Identifying bank lending reaction to monetary policy through data frequency [§]

Christiano Arrigoni Coelho[†], João M P De Mello[‡] and Márcio G. P. Garcia[¥]

Abstract

We study how monetary policy affects bank lending behavior with an unique database and an event-study approach. Using the daily frequencies of interest rates and new loans in our data as a source of identification, we estimate banks' reactions to monetary policy committee (Copom) decisions and to announcements of reserve requirement changes. We argue that these estimated reduced-form coefficients can be interpreted as supply shifts. The behavior of the estimates corroborates the claim that we capture supply movements, since new loans depends negatively on unexpected basic interest rate and reserve requirements changes, and the opposite is true for the lending interest rate. Evidence suggests that banking lending channel is unimportant. Results are robust to using different bank characteristics to define financial constraint, to the monetary policy instrument – basic interest rates or reserve requirement –, and to the measure of monetary policy stance.

KEY WORDS: monetary policy transmission; credit markets; banking lending channel.

JEL CODES: E52; E58.

[§]We would like to thank Roberto Rigobon, Sérgio Werlang, Márcio Nakane, Leonardo Rezende and Juliano Assunção for insightful comments. Opinions expressed here are solely from the authors, and do not reflect any official position of the Central Bank of Brazil
[†] Central Bank of Brazil and Departamento de Economia, PUC-Rio: christiano.coelho@bcb.gov.br.
[‡] Departamento de Economia, PUC-Rio: jmpm@econ.puc-rio.br.
[¥] Departamento de Economia, PUC-Rio: mgarcia@econ.puc-rio.br.

I. Introduction

Monetary policy affects economic activity through different channels. One mechanism is the credit channel, which consists in how monetary policy impacts the real sector through its effect on the functioning of credit markets. The credit channel can be divided in two types: the broad credit channel and the banking lending channel. The former focus on a broad view of credit markets and studies how monetary policy affects the net position of lenders and borrowers in the economy. The second refers to how monetary policy shifts the supply side schedule of the banking sector.

Banks fund a significant part of their operation issuing deposits, normally the cheapest way to get funding[1]. Assuming that deposits and other types of funding are less-than-perfect substitutes, monetary policy, as long as it affects the amount of deposits in the banking system, will shift the supply schedule of bank credit, a transmission mechanism known as the banking lending channel.

The empirical literature first tried to identify the banking lending channel using aggregated data as in Bernanke and Blinder [1992][2]. Since results contained both demand and supply shifts, subsequent research concentrated on bank-level information. The seminal paper in this area is Kashyap and Stein [1994][3], whose identification strategy consists in using bank characteristics to identify the banking lending effect. Assume that smaller banks, relative to larger ones, have more difficulty raising funds in deposit markets. In this case, differences in reactions of small and large banks to changes in monetary policy may be interpreted as evidence of the bank lending channel. In this paper we contribute to the empirical understanding of the bank lending channel. We follow the literature in using bank characteristics to select banks' types more likely to be restricted in the non deposit debt market. However, we propose a sharper identification strategy of bank-credit supply shifts induced by monetary policy.

Equilibrium credit quantity could change for other reasons. Bank's opportunity cost is affected by monetary policy creating incentives for them to change their mix

[1] Of course, deposits come at a price. As soon as there is the possibility of withdrawing at any time and banks invest a substantial share of their funds in credit, an asset with low liquidity and long maturity, deposits cause a potential problem of liquidity unbalance between banks' assets and liabilities.
[2] Other paper using aggregated data was Kashyap et al. [1993].
[3] Other papers in this area were Kashyap and Stein [2000], Takeda et al. [2005] and Arena et al. [2007].

between credit and public bonds.[4] Credit demand also shifts after a monetary policy change. The success of the banking lending channel identification depends crucially on disentangling these competing effects.

While using bank characteristics as an identification strategy may isolate differences in the opportunity costs across banks, it is not obvious whether it accounts for demand shifts. Because of market segmentation, bank-level credit demand may also react differently to changes in monetary policy.

The main novelty of this paper is to use a new dataset better suited to identify changes in demand and supply. Differently from the literature, we have daily bank-level data on interest rate and quantity. The high frequency of the data is used to identify supply and demand. The key identifying assumption we make is that supply reacts faster than demand to monetary shocks. By looking at a short window around the monetary policy committee meeting and announcements of change in reserve requirement rules, we hold demand constant, and thus reduced-form estimates of the impact of changes in the monetary policy on equilibrium amounts may be interpreted as supply shifts. This is because the channel through which monetary policy affects credit demand is expectations of future conditions on inflation and economic activity. This indirect channel is more likely to respond slowly, as events unfold. On the other hand, monetary policy has an immediate effect on the supply of loans, by directly impacting the marginal cost of supplying loans. It is common for Brazilian banks to hold credit committee meetings following Copom's decisions to adjust rates of the different kinds of loans.

Interest rates also convey information about relative shifts on demand and supply. Differently from the effects on credit quantity, the shifts on credit demand and supply caused by monetary policy have opposite effects on credit interest rate. For example, through the demand channel, a tightening of monetary policy will reduce the equilibrium rate. Through the supply channel, it induces an increase in equilibrium rate. Hence, one can corroborate our identification strategy by looking at the sign of the reduced form impact of monetary policy on lending rates.

[4] Because of the high level of public debt in Brazil, there is a high proportion of public bonds on banks' balance sheets. The real interest rates on public bonds are also very high.

Our results show that credit volume and interest rate respond strongly to monetary policy changes in the direction one would expect if we were estimating a supply response, i.e., after basic interest rate or reserve requirements ratio increases, credit interest rate increases and credit volume diminishes. Furthermore, estimates do not show that small and/or domestically owned banks react more to monetary policy actions than large and/or foreign owned banks. Thus, our results do not support the existence of a banking lending channel in Brazil.

The paper is organized as follows. In the section II we provide an overview of the recent evolution of the Brazilian credit market and the description of our dataset. Section III highlights our empirical strategy, with emphasis on the identification strategy. Results and discussion are in section IV. Section V concludes.

II. The credit market in Brazil and database description

The performance of credit markets in Brazil is poor by international standards. Spreads are high, and credit volume is low even when compared to other emerging economies. Gelos (2006) calculates that the average interest rate margin in Brazil is of 8.9%, while the emerging economies average is of 5% and Latin American countries average is of 8%[5]. In the same paper the author shows that Brazilian credit to private sector-to-GDP ratio was the sixth smallest in a sample of sixteen countries, below those of Chile, Bolivia, Costa Rica and Honduras.[6]

Another characteristic of the Brazilian credit market is the large participation of the public sector. Despite the PROER program--a federally sponsored program created in the nineties to decrease government participation in the banking system through privatization of bankrupt state-government-owned banks--the government participation in the banking sector is still high. Two of the three largest commercial banks in Brazil are

[5] In table 1 of Gelos (2006) the interest rate margins, measured as the bank total interest rate income minus total interest rate expense divided by the sum of total interest bearing assets, were 6.6% for Mexico, 5.5% for Chile and 4% for Colombia.

