)
Liq_{t-1}	0.0422***	0.0517***	0.0476***	0.0305***	0.0425***	0.0757***
	(0.0126)	(0.0167)	(0.0177)	(0.0103)	(0.0146)	(0.0178)
$\Delta\ IP_{t-1}$	0.128***	0.127***	-0.207***	-0.00834	-0.00818	-0.144***
	(0.0170)	(0.0175)	(0.0374)	(0.0159)	(0.0165)	(0.0366)
Up_{t-1}	-0.0677***	-0.0650***	-0.354**			
	(0.0188)	(0.0184)	(0.171)			
State-Owned		0.0234	-0.0925***		0.00996	-0.0658**
		(0.0262)	(0.0292)		(0.0217)	(0.0258)
Foreign		0.0536*	0.0447		0.0514**	0.0438*
		(0.0289)	(0.0398)		(0.0254)	(0.0246)
Up_{t-1}*State-Owned			0.166***			
			(0.0377)			
$Size_{t-1}$*Up_{t-1}			0.0456***			
			(0.0110)			
Cap_{t-1}*Up_{t-1}			0.202***			
			(0.0568)			
Crisis*$Size_{t-1}$*Up_{t-1}			-0.0256**			
			(0.0105)			
Crisis*Cap_{t-1}*Up_{t-1}			-0.179***			
			(0.0533)			
Crisis*Liq_{t-1}*Up_{t-1}			-0.0486*			
			(0.0283)			
$Down_{t-1}$				0.0460**	0.0414**	0.450***
				(0.0203)	(0.0202)	(0.159)
$Down_{t-1}$*State-Owned						0.122***
						(0.0300)
$Down_{t-1}$*Foreign						0.0599*
						(0.0352)
$Size_{t-1}$*$Down_{t-1}$						-0.0350***
						(0.00887)
Cap_{t-1}*$Down_{t-1}$						-0.0973**
						(0.0415)
Liq_{t-1}*$Down_{t-1}$						-0.0392*
						(0.0219)
Crisis*$Size_{t-1}$*$Down_{t-1}$						-0.0299***
						(0.00340)
Crisis*Cap_{t-1}*$Down_{t-1}$						-0.198***
						(0.0371)
Constant	-0.0329	-0.0485	0.144	-0.108	-0.122	-0.293***
	(0.0862)	(0.0926)	(0.121)	(0.0735)	(0.0803)	(0.102)
Time Dummies	YES	YES	YES	YES	YES	YES
Observations	325	325	325	325	325	325
Number of banks	76	76	76	76	76	76
AR(1)	0.1705	0.2537	0.0294	-0.1134	0.0533	0.0582
Wald	396.0***	349.3***	190.6***	138.0***	90.93***	559.4***
Modified Wald Test	2.1 $\cdot 10^6$***	2.3 $\cdot 10^8$***	1.6 $\cdot 10^8$***	1.6 $\cdot 10^5$***	7.7 $\cdot 10^6$***	1.5 $\cdot 10^5$***

This table presents the results of how changes in monetary policy affect loan growth. More precisely, we show the results of how changes in monetary policy affect loan growth in a different way depending on banks' size, capitalization and liquidity. We also include NPL_{t-1} and the dummy neutral in the regression but they were not statistically significant. In Column (1) we regress our baseline model with the dummy Up_{t-1}. In Column (2) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (3) we add the interactions. In Column (4) we regress our baseline model with the dummy $Down_{t-1}$. In Column (5) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (6) we add the interactions. The method used was the FGLS estimator, corrected for heteroscedasticity and autocorrelation (AR1). For heteroskedasticity we used the Modified Wald Test for groupwise heteroskedasticity. The independent variables are presented with one lag. We also add the dummies with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 6: Determinants of NPL