[6] For the difficulties in international comparisons of bank spreads see Costa and Nakane (2005). For the methodological decomposition of bank spread between costs, taxes and profit margin in Brazil see Costa and Nakane (2004).

state-owned[7] and the federal government owns a very large national development public bank (BNDES) that alone was, as of December 2002, responsible for 22.8%[8] of the total credit. In general, state-owned banks have preferential or exclusive access to sources of funds that are more stable and have smaller cost. The allocation of these resources is directed to some types of borrowers. Banco do Brasil provides credit to the rural sector, Caixa Econômica Federal is legally obligated to channel a given ratio of their funds to housing loans and BNDES channels a significant part of their resources to the infrastructure and exporter sectors and to the large firms.

These resources channeled for some category of borrowers are called earmarked or channeled credit. Those loans have specific funding and allocation, and the price in both sides of the market are not freely negotiated. The remaining loans in the credit market are called non-earmarked or freely allocated credit. In this category is included all kind of credit where all characteristics of the contract (price, quantity, kind of interest rate indexation, maturity, etc) are freely negotiated between lender and borrower. In our database we have only freely allocated loans. Since our primary interest is to access the monetary policy effect on credit interest rate and volume, it is natural to use only the freely allocated credit, since the regulated channeled credit probably does not respond to the monetary policy with the same intensity.

In April of 2004, freely allocated credit was 62% of the total credit, while channeled resources accounted for the others 38%. In September of 2007, the proportion of freely allocated credit increased to 70%. Of course, the existence of a substantial volume of earmarked credit makes monetary policy less effective.

We use an original and unique database from the Central Bank of Brazil (not available for the public domain because of banking privacy). Data come from banks call reports. Information about interest rates, new loans and volume are available at daily frequency. On a monthly basis, banks report data on maturity and default rates. This dataset contains only non-earmarked credit. The data begin in June of 2000 and goes up

[7] Banco do Brasil is the largest commercial bank and Caixa Econômica Federal is the third, when we measure bank's size by total assets. Both are owned by federal government.

[8] This value refers to December of 2002 and includes the contracts where commercial banks intermediates the transaction between BNDES and some borrower. This kind of loan generally is for micro, small and medium size firms.

to December of 2006. As our identification strategy uses the daily frequency only the interest rate and new loans variables are used as dependent variables.

Loans are classified into seventeen types of credit: six types of consumer loans, and eleven types of credit to firms. Credit types differ in several dimensions, such as the level and type of collateral, the type of borrower and the purpose of borrowing, which is linked to the maturity of the credit, and the presence of interest rate indexation[9].

Our main independent variables will be the basic interest rate surprise around the monetary policy committee meeting and variations on the effective reserve requirements ratio. In Brazil, reserve requirements are frequently used as an auxiliary monetary policy instrument, which make them an important parameter for the banks' decisions on credit interest rate and volume.

The basic interest rate surprise is defined as the new target set for the basic interest rate (hereafter called SELIC rate) minus the median of the expectations of the basic interest rate in the day before the meeting. The series of the target of the SELIC rate and the expectations are available at the Central Bank of Brazil's website (www.bcb.gov.br). The series of the expectation begins only in November of 2001, which restricts the sample period.

Graph 1 shows the pattern of the unexpected variation of the Selic rate. The graph shows large unexpected changes by the end of 2002: 3% per year in October of 2002, 1% per year in November of 2002 and December of 2002. This divergence of expected and actual SELIC rates reflects the macroeconomic instability preceding the election of President Lula. In the first two months of the new administration, the expected SELIC rate was smaller than the actual SELIC rate, now reflecting the central bank's attempt to build reputation of toughness. In the second semester of 2003, the opposite happened: from August through November of 2003 there were unexpected reductions in the SELIC rate. After that, there were two long periods without surprises in the conduct of monetary policy: November of 2004 to March of 2005, and June of 2006 to July of 2007.

[9] In our sample we will work only with loans which have predetermined nominal interest rates. This excludes from the sample the three modalities linked to exports and imports since the interest rates in these modalities have exchange rate indexation and the two types of credit linked to housing (individuals and firms), which are indexed to a rate settled by the government (TR rate) . This sample cut avoids the unnecessary noise that expectations calculations would bring to our data at low cost, since most of the freely allocated credit in Brazil has predetermined interest rate.

Graph 1 - Actual x Unexpected Selic variation

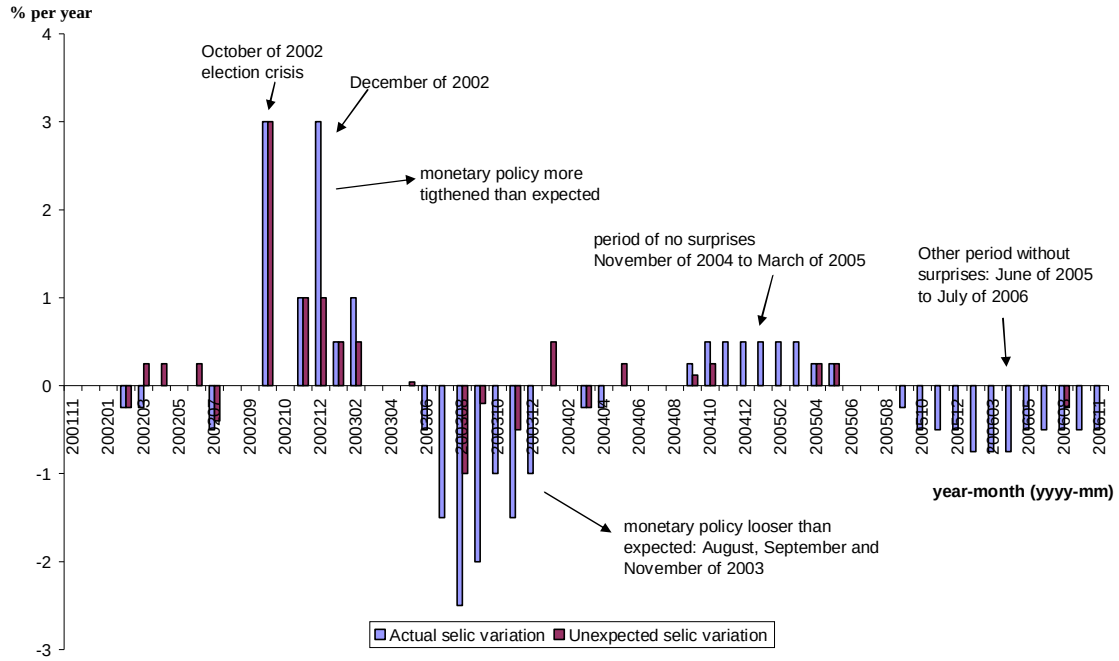


Table 1 has pairwise correlations between change in lending interest rate and Selic (unexpected and actual), and changes in new loans and Selic (unexpected and actual). A clear pattern emerges from this table. Plain correlations show it takes two days for changes in the basic rate to affect lending rates and quantities. But with longer windows - three and four days - the correlation between unexpected changes in SELIC and lending rates (quantities) has the expected positive (negative) sign. For the following window, five days, the correlations either drop significantly or even change the sign. A similar pattern is observed for the actual SELIC variation, with the difference that for the new loans variable the correlation on the first two days already has the expected sign.

Table 1 - Correlations between interest and new loans and selic*

	Unexpected selic variation	Actual selic variation
$interest_{t-1}$	-0.25	-0.15
$interest_{t-2}$	-0.20	-0.01
$interest_{t-3}$	**0.19**	**0.16**
$interest_{t-4}$	**0.38**	**0.38**
$interest_{t-5}$	0.12	0.13
new_loans_{t-1}	0.10	-0.11
new_loans_{t-2}	0.002	-0.14
new_loans_{t-3}	**-0.22**	**-0.23**
new_loans_{t-4}	**-0.08**	**-0.28**
new_loans_{t-5}	0.14	-0.0001

*Source: Own elaboration from the Central Bank of Brazil data. The definitions of the variables are the following: $interest_{t-1}$ is the difference between the average credit annual interest rate one day after the monetary policy committee meeting and the average interest rate one day before the meeting; $interest_{t-2}$ is the difference between the average credit annual interest rate two days after the monetary policy committee meeting and the average interest rate one day before the meeting; the same logic applies to higher order differences and for new loans.

Having presented the main stylized facts about the effects of basic interest rate management on banks' loans, we now move to analyze the effects of reserve requirements. Brazil has a complex reserve requirement structure. Until 2002 there were three different ratios for three different forms of deposits: demand, time and saving deposits. Besides, there were different deductions and exemptions for each of them. The deduction is a discount in the total amount that would be subject to the reserve requirement before the incidence of the ratio, while the exemption is the amount exempt of the reserve requirement charge after the calculation of the reserve requirement amount. In practice, Brazil has a progressive reserve requirement structure: the more deposits the bank issues, the higher its reserve requirement ratio will be.

Another important feature of the reserve requirement rules in Brazil is that each kind of deposit has a different remuneration. While demand deposits reserve requirements have zero remuneration, time deposits have remuneration equal to the SELIC rate and saving deposits have a regulated remuneration legally determined[10].

[10] Its remuneration is equal to TR rate plus 6% per year. The TR rate is determined by the government.

In August of 2002, in the beginning of the election crisis of 2002, this structure became even more complex with the creation of the additional reserve requirement ratio. It was a new category of reserve requirement on the three types of deposits at the same time. The new rule established that besides the other ratios that already existed, a new ratio of 3% for time and demand deposits and 5% for saving deposits would be created. Besides, there would be a deduction of R$30 millions in the required amount, in order not to make the new rule impracticable for small banks. For this new category was established a remuneration equals the SELIC rate.

Currently there is a 45% ratio for demand deposits and a 15% ratio for time and saving deposits. Besides that, there is an additional reserve requirement ratio of 8% for the demand and time deposits and of 10% for saving deposits. The demand deposits reserve requirement has an R$44 millions deduction, the time deposits reserve requirement has an R$30 millions deduction and an R$300 millions exemption[11] and the additional reserve requirement has an R$100 millions deduction.

In the table 2, we show the seven changes in the reserve requirements rules during the sample period:

Table 2 - Changes in the rules of reserve requirements in Brazil: 2002-2006

Announcement date	Type of deposit	Ratio's change	Deduction's change	Exemption's change
6/14/2002	Time deposits	10% to 15%	None	None
6/24/2002	Saving deposits	15% to 20%	None	None
8/14/2002	Additional	0% to 3% (demand and time deposits) and 0% to 5% (saving)	R$0 to R$30 millions	None
10/11/2002	Additional	3% to 8% (demand and time deposits) and 5% to 10% (saving)	R$30 millions to R$100 millions	None
2/19/2003	Demand deposits	45% to 60%	R$4 millions to R$44 millions	None
8/8/2003	Demand deposits	60% to 45%	None	None
11/19/2004	Time deposits	None	None	R$0 to R$300 millions

In order to be able to use all these changes, we created a measure of a general reserve requirement ratio for each bank taking into account all kinds of reserve requirement at the same time. We first define:

[11] This means that banks with time deposits liability less than R$300 millions do not need to accomplish it.

$ratio_t^d$ - reserve requirement ratio of demand deposits in period *t*.

$ratio_t^T$ - reserve requirement ratio of time deposits in period *t*.

$ratio_t^s$ - reserve requirement ratio of saving deposits in period *t*.

$ratio_t^{add}$ - additional reserve requirement ratio of the demand deposits in period *t*.

$ratio_t^{adt}$ - additional reserve requirement ratio of time deposits in period *t*.

$ratio_t^{ads}$ - additional reserve requirement ratio of saving deposits in period *t*.

$demand_{it}$ - demand deposits of bank *i* in period *t*.

$time_{it}$ - time deposits of bank *i* in period *t*.

$savings_{it}$ - saving deposits of bank *i* in period *t*.

d_t^d - deduction of demand deposits in period *t*.

d_t^T - deduction of time deposits in period *t*.

d_t^{ad} - deduction of additional deposits in period *t*.

$exemp_t^d$ – exemption of the demand deposits in period t.

$exemp_t^T$ – exemption of the time deposits in period t.

Given these definitions, the general formula will be:

$$Total\_ratio_{it} = \frac{\left\{ \begin{array}{l} \max\left\{ ratio_t^d \left[\max\left(demand_{it} - d_t^d, 0 \right) \right] - exemp_t^d, 0 \right\} + \max\left\{ ratio_t^T \left[\max\left(time_{it} - d_t^T, 0 \right) \right] - exemp_t^T, 0 \right\} + ratio_t^s savings_{it} \\ + \max\left[\left(ratio_t^{add} demand_{it} + ratio_t^{adt} time_{it} + ratio_t^{ads} savings_{it} - d_t^{ad} \right), 0 \right] \end{array} \right\}}{demand_{it} + time_{it} + savings_{it}}$$

$Total\_ratio_{it}$ is the general reserve requirement ratio of bank *i* in period *t* putting together all kinds of reserve requirement in Brazil. Since each of these reserve requirements has a different remuneration and a different opportunity cost, this is not the ideal way to calculate this value. But given the trade-off between precisely calculating the ratio for each type of reserve requirement and increasing the sample by putting together all variations in the reserve requirement, we gave opted for the latter.

In order to calculate the total ratio change for each bank at the time of the reserve requirement announcement we applied the new rule announced to the demand, time and saving deposits that each bank had in the day of the announcement. This way, we are able

to precisely calculate the actual change for each bank. For example, increases in reserve requirements occurring together with increases in the deductions may represent a net reserve requirements decrease for few banks with small levels of deposits. So, we are measuring the reserve requirement in a much more precisely way than normally it is measured in empirical works that use monthly averages of ratios or aggregate quantities.