Dependent Variable: $\Delta\ NPL_t$	(1) Baseline	(2) Ownership	(3) Interaction
$\Delta\ NPL_{t-1}$	-0.129***	-0.130***	-0.161***
	(0.0152)	(0.0152)	(0.0151)
$\Delta\ Selic_{t-1}$	0.293***	0.298***	1.739*
	(0.108)	(0.109)	(1.022)
State-Owned		-0.0145*	-0.0157*
		(0.00833)	(0.00867)
Foreign		0.00259	0.00263
		(0.00806)	(0.00819)
$Size_{t-1}$*$\Delta\ Selic_{t-1}$			-0.0826*
			(0.0467)
Cap_{t-1}*$\Delta\ Selic_{t-1}$			-0.133*
			(0.0681)
Liq_{t-1}*$\Delta\ Selic_{t-1}$			-0.154
			(0.146)
Crisis*$Size_{t-1}$*$\Delta\ Selic_{t-1}$			0.0282
			(0.0258)
Crisis*Cap_{t-1}*$\Delta\ Selic_{t-1}$			0.398*
			(0.216)
Crisis*Liq_{t-1}*$\Delta\ Selic_{t-1}$			0.106
			(0.559)
Crisis			0.0665***
			(0.0166)
Constant	0.0131***	0.0158***	0.0129**
	(0.00373)	(0.00523)	(0.00544)
Time Dummies	YES	YES	YES
Observations	5155	5155	5140
Number of banks	99	99	99
AR(1)	0.0398	0.0398	0.0732
Wald	125.4***	129.4***	188.0***
Modified Wald Test	5.0 $\cdot 10^7$***	4.2 $\cdot 10^7$***	4.3 $\cdot 10^7$***

This table presents the variables that affect NPL and the results for public, foreign and private banks. We also include $Loans_{t-1}$, $Size_{t-1}$, Cap_{t-1}, Liq_{t-1}, $\Delta\ Selic_t$*Public/Foreign in the regression but they were not statistically significant. NPL is in the logit format, $ln\left(\frac{npl}{1-npl}\right)$. In Column (1) we regress our baseline model. In Column (2) we add to the baseline model the dummies for ownership, Public and Foreign. In Column (3) we add the interactions. The method used was the FGLS estimator, corrected for heteroscedasticity and autocorrelation (AR1). For heteroskedasticity we used the Modified Wald Test for groupwise heteroskedasticity. The independent variables are presented with one lag. We also add the Selic with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 7: The effects of monetary policy on NPL

Dependent Variable: $\Delta\ NPL_t$	(1) Baseline	(2) Ownership	(3) Interaction	(4) Baseline	(5) Ownership	(6) Interaction
$\Delta\ NPL_{t-1}$	-0.168***	-0.168***	-0.131***	-0.167***	-0.167***	-0.154***
	(0.0146)	(0.0146)	(0.0152)	(0.0145)	(0.0145)	(0.0150)
Up_{t-1}	0.0442***	0.0440***	0.972***			
	(0.00848)	(0.00854)	(0.288)			
State-Owned		-0.0132*	-0.00879		-0.0129*	-0.0138
		(0.00748)	(0.00819)		(0.00704)	(0.00920)
Foreign		0.000185	0.00102		0.000395	0.00694
		(0.00741)	(0.00823)		(0.00720)	(0.00756)
Liq_{t-1}*Up_{t-1}			-0.0189*			
			(0.0107)			
Crisis*$Size_{t-1}$*Up_{t-1}			-0.0284*			
			(0.0156)			
Crisis*Cap_{t-1}*Up_{t-1}			0.133*			
			(0.0787)			
Crisis*Liq_{t-1}*Up_{t-1}			0.102*			
			(0.0566)			
Crisis			0.0792***			0.0538***
			(0.0147)			(0.0139)
$Down_{t-1}$				-0.0234***	-0.0235***	-0.103*
				(0.00620)	(0.00619)	(0.0538)
$Size_{t-1}$*$Down_{t-1}$						0.00507*
						(0.00287)
Cap_{t-1}*$Down_{t-1}$						0.0128
						(0.0143)
Liq_{t-1}*$Down_{t-1}$						3.88e-05
						(0.00846)
Constant	-0.0178***	-0.0143***	-0.0201***	0.000465	0.00408	0.0139**
	(0.00378)	(0.00502)	(0.00543)	(0.00407)	(0.00523)	(0.00609)
Time Dummies	YES	YES	YES	YES	YES	YES
Observations	5155	5155	5140	5155	5155	5140
Number of banks	99	99	99	99	99	99
AR(1)	0.0864	0.0860	0.0330	0.0917	0.0903	0.0682
Wald	215.3***	217.8***	183.6***	206.3***	208.6***	174.9***
Modified Wald Test	6.5 $\cdot 10^7$***	6.2 $\cdot 10^7$***	5.7 $\cdot 10^7$***	7.0 $\cdot 10^7$***	6.6 $\cdot 10^7$***	4.0 $\cdot 10^7$***