Table 3 below shows the annual banking system averages of deposits amount of all kinds, including their sum (total deposits). It shows that the volume of time deposits is the largest, being almost three times larger than demand deposits and 25% larger than saving deposits. Between 2002 and 2006, the growth rate of time deposits was 90.4%, of demand deposits was 95.4%, of saving deposits was 33.3% and of total deposits was 68.5%. The required volume growth rates between 2002 and 2006 were: 62.5% for reserve requirements on time deposits, 91% for reserve requirements on demand deposits, 33.3% for reserve requirements on saving deposits, 390% for the additional reserve requirements and 105% for the reserve requirements on total deposits. So, in the period, there was a clear tightening stance of monetary policy through reserve requirements, since the growth rate of the total required volume was well above the growth of total deposits, mainly because the creation of the additional reserve requirement and posterior increase in its ratio.

Table 3 - Deposits and required volumes*

year	Demand deposits	Time deposits	Savings	Total Deposits	Required volume Demand deposits	Required volume Time deposits	Required volume Savings	Required volume Additional	Required volume Total
2000	40.0	126.1	109.5	275.6	17.9	0	16.4	0	34.3
2001	44.8	131.8	113.8	290.4	20.1	4.1	17.1	0	41.3
2002	49.7	146.8	128.5	325.1	22.3	18.7	23.2	8.5	72.7
2003	58.8	158.9	138.7	356.3	29.7	23.2	27.7	25.9	106.6
2004	72.0	174.0	148.9	394.9	31.4	23.8	29.8	29.3	114.3
2005	82.9	225.9	161.1	469.9	36.3	23.4	32.2	35.6	127.6
2006	97.1	279.5	171.3	547.8	42.6	30.4	34.3	41.7	149.0

* Average values during the year measured in R$ billions; for 2000, values from June to December.

Table 4 below shows the annual banking system averages of the all kinds of reserve requirement ratios, including the constructed measure total ratio. It shows that the effective requirement total ratio increase from 22.4% in 2002 to 27.2% in 2006, meaning a total growth in the period 2002-2006 of 21% (an average annual growth of 4.2%). But the table also shows that there was variability in this ratio during the period. First the ratio increased from 22.4% in 2002 to 29.9% in 2004, then declining in 2005 and 2006 to 27.2%. In the same period, the Selic rate changed more, from 18% per year in 2002 to 26.5% per year in the beginning of 2003 and then gradually decreased to 13.25% in 2006.

As expected, reserve requirements changes were less frequent than changes in the Selic rate. They were also smaller, but variability was enough to estimate his effect on credit variables. That variability is a singular characteristic of Brazil, whose monetary policy still uses reserve requirement as an auxiliary, however important, tool. Table 5 has the requirement reserve ratio for six selected countries. Among them, three abolished the reserve requirement use. Among the three that still have reserve requirement, only India has frequently changed its ratio. The last change in the US was 16 years ago and in Chile was 28 years ago. Comparing the figures in tables 4 and 5 we can see that despite the fact the reserve requirement being no longer in use in almost all countries, it is still important in Brazil.

Table 4 - Reserve requirement ratios in Brazil*

year	Demand ratio	Time ratio	Savings ratio	Additional ratio	Total ratio
2000	44.8%	0%	15.0%	0%	12.5%
2001	44.8%	3.1%	15.0%	0%	14.2%
2002	44.8%	12.7%	18.1%	2.6%	22.4%
2003	50.5%	14.6%	20%	7.3%	29.9%
2004	43.7%	13.7%	20%	7.4%	29.0%
2005	43.8%	10.4%	20%	7.6%	27.2%
2006	43.9%	10.9%	20%	7.6%	27.2%

* annual average ratio,based on monthly average of requirements volume and deposits; for 2000, values from June to December

Table 5 - Reserve requirement ratios for selected countries*

	Ratio	Last Change
United States	10%(demand deposits)	1992
United Kingdom	None	None
Australia	None	None
Mexico	None	None
India	7.5%	October 2007**
Chile	9%(demand deposits); 3,6% (time deposits)	1980

*Source: "Monetary policy framework and central banks operations", BIS, 23 April 2008

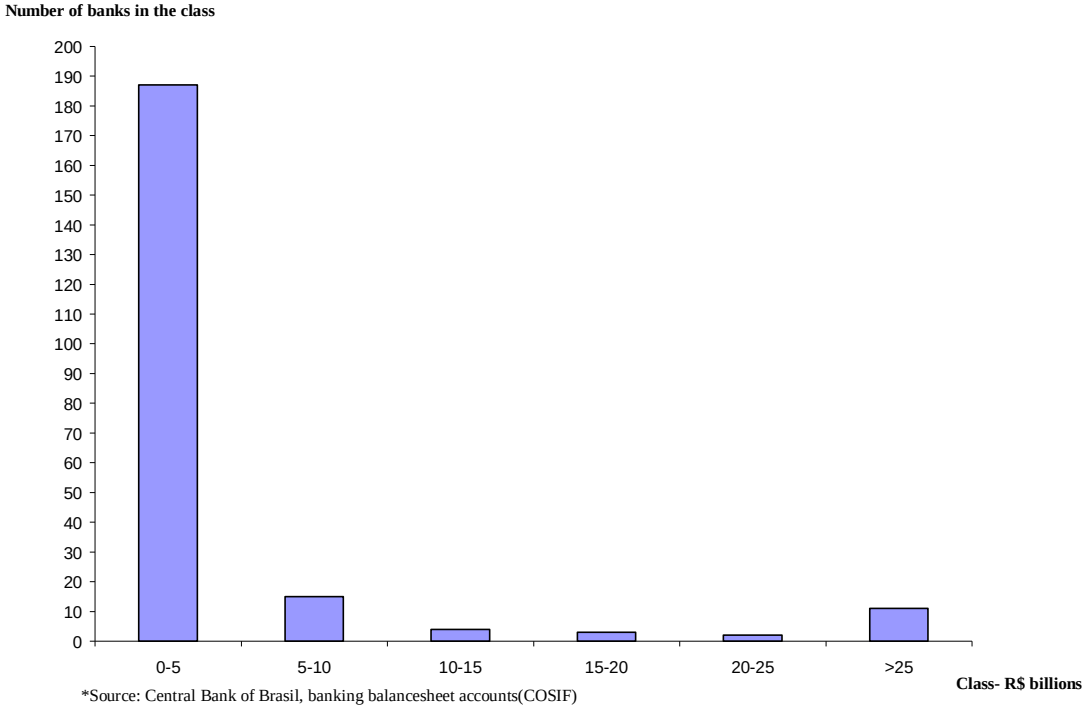
** Only in 2007, India changed reserve requirement ratio four times

In our estimations we will use bank's characteristics linked to the probability of a bank being financially restricted. The main characteristic used in this paper is the size of the bank. We will measure bank's size by banks' total asset. We get the total asset from the balance sheet accounts reported to Central Bank of Brazil[12]. In our final sample there

[12] This Database is called Cosif (Plano Contábil das Instituições Financeiras do Sistema Financeiro Nacional) which can be translated as the Account Plan of Financial Institutions from the National Financial System.

are 221 banks. In the graph 2 below we show the distribution of the banks in our sample by total asset[13]. This graph illustrates the banking market structure in Brazil. At one extreme there is a large amount of small banks (187 banks), whose average total asset in the sample period was smaller than R$5billions. These banks represented 13% of the system total assets. In the other extreme there is a small amount of large universal banks (11 banks)[14] whose average total asset was more than R$25 billions. These banks represented 66.4% of the system total assets. Between these two extremes, there is a small amount of medium size banks (24 banks), whose total asset varied from R$5 billions to R$25 billions. These banks represented 20.6% of the system total assets.

Graph 2 - Distribution of banks by total asset*



*Source: Central Bank of Brasil, banking balancesheet accounts(COSIF)

As our focus is in how changes in the Selic and total ratio can affect the functioning of deposit markets, it is interesting to analyze the funding composition of

[13] In order to do this graph we took the average value of the total assets of each bank in the sample period. In the graph we divided banks in classes by the total assets. The first class has banks with total assets between R$0 and R$5 billions. Each subsequent class has a fixed size of R$5 billions, except the last class, where we included all banks with total assets larger than R$25 billions.

[14] From these, three are state-owned banks (the first, the second and the eleventh largest banks) and represented 22.1% of system total asset. Three are foreign banks and represented 8.2% of the system total assets. The rest are domestic private banks and represented 38.3% of the system total asset. One of the banks in this group is not a retail bank, but instead its main market niches are the fortune administration of rich clients and large companies.

each category of size in Brazil. From the previous analysis we will classify banks in the following way: the eleven largest banks we will call large banks. The 24 banks with total asset between R$5 billions and R$25 billions we will call medium size banks and the smallest banks with total asset less than R$5 billions we will call small banks. Table 5 shows the proportion of deposit funding for each bank's category and how this deposit funding is divided among demand, time and saving deposits.

From this table we can see clear differences in the way each class of bank funding his operation. Large banks have the highest percentage of their liability as deposits, but medium banks have a smaller proportion than the small ones.

For the large banks demand and saving deposits are an important source of funding (22.3% of their funding on average) as it is time deposits (23.4%). For the medium and small size banks time deposits is the only deposit funding that is quantitative important. But it is more relevant for the small banks than for the medium size banks. Banks must have branches all over the country in order to be able to compete for the demand and saving deposits. The time deposits are segmented between large denomination CDs and the "retail" market for individuals. Small and medium size banks are able to get funding in this wholesale CDs market.

So, these numbers show that probably all kinds of banks are affected by the reserve requirement on time deposits, while reserve requirements on saving and demand deposits affect mainly the large banks. As our measure of reserve requirement change take into account all of the types of deposits at the same time, total ratio changes caused by changes in the demand and saving deposits reserve requirement will not affect the most part of the small and medium banks.

Table 6: Deposit funding by bank's size - % of total liability*

	Large banks			
	Total deposits/liability	Demand deposits/liability	Time deposits/liability	Saving deposits/liability
average	45.7	8.1	23.4	14.2
median	45.6	8.9	22.0	12.4
minimum	25.8	2.9	3.2	1.2
maximum	74.7	13.0	43.6	31.3
	Medium banks			
	Total deposits/liability	Demand deposits/liability	Time deposits/liability	Saving deposits/liability
average	20.7	2.5	14	4.6
median	18.1	0.7	11	0
minimum	0	0	0	0
maximum	65.2	9	38	29.1
	Small banks			
	Total deposits/liability	Demand deposits/liability	Time deposits/liability	Saving deposits/liability
average	33.8	3.5	29	1.2
median	25.5	0.5	20	0
minimum	0	0	0	0
maximum	98.1	67	98	37.3

*Source: Own elaboration from banks' balance sheet accounts (Cosif, Central Bank of Brazil)

Table 7 is akin to Table 1, but splits the banks in large, medium and small. It shows that the correlations using the large banks for the 3-day and 4-day windows are in general higher and it always has the right sign. For the medium banks the new loans correlations have the right sign but interest rate does not in general, only in the 5-day window. For the small banks, new loans correlations follow the same pattern and interest rate correlation has the right sign in the 1-day, 4-day and 5-day windows. This table shows the general result we will find later in this paper: larger banks react more to changes in monetary policy than medium and small banks. This evidence does not support the banking lending view of monetary policy transmission[15].

[15] A very similar pattern of that in tables 1 and 6 is found for reserve requirement total ratio. We omit them for conciseness.

Table 7 - Correlations between selic and credit variables*

	Large banks	
	Unexpected selic variation	**Actual selic variation**
interest $_{t-1}$	-0.04	-0.01
interest $_{t-2}$	-0.06	-0.05
interest $_{t-3}$	**0.10**	**0.09**
interest $_{t-4}$	**0.13**	**0.26**
interest $_{t-5}$	0.12	0.13
new_loans $_{t-1}$	0.07	-0.15
new_loans $_{t-2}$	0.061	-0.09
new_loans $_{t-3}$	**-0.13**	**-0.19**
new_loans $_{t-4}$	**-0.11**	**-0.31**
new_loans $_{t-5}$	0.14	-0.02
	Medium banks	
	Unexpected selic variation	**Actual selic variation**
interest $_{t-1}$	-0.04	-0.09
interest $_{t-2}$	-0.03	-0.12
interest $_{t-3}$	**-0.12**	**-0.18**
interest $_{t-4}$	**-0.06**	**-0.17**
interest $_{t-5}$	0.14	0.04
new_loans $_{t-1}$	0.04	-0.11
new_loans $_{t-2}$	0.07	-0.11
new_loans $_{t-3}$	**-0.02**	**-0.11**
new_loans $_{t-4}$	**-0.11**	**-0.31**
new_loans $_{t-5}$	0.17	0.02
	Small banks	
	Unexpected selic variation	**Actual selic variation**
interest $_{t-1}$	0.03	-0.03
interest $_{t-2}$	-0.002	-0.07
interest $_{t-3}$	**-0.06**	**-0.10**
interest $_{t-4}$	**0.07**	**0.09**
interest $_{t-5}$	0.08	0.01
new_loans $_{t-1}$	-0.05	-0.17
new_loans $_{t-2}$	0.01	-0.15
new_loans $_{t-3}$	**-0.07**	**-0.10**
new_loans $_{t-4}$	**-0.07**	**-0.24**
new_loans $_{t-5}$	0.17	0.01

*Source: Own elaboration from the Central Bank of Brazil data. The definitions of the variables are the following: *interest* $_{t-1}$ is the difference between the average credit annual interest rate one day after the monetary policy committee meeting and the average interest rate one day before the meeting; *interest* $_{t-2}$ is the difference between the average credit annual interest rate two days after the monetary policy committee meeting and the average interest rate one day before the meeting; the same logic applies to higher order differences and for new loans.