This table presents the results of how changes in monetary policy affect NPL. We also include $Loans_{t-1}$, $Size_{t-1}$, Cap_{t-1}, $DummyUp/Down * Public/Foreign$, and the dummy neutral in the regression but they were not statistically significant. NPL is in the logit format, $ln\left(\frac{npl}{1-npl}\right)$. In Column (1) we regress our baseline model with the dummy Up_{t-1}. In Column (2) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (3) we add the interactions. In Column (4) we regress our baseline model with the dummy $Down_{t-1}$. In Column (5) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (6) we add the interactions. The method used was the FGLS estimator, corrected for heteroscedasticity and autocorrelation (AR1). For heteroskedasticity we used the Modified Wald Test for groupwise heteroskedasticity. The independent variables are presented with one lag. We also add the dummies with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 8: Determinants of NPL - Average

Dependent Variable: $\Delta\ NPL_t$	(1) Baseline	(2) Ownership	(3) Interaction
$\Delta\ NPL_{t-1}$	-0.138***	-0.131***	-0.131***
	(0.0458)	(0.0442)	(0.0487)
$\Delta\ Selic_{t-1}$	12.69***	12.42***	28.64**
	(1.683)	(1.577)	(11.85)
State-Owned		-0.126***	-0.114***
		(0.0370)	(0.0385)
Foreign		0.0182	0.0343
		(0.0539)	(0.0545)
$Size_{t-1}$*$\Delta\ Selic_{t-1}$			-0.965
			(0.695)
Cap_{t-1}*$\Delta\ Selic_{t-1}$			-2.679
			(4.286)
Liq_{t-1}*$\Delta\ Selic_{t-1}$			3.194
			(2.219)
Crisis*$Size_{t-1}$*$\Delta\ Selic_{t-1}$			0.635
			(0.748)
Crisis*Cap_{t-1}*$\Delta\ Selic_{t-1}$			7.147
			(6.182)
Crisis*Liq_{t-1}*$\Delta\ Selic_{t-1}$			-9.841**
			(4.020)
Crisis			0.00537
			(0.0521)
Constant	0.0492**	0.0831***	0.0806*
	(0.0203)	(0.0263)	(0.0444)
Time Dummies	YES	YES	YES
Observations	323	323	323
Number of banks	75	75	75
AR(1)	0.1742	0.1389	0.0819
Wald	93.48***	110.4***	111.6***
Modified Wald Test	$1.0 \cdot 10^7$***	$1.1 \cdot 10^10$***	$2.1 \cdot 10^11$***

This table presents the variables that affect NPL and the results for public, foreign and private banks. We also include $Loans_{t-1}$, $Size_{t-1}$, Cap_{t-1}, Liq_{t-1}, $\Delta\ Selic_t$*Public/Foreign in the regression but they were not statistically significant. NPL is in the logit format, $ln\left(\frac{npl}{1-npl}\right)$. In Column (1) we regress our baseline model. In Column (2) we add to the baseline model the dummies for ownership, Public and Foreign. In Column (3) we add the interactions. The method used was the FGLS estimator, corrected for heteroscedasticity and autocorrelation (AR1). For heteroskedasticity we used the Modified Wald Test for groupwise heteroskedasticity. The independent variables are presented with one lag. We also add the Selic with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 9: The effects of monetary policy on NPL - Average