III. Empirical Strategy

The challenge to identify the bank lending channel literature is similar to the standard problem in demand and supply estimation. The bank lending channel refers to the supply side of the credit market, but only equilibrium values are observed. Following a monetary policy shock, it is conceivable that not only the supply of credit shifts, but also demand for credit.

Until now, the empirical literature strategy has used bank characteristics to isolate demand factors[16]. Different types of banks may differ in their access to means of funding other than deposits. In such case, monetary shocks may have different impacts on bank lending for supply reasons. Typical bank characteristics used to split banks into "open" and "limited" access to alternative funding are size, liquidity and ownership (foreign versus domestic).

Nevertheless, bank type segmentation implies that monetary shocks can have a heterogeneous impact on the bank-level for demand reasons. Consider middle market and large universal banks. As a matter of fact, middle market banks specialize in receivables' discounting for Small and Medium Enterprises. Large Universal banks, in addition to discounting, do short and medium term working capital loans for larger firms. It is quite conceivable that large firms lower their demand of medium-term working capital in response to monetary tightening, but SMEs will not cut their demand for discounting.

In addition to the strategy used in the literature, we use the high frequency of our data as an identification source. Monetary economics assumes that there are lags for the output and inflation to be affected by the traditional monetary policy mechanism[17]. This occurs because in the short run, decisions linked to consumption and investment have some inertia. Since monetary policy affects banks' marginal cost immediately, the credit supply's reaction to monetary policy is faster than credit demand's. Our dataset has features that allow us to use this difference in reaction timing to estimate the importance of the bank lending channel. First, as mentioned, the frequency of the data is used. Daily

[16] For example: Kashyap and Stein [1994], Kashyap and Stein [2000], Takeda et al. [2005] and Arena et al. [2007].
[17] See for example Christiano et al [1999].

data allow us to perform an event study around monetary policy committee meeting, which sets the SELIC interest rate, and announcements of changes in reserve requirements rules. If we use a window that is short enough, we can be more confident than previous literature that we are estimating a supply response. Second, our dataset has information not only about the credit stock, but also about flows, i.e., new loans. This is crucial for our strategy to be successful since stocks are relatively fixed in the very short-run. Finally, we have information on the lending interest rate, which is useful to confirm that our results are indeed driven by supply factors. For example, assume that we find that small banks cut their lending more than large banks, *but* that their interest rate are less sensitive to changes in the SELIC. In this case, under the usual assumption in the literature that large banks have better alternative means of funding, the bank lending channel hypothesis is falsified: small banks' interest rates should respond *more* to changes in the basic rate.

In the event study, we look at the days in which the monetary policy committee had a meeting to set a new target for the interest rate and the days in which the Central Bank of Brazil announced a change in the reserve requirements rules impacting our constructed measure of reserve requirement ratio. We use the surprise of the basic interest rate announcement, subtracting from the new interest rate announced, the market expected interest rate in the day before the meeting,[18] and the actual changes in the total reserve requirement ratio as explained above (the calculated change in total ratio)[19]. These are the news of monetary policy and our empirical strategy assumes that banks reaction to the news is faster than their clients' reaction[20]. We then compare the behavior of new loans and interest rate immediately after and before the announcements. Short windows of three to eight days are used. As explained above, plain correlations suggest at least two-days delay in banks' responses to Selic rate and reserve requirement ratio.

The estimated equations are:

[18] As a robustness test we used the actual interest rate changes too. Results are available upon request.
[19] We are assuming that the actual and unexpected reserve requirement changes are always the same.
[20] For the reserve requirement ratio, this assumption is not strictly necessary, since there is no clear link between reserve requirement ratio and credit demand.

$$New\_loans_{ijt+N} - New\_loans_{ijt-1} = c_{ij} + \beta_1 \times characteristic_{it} + \beta_2 \times \left\{ selic_t - median_{t-1}\left[E^i_{t-1}\left(selic_t \right) \right] \right\}$$
$$+\beta_3 \times characteristic_{it} \times \left\{ selic_t - median_{t-1}\left[E^i_{t-1}\left(selic_t \right) \right] \right\} + \beta_4 \times \Delta total\_ratio_{it} \quad (1)$$
$$+\beta_5 \times characteristic_{it} \times \Delta total\_ratio_{it} + \varepsilon_{ijt}$$

$$Interest_{ijt+N} - Interest_{ijt-1} = c_{ij} + \gamma_1 \times characteristic_{it} + \gamma_2 \times \left\{ selic_t - median_{t-1}\left[E^i_{t-1}\left(selic_t \right) \right] \right\}$$
$$+\gamma_3 \times characteristic_{it} \times \left\{ selic_t - median_{t-1}\left[E^i_{t-1}\left(selic_t \right) \right] \right\} + \gamma_4 \times \Delta total\_ratio_{it} \quad (2)$$
$$+\gamma_5 \times characteristic_{it} \times \Delta total\_ratio_{it} + \upsilon_{ijt}$$

The subscript *i* refers to the bank, *j* refers to the type of credit, and the dimension *t* to the period, which is linked to a monetary policy committee meeting or an announcement of reserve requirement change. We include fixed-effect dummies for the pair bank-type of credit. The coefficients of interest are β_3, β_5, γ_3 and γ_5. The expected signs of these coefficients according with banking lending channel view depend on how the banking characteristic is linked to the likelihood of the banking being financially restricted. For example, the standard assumption in the literature is that larger banks are less restricted in funding options. For new loans, we expect a negative sign for β_2 and β_4, the "normal" effects of monetary policy. If smaller banks have more difficult to trade deposits for other kind of debts, then their sensibility to monetary policy will be higher, meaning that β_3 and β_5 should be positive if the bank lending channel is operative. The expected sign of the "normal" effects of monetary policy on interest rate, γ_2 and γ_4 are positive. Analogously, the expected sign of γ_3 and γ_5 will be negative when the bank characteristic is the size.

IV. Results

IV.A General effects of monetary policy

In this subsection we analyze the estimates of monetary policy effect on credit interest rate and volume without any banking characteristic. These results are an average effect of the monetary policy in these variables[21].