Dependent Variable: $\Delta\ NPL_t$	(1) Baseline	(2) Ownership	(3) Interaction	(4) Baseline	(5) Ownership	(6) Interaction
$\Delta\ NPL_{t-1}$	-0.0958*	-0.107**	-0.118**	-0.0958*	-0.107**	-0.121***
	(0.0502)	(0.0498)	(0.0484)	(0.0502)	(0.0498)	(0.0407)
Up_{t-1}	0.193***	0.199***	0.550**			
	(0.0348)	(0.0373)	(0.249)			
State-Owned		-0.133***	-0.130**		-0.133***	-0.108**
		(0.0377)	(0.0514)		(0.0377)	(0.0444)
Foreign		0.0207	0.0435		0.0207	-0.0157
		(0.0463)	(0.0529)		(0.0463)	(0.0470)
$Size_{t-1}$*Up_{t-1}			-0.0521***			
			(0.0156)			
Cap_{t-1}*Up_{t-1}			-0.359***			
			(0.110)			
Liq_{t-1}*Up_{t-1}			-0.128*			
			(0.0772)			
Crisis*$Size_{t-1}$*Up_{t-1}			0.0471***			
			(0.0124)			
Crisis*Cap_{t-1}*Up_{t-1}			0.429***			
			(0.134)			
Crisis*Liq_{t-1}*Up_{t-1}			0.164*			
			(0.0942)			
$Down_{t-1}$				-0.193***	-0.199***	-0.922***
				(0.0348)	(0.0373)	(0.261)
$Size_{t-1}$*$Down_{t-1}$						0.0384***
						(0.0147)
Cap_{t-1}*$Down_{t-1}$						0.0479
						(0.0787)
Liq_{t-1}*$Down_{t-1}$						-0.155***
						(0.0157)
Crisis*$Size_{t-1}$*$Down_{t-1}$						0.0165
						(0.0102)
Crisis*Cap_{t-1}*$Down_{t-1}$						0.130
						(0.108)
Crisis*Liq_{t-1}*$Down_{t-1}$						-0.132
						(0.0879)
Constant	-0.0916***	-0.0732**	0.00352	0.102***	0.126***	0.159***
	(0.0278)	(0.0320)	(0.0312)	(0.0215)	(0.0269)	(0.0407)
Time Dummies	YES	YES	YES	YES	YES	YES
Observations	323	323	323	323	323	323
Number of banks	75	75	75	75	75	75
AR(1)	0.0883	0.0690	0.0690	0.0883	0.0690	0.0730
Wald	40.35***	48.27***	81.89***	40.35***	48.27***	194.8***
Modified Wald Test	$1.2 \cdot 10^{1}2$***	$6.0 \cdot 10^{9}$***	$4.1 \cdot 10^{6}$***	$1.2 \cdot 10^{1}2$***	$6.0 \cdot 10^{9}$***	$3.9 \cdot 10^{7}$***

This table presents the results of how changes in monetary policy affect NPL. We also include $Loans_{t-1}$, $Size_{t-1}$, Cap_{t-1}, $Crisis$, $DummyUp/Down * Public/Foreign$, and the dummy neutral in the regression but they were not statistically significant. NPL is in the logit format, $ln\left(\frac{npl}{1-npl}\right)$. In Column (1) we regress our baseline model with the dummy Up_{t-1}. In Column (2) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (3) we add the interactions. In Column (4) we regress our baseline model with the dummy $Down_{t-1}$. In Column (5) we regress the baseline model adding the dummies for ownership, Public and Foreign. In Column (6) we add the interactions. The method used was the FGLS estimator, corrected for heteroscedasticity and autocorrelation (AR1). For heteroskedasticity we used the Modified Wald Test for groupwise heteroskedasticity. The independent variables are presented with one lag. We also add the dummies with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 10: Determinants of Credit Risk Exposure

Dependent Variable: Δ $Risk_t$	(1) Baseline	(2) Interaction	(3) Baseline	(4) Interaction
$Size_{t-1}$	0.0197***	0.0373***	0.0197***	0.0373***
	(0.00418)	(0.00527)	(0.00455)	(0.00619)
Cap_{t-1}	-0.0229***	-0.0131*	-0.0229**	-0.0131
	(0.00674)	(0.00708)	(0.0105)	(0.00975)
Liq_{t-1}	0.0248***	0.0188***	0.0248***	0.0188***
	(0.00370)	(0.00377)	(0.00880)	(0.00705)
Δ $Selic_{t-1}$	-0.102**	-0.956*	-0.102**	-0.956*
	(0.0509)	(0.572)	(0.0506)	(0.548)
Δ NPL_{t-1}*Δ $Selic_{t-1}$		-9.250**		-9.250**
		(3.600)		(4.009)
Δ $Selic_{t-1}$ * State-Owned		0.272*		0.272**
		(0.154)		(0.108)
Δ $Selic_{t-1}$ * Foreign		-0.139		-0.139
		(0.140)		(0.171)
$Size_{t-1}$*Δ $Selic_{t-1}$		0.0481*		0.0481*
		(0.0287)		(0.0275)
Cap_{t-1}*Δ $Selic_{t-1}$		0.0832**		0.0832*
		(0.0414)		(0.0467)
Liq_{t-1}*Δ $Selic_{t-1}$		-0.116**		-0.116
		(0.0546)		(0.0906)
Crisis*$Size_{t-1}$*Δ $Selic_{t-1}$		-0.0587		-0.0587
		(0.0830)		(0.0532)
Crisis*Cap_{t-1}*Δ $Selic_{t-1}$		-0.0453		-0.0453
		(0.254)		(0.136)
Crisis*Liq_{t-1}*Δ $Selic_{t-1}$		0.00768		0.00768
		(0.256)		(0.119)
Crisis		-0.103		-0.103
		(0.127)		(0.0852)
Constant	-0.456***	-0.832***	-0.456***	-0.832***
	(0.0864)	(0.109)	(0.104)	(0.139)
Fixed Effects	FE	FE	FE Cluster	FE Cluster
Time Dummies	YES	YES	YES	YES
Observations	5239	5140	5239	5140
R^2	0.020	0.044	0.020	0.044
Number of banks	99	99	99	99
F statistic	20.52***	4.244***	10.67***	5.610***

This table presents the variables that affect Risk and the results for state-owned, private and foreign banks. Risk is represented as the ratio between total Loans and total Assets. We also include $Risk_{t-1}$, NPL_{t-1}, $Loans_{t-1}$, and $State - Owned/Foreign$ in the regression but they were not statistically significant. In Column (1) we regress the baseline model using fixed effects. In Column (2) we regress the baseline model with the interactions using fixed effects. In Column (3) we regress the same baseline model using fixed effects cluster. In Column (4) we regress the baseline model with the interactions using fixed effects cluster . The method used was the OLS estimator. The independent variables are presented with one lag. We also add Selic with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 11: The Effects of Monetary Policy on Credit Risk Exposure

Dependent Variable: $\Delta\ Risk_t$	(1) Baseline	(2) Interaction	(3) Baseline	(4) Interaction	(5) Baseline	(6) Interaction	(7) Baseline	(8) Interaction
$Size_{t-1}$	0.0241***	0.0262***	0.0247***	0.0296***	0.0241***	0.0262***	0.0247***	0.0296***
	(0.00439)	(0.00446)	(0.00443)	(0.00463)	(0.00445)	(0.00446)	(0.00473)	(0.00529)
Cap_{t-1}	-0.0200***	-0.0205***	-0.0196***	-0.0129*	-0.0200*	-0.0205*	-0.0196*	-0.0129
	(0.00676)	(0.00684)	(0.00677)	(0.00731)	(0.0103)	(0.0104)	(0.0100)	(0.00997)
Liq_{t-1}	0.0240***	0.0200***	0.0242***	0.0238***	0.0240***	0.0200***	0.0242***	0.0238***
	(0.00368)	(0.00373)	(0.00368)	(0.00368)	(0.00878)	(0.00754)	(0.00879)	(0.00868)
Up_{t-1}	-0.0122**	-0.0173***			-0.0122*	-0.0173**		
	(0.00525)	(0.00555)			(0.00680)	(0.00767)		
$\Delta\ NPL_{t-1}$*Up_{t-1}		-0.567**				-0.567*		
		(0.221)				(0.308)		
$Down_{t-1}$			0.00324	0.0646*			0.00324	0.0646
			(0.00377)	(0.0351)			(0.00462)	(0.0452)
$Down_{t-1}$*State-Owned				-0.00625				-0.00625*
				(0.00824)				(0.00329)
$Down_{t-1}$*Foreign				0.0131*				0.0131**
				(0.00744)				(0.00620)
$Size_{t-1}$*$Down_{t-1}$				-0.00403**				-0.00403
				(0.00198)				(0.00263)
Cap_{t-1}*$Down_{t-1}$				-0.0132*				-0.0132
				(0.00740)				(0.0110)
Crisis				-0.0257***				-0.0257***
				(0.00940)				(0.00699)
Constant	-0.550***	-0.597***	-0.564***	-0.655***	-0.550***	-0.597***	-0.564***	-0.655***
	(0.0907)	(0.0922)	(0.0915)	(0.0955)	(0.103)	(0.103)	(0.109)	(0.120)
Fixed Effects	FE	FE	FE	FE	FE Cluster	FE Cluster	FE Cluster	FE Cluster
Time Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Observations	5239	5140	5239	5239	5239	5140	5239	5239
R^2	0.035	0.037	0.032	0.035	0.035	0.037	0.032	0.035
Number of banks	99	99	99	99	99	99	99	99
F statistic	7.171***	7.069***	7.719***	6.886***	5.277***	5.319***	5.638***	6.264***