[21] In all estimations using new loans as dependent variable, we will estimate the model with cumulated windows, i.e., the cumulated sum of the variation of new loans in the following days of monetary policy change. For example, in the case of the cumulated window in the eight days after monetary policy change

Tables 8 and 9 show the results:

Table 8 : Dependent variable: ***New_loans*** $_{t+N}$ **-** ***New_loans*** $_{t-1}$ †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*	*N=3 and N=4*	*N=3,4 and 5*	*N=1 to 5*	*N=1 to 8*
Δselic	-263***	-119***	189***	-33	-18	-381***	-571***	-573***	-806***	-1,812***
	(46)	(24)	(44)	(34)	(46)	(60)	(70)	(78)	(135)	(284)
Δtotal_ratio	-5,331***	1,328	-2,537*	-5,127***	-5,339***	-4,625**	-12,177***	-22,948***	-41,926***	-83,167***
	(1,795)	(1,372)	(1,422)	(1,845)	(1,962)	(2,319)	(2,817)	(3,449)	(4,823)	(9,210)
N obs	50114	49892	49618	49456	49271	49911	49611	49166	48783	47797
N grupos	1085	1083	1085	1084	1083	1078	1082	1080	1077	1072
R^2	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.002

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

Table 9 : Dependent variable: ***Interest_rate*** $_{t+N}$ ***-Interest_rate*** $_{t-1}$ †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*
Δselic	.62***	1.3***	.31*	.54***	.0021	.65***
	(.18)	(.18)	(.17)	(.18)	(.2)	(.21)
Δtotal_ratio	23***	27***	14**	24***	36***	31***
	(6.2)	(7.3)	(6.1)	(8.6)	(8.4)	(9.5)
N obs	29869	29486	29347	29382	29050	29617
N grupos	812	807	806	807	818	814
R^2	0.001	0.002	0.001	0.001	0.001	0.001

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

The results show that Selic rate and total ratio have a negative and statistical significant effect on new loans and that they have a positive and statistical significant effect on lending interest rate.

In quantitative terms, an increase of the Selic rate of 1% per year implies in a drop of new loans between R$119 thousands (N=3) and R$1.8 millions (N=1 to 8). An increase of the total reserve requirement ratio of 1% implies in a drop of new loans between R$46 thousands (N=8) and R$831 thousands (N=1 to 8).[22]

(the last column in the results tables for new loans), the dependent variable is: $\left(\sum_{j=1}^{8} Nov\_conc_{t+j} \right) - Nov\_conc_{t-1}$

[22] Looking at the table 3, this increase of 1% in the total ratio implies an increase of R$4.2 billions in the system total requirement volume in the sample period. But the estimated effect is an average affect. We have to multiply the average effect by the number of banks in order to make numbers comparables. Doing the calculations, the aggregated estimated effect is between R$10.2 millions and R$183.6 millions, which implies that the drop in the credit volume is between 0.25% and 4.4% of the increase in the amount of money being required (R$4.2 billions). This low response of credit volume is expected, since we are

The effect of Selic on credit interest rate is positive and statistically significant in 5 of 6 windows. The estimated pass-through in almost all windows (with the exception of the 4-day window) is less than 1, which means that not all variation of Selic is passed on credit interest rate. This stickiness can be explained by the market structure and/or issues related to adverse selection in credit markets as in Stiglitz and Weiss (1981). The effect of reserve requirement total ratio on credit interest ratio is positive and statistically significant in all windows. The estimated coefficients show that after a 1% increase on total ratio, credit interest rate increases between 0.14% and 0.36% per year.

The signs and magnitudes of our estimated responses to Selic and total ratio are in line with supply responses. This indicates that our identification strategy is reliable.

IV.B Size

In this subsection we use size as the banking characteristic influencing the way banks react to monetary policy. The intuition is that as larger banks have more collateral to offer, they probably will find easier to trade deposits for other kind of debts. Besides that, investors could be more willing to buy shares of larger banks if they think that government sees them as too big to fail. We use the following normalized measure of bank's size as in Takeda et al (2005):

$$size_{it} = \log\left(Total\_assets_{it}\right) - \frac{1}{N_t}\sum_{i=1}^{N_t}\log\left(Total\_assets_{it}\right)$$

Tables 10 and 11 show the results for new loans and interest rate:

working with short windows, which make us underestimate the long run impact of reserve requirements on credit volume.

Table 10 : Dependent variable: *New_loans $_{t+N}$ - New_loans $_{t-1}$* †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*	*N=3 and N=4*	*N=3,4 and 5*	*N=1 to 5*	*N=1 to 8*
size	271***	50	-55	-187***	-64	341***	1,541***	2,756***	5,355***	9,472***
	(66)	(45)	(55)	(53)	(69)	(82)	(105)	(161)	(281)	(500)
Δselic	-119***	-62***	96***	-24	-8.7	-197***	-234***	-195***	-242***	-622***
	(20)	(12)	(20)	(18)	(21)	(27)	(32)	(40)	(71)	(135)
size x Δselic	-162***	-65***	108***	-14	-12	-208***	-353***	-374***	-530***	-1,155***
	(32)	(16)	(31)	(22)	(32)	(41)	(47)	(51)	(87)	(189)
Δtotal_ratio	3,844***	-963	467	-1,077	932	2,073	6,205***	10,095***	15,781***	27,676***
	(1,261)	(925)	(877)	(1,225)	(1,323)	(1,446)	(1,988)	(2,672)	(4,061)	(7,696)
size x Δtotal_ratio	-7,128***	1,837	-2,419	-3,368*	-5,019**	-5,070*	-13,581***	-24,442***	-42,423***	-81,874***
	(2,109)	(1,608)	(1,623)	(2,005)	(2,326)	(2,617)	(3,410)	(4,009)	(5,318)	(10,344)
N obs	50000	49778	49514	49353	49174	49817	49497	49062	48681	47710
N grupos	1085	1083	1085	1084	1083	1078	1082	1080	1077	1072
R^2	0.003	0.001	0.001	0.001	0.001	0.002	0.009	0.011	0.013	0.018

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

Table 11: Dependent variable: *Interest_rate $_{t+N}$ -Interest_rate $_{t-1}$* †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*
size	.89**	.51	.87**	.9**	1.1***	1.3***
	(.42)	(.35)	(.36)	(.39)	(.44)	(.41)
Δselic	.18	1***	.16	.084	-.28	.19
	(.27)	(.23)	(.23)	(.23)	(.28)	(.31)
size x Δselic	.31***	.22***	.11	.32***	.2**	.32***
	(.094)	(.073)	(.079)	(.074)	(.09)	(.1)
Δtotal_ratio	20**	14	-.75	10	29***	29**
	(8)	(9.2)	(7.1)	(12)	(11)	(13)
size x Δtotal_ratio	2.9	9.1***	9.4***	8.7**	4.9	1.6
	(2.7)	(3.2)	(3)	(4)	(3.3)	(4.2)
N obs	29797	29410	29285	29317	28994	29561
N grupos	812	807	806	807	818	814
R^2	0.002	0.003	0.001	0.001	0.001	0.002

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

Results in tables 11 and 12 show that, as in our previous estimations, banks react to changes in monetary policy in the expected way, if we are indeed capturing a supply response. They increase lending interest rates, and there is a contraction of new loans after a monetary policy contraction.

Results, however, are not in accordance to the bank lending channel in these two tables. Results are the opposite of what one would expect if banking lending channel

were operative: larger banks react more to monetary policy, changing more quantity and interest rate in response to monetary policy changes (Selic and total ratio)[23]. So, the results can not be explained by the difference in the access to alternative source of funds between small and large banks. A possible explanation is that the monetary policy effect on the banks' assets allocation between credit and bonds (mainly public bonds) is larger for the large banks.