This table presents the variables that affect Risk and the results for state-owned, private and foreign banks. Risk is represented as the ratio between total Loans and total Assets. We also include $Risk_{t-1}$, NPL_{t-1}, $Loans_{t-1}$, and $Selic_{t-1}$*$State-owned/Foreign$ in the regression but they were not statistically significant. In Column (1) we regress the baseline model with the dummy Up_{t-1} using fixed effects. In Column (2) we regress the baseline model with the interactions using fixed effects. In Column (3) we regress the baseline model with the dummy $Down_{t-1}$ using fixed effects. In Column (4) we regress the baseline model with the interactions using fixed effects. In Column (5) we regress the baseline model with the dummy Up_{t-1} using fixed effects cluster. In Column (6) we regress the baseline model with the interactions using fixed effects cluster. In Column (7) we regress the baseline model with the dummy $Down_{t-1}$ using fixed effects cluster. In Column (8) we regress the baseline model with the interactions using fixed effects cluster. The method used was the OLS estimator. The independent variables are presented with one lag. We also add the dummies with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 12: Determinants of Z-score

Dependent Variable: Z-score	(1) Baseline	(2) Interaction	(3) Baseline	(4) Interaction
$Size_{t-1}$	0.734***	0.362***	0.734***	0.362**
	(0.0951)	(0.122)	(0.109)	(0.138)
Cap_{t-1}	0.987***	0.793***	0.987***	0.793***
	(0.177)	(0.175)	(0.252)	(0.237)
$\Delta Selic_{t-1}$	-10.67***	-11.39**	-10.67***	-11.39**
	(1.850)	(5.521)	(1.945)	(5.412)
Cap_{t-1}*$\Delta Selic_{t-1}$		-5.659*		-5.659**
		(2.981)		(2.828)
Crisis*Cap_{t-1}*$\Delta Selic_{t-1}$		12.63***		12.63***
		(1.836)		(2.151)
Crisis		0.288**		0.288**
		(0.123)		(0.139)
Constant	-9.634***	-2.067	-9.634***	-2.067
	(1.973)	(2.493)	(2.245)	(2.795)
Fixed Effects	FE	FE	FE Cluster	FE Cluster
Time Dummies	YES	YES	YES	YES
Observations	513	513	513	513
R^2	0.195	0.300	0.195	0.300
Number of banks	99	99	99	99
F statistic	24.89***	24.98***	16.87***	11.74***

This table presents the variables that affect risk taking. We measure bank risk using the z-score of each bank, which is the mean of return on assets plus the mean of equity-ratio divided by the standard deviation of the return on assets. We also include NPL_{t-1}, Liq_{t-1}, $Loans_{t-1}$ and $State-Owned/Foreign$ in the regression but they were not statistically significant. In Column (1) we regress the baseline model using fixed effects. In Column (2) we regress the baseline model with the interactions using fixed effects. In Column (3) we regress the same model using fixed effects cluster. In Column (4) we regress the baseline model with the interactions using fixed effects cluster. The method used was the OLS estimator. The independent variables are presented with one lag. We also add Selic with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

Table 13: The Effects of Monetary Policy on Z-score

Dependent Variable: Z-score	(1) Baseline	(2) Interaction	(3) Baseline	(4) Interaction	(5) Baseline	(6) Interaction	(7) Baseline	(8) Interaction
$Size_{t-1}$	0.587***	0.312**	0.587***	0.293***	0.587***	0.312**	0.587***	0.293**
	(0.0928)	(0.124)	(0.0928)	(0.112)	(0.102)	(0.140)	(0.102)	(0.127)
Cap_{t-1}	0.860***	0.870***	0.860***	0.773***	0.860***	0.870***	0.860***	0.773***
	(0.177)	(0.185)	(0.177)	(0.177)	(0.250)	(0.263)	(0.250)	(0.247)
Up_{t-1}	-0.537***	-0.451*			-0.537***	-0.451*		
	(0.0845)	(0.245)			(0.0990)	(0.234)		
Cap_{t-1}*Up_{t-1}		-0.209*				-0.209*		
		(0.126)				(0.115)		
Crisis*Cap_{t-1}*Up_{t-1}		0.653***				0.653***		
		(0.0853)				(0.103)		
Crisis		1.165***		0.130		1.165***		0.130
		(0.148)		(0.125)		(0.218)		(0.137)
$Down_{t-1}$			0.537***	0.541**			0.537***	0.541**
			(0.0845)	(0.245)			(0.0990)	(0.248)
Cap_{t-1}*$Down_{t-1}$				0.175				0.175
				(0.127)				(0.113)
Crisis*Cap_{t-1}*Up_{t-1}				-0.568***				-0.568***
				(0.0888)				(0.116)
Constant	-6.311***	-0.839	-6.847***	-0.816	-6.311***	-0.839	-6.847***	-0.816
	(1.929)	(2.543)	(1.934)	(2.321)	(2.085)	(2.844)	(2.103)	(2.575)
Fixed Effects	FE	FE	FE	FE	FE Cluster	FE Cluster	FE Cluster	FE Cluster
Time Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Observations	513	513	513	513	513	513	513	513
R^2	0.180	0.296	0.180	0.290	0.180	0.296	0.180	0.290
Number of banco	99	99	99	99	99	99	99	99
F statistic	22.45***	24.50***	22.45***	23.74***	13.47***	12.13***	13.47***	10.64***

This table presents the variables that affect Risk and the results for state-owned, private and foreign banks. Risk is represented as the ratio between total Loans and total Assets. We also include $Risk_{t-1}$, NPL_{t-1}, $Loans_{t-1}$, and $State-owned/Foreign$ in the regression but they were not statistically significant. In Column (1) we regress the baseline model with the dummy Up_{t-1} using fixed effects. In Column (2) we regress the baseline model with the interactions using fixed effects. In Column (3) we regress the baseline model with the dummy $Down_{t-1}$ using fixed effects. In Column (4) we regress the baseline model with the interactions using fixed effects. In Column (5) we regress the baseline model with the dummy Up_{t-1} using fixed effects cluster. In Column (6) we regress the baseline model with the interactions using fixed effects cluster. In Column (7) we regress the baseline model with the dummy $Down_{t-1}$ using fixed effects cluster. In Column (8) we regress the baseline model with the interactions using fixed effects cluster. The method used was the OLS estimator. The independent variables are presented with one lag. We also add the dummies with more lags but the results were not statistically significant. The symbols ***,**,* stand for statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are provided in parenthesis.

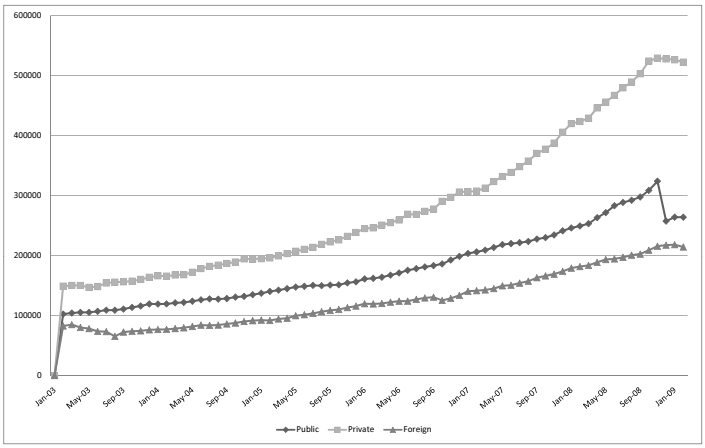

Figure 1: This figure presents the credit growth (in million of Brazilian reais) for state-owned, private and foreign banks from January 2003 to February 2009.

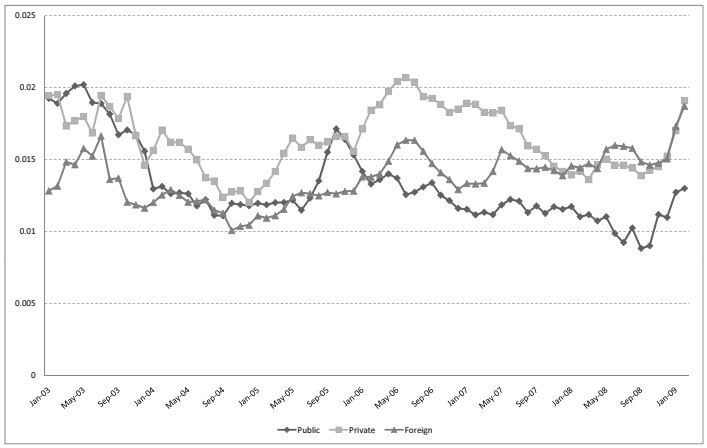

Figure 2: This figure presents the ratio of Non Performing Loans over total Loans (in million of Brazilian reais) for state-owned, private and foreign banks from January 2003 to February 2009.

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