IV.C Liquidity

The second characteristic used is liquidity. The intuition for using this feature is that banks with more liquidity probably have the capacity to offer collateral with higher quality (government bonds, for example) and this liquidity serves as buffer stock when reacting to the monetary policy shocks.

We define a normalized measure of liquidity in the same spirit as in Takeda et al. (2005):

$$liquidity_{it} = \frac{cash_{it} + \text{free securities}_{it} + \text{interbanking aplications}_{it}}{Total\_assets_{it}} - \sum_{t=1}^{T}\sum_{i=1}^{N_t}\frac{1}{N_t}\frac{cash_{it} + \text{free securities}_{it} + \text{interbanking aplications}_{it}}{Total\_assets_{it}}$$

Tables 12 and 13 show the results:

Table 12 : Dependent variable: *New_loans* $_{t+N}$ - *New_loans* $_{t-1}$ †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*	*N=3 and N=4*	*N=3,4 and 5*	*N=1 to 5*	*N=1 to 8*
liquidity	466***	182	-96	-558***	-183	189	2,162***	3,605***	6,806***	11,197***
	(128)	(116)	(127)	(148)	(169)	(182)	(210)	(306)	(526)	(866)
Δselic	-257***	-121***	182***	-40	-19	-367***	-532***	-508***	-691***	-1,583***
	(45)	(25)	(41)	(33)	(43)	(57)	(67)	(75)	(130)	(269)
liquidity x Δselic	48	-103	-163	-47	35	346	450*	781***	1,281***	3,312***
	(181)	(113)	(141)	(134)	(137)	(217)	(266)	(267)	(465)	(931)
Δtotal_ratio	-5,261***	1,360	-2,056	-5,387***	-5,332***	-5,100**	-11,293***	-20,808***	-38,579***	-78,247***
	(1,681)	(1,303)	(1,364)	(1,882)	(1,829)	(2,140)	(2,633)	(3,217)	(4,512)	(8,652)
liquidity x Δtotal_ratio	1,096	693	9,784	-4,483	196	-9,833	15,797	38,794**	59,983**	88,905**
	(8,838)	(7,127)	(6,814)	(10,615)	(8,151)	(10,488)	(13,643)	(16,816)	(23,614)	(42,854)
N obs	50000	49778	49514	49353	49174	49817	49497	49062	48681	47710
N grupos	1085	1083	1085	1084	1083	1078	1082	1080	1077	1072
R^2	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.003

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

[23] In these estimations we are estimating an average effect of all credit types. Results, available upon request, did not change when we estimate a model where each type of credit has a different response to the monetary policy.

Table 13 : Dependent variable: *Interest_rate* $_{t+N}$ *-Interest_rate* $_{t-1}$ †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*
liquidity	-1.4	-.49	-1.6	-.56	-4.4***	-1.8
	(1.3)	(1.3)	(1.2)	(1.3)	(1.5)	(1.3)
Δselic	.4	1.4***	.34*	.48**	-.12	.56*
	(.29)	(.17)	(.18)	(.21)	(.22)	(.29)
liquidity x Δselic	-4	.71	.97	-.83	-1.4	-1.4
	(3.3)	(1.1)	(1.3)	(1.7)	(1.5)	(3.1)
Δtotal_ratio	20***	29***	12*	25***	37***	31***
	(6.5)	(8)	(6.7)	(9.6)	(9.5)	(11)
liquidity x Δtotal_ratio	-66	20	-41	33	28	17
	(45)	(43)	(44)	(54)	(55)	(61)
N obs	29797	29410	29285	29317	28994	29561
N grupos	812	807	806	807	818	814
R^2	0.001	0.002	0.001	0.001	0.001	0.001

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

Table 12 shows that liquidity has a positive impact in the way new loans react to Selic and total ratio in the cumulated windows (the last four columns), as is expected by the banking lending channel. However, this result does not show in any individual window.

Table 13 shows that liquidity does not influence the way credit interest rate respond to Selic and total ratio.

So, despite the fact that liquidity impact the way new loans react to monetary policy in the cumulated windows, this result does not seem robust, since it is not valid for credit interest rate and for the new loans estimations using individual windows.

IV.D Size and liquidity

In this subsection we will estimate the model with size, liquidity and their interaction. Tables 14 and 15 show the results:

Table 14 : Dependent variable: *New_loans $_{t+N}$ - New_loans $_{t-1}$* †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*	*N=3 and N=4*	*N=3,4 and 5*	*N=1 to 5*	*N=1 to 8*
size	284***	56	-56	-202***	-69	345***	1,601***	2,856***	5,537***	9,728***
	(67)	(46)	(56)	(54)	(70)	(83)	(106)	(163)	(285)	(505)
liquidity	568***	208	-134	-700***	-236	271	2,766***	4,695***	8,894***	14,717***
	(148)	(130)	(146)	(171)	(194)	(208)	(255)	(381)	(667)	(1,109)
Δselic	-107***	-61***	89***	-35**	-10	-180***	-177***	-101**	-74	-307**
	(20)	(13)	(17)	(17)	(19)	(25)	(32)	(41)	(73)	(136)
Δtotal_ratio	3,313***	-1,086	174	-965	361	1,435	5,985***	10,009***	16,564***	28,513***
	(1,082)	(803)	(847)	(1,142)	(1,168)	(1,254)	(1,715)	(2,344)	(3,657)	(6,918)
size x liquidity	480***	166*	-110	-567***	-118	154	1,987***	3,229***	6,076***	9,690***
	(110)	(100)	(112)	(132)	(151)	(152)	(182)	(264)	(450)	(732)
size x Δselic	-154***	-66***	102***	-21	-13	-200***	-324***	-329***	-451***	-1,010***
	(31)	(16)	(28)	(22)	(30)	(39)	(45)	(48)	(81)	(175)
size x Δtotal_ratio	-6,496***	1,864	-1,998	-3,492*	-4,572**	-4,762**	-12,288***	-22,092***	-38,932***	-75,811***
	(1,880)	(1,467)	(1,520)	(1,959)	(2,118)	(2,350)	(3,017)	(3,543)	(4,753)	(9,234)
liquidity x Δselic	103	-45	-146	-61	22	331*	564***	921***	1,584***	3,544***
	(139)	(91)	(113)	(110)	(112)	(169)	(216)	(246)	(441)	(840)
liquidity x Δtotal_ratio	-7,173	-2,101	-4,144	1,580	-8,464	-10,017	-233	4,715	21,689	34,731
	(7,974)	(4,499)	(4,742)	(8,040)	(6,227)	(7,137)	(12,367)	(19,498)	(32,241)	(60,183)
size x liquidity x Δselic	92	-89	-182*	-40	33	273*	324*	460***	651**	1,936***
	(133)	(78)	(106)	(92)	(103)	(159)	(188)	(175)	(300)	(650)
size x liquidity x Δtotal_ratio	13,967	-571	12,631*	21	12,279	5,667	25,788	50,165***	72,289***	128,240***
	(9,874)	(7,252)	(7,119)	(9,805)	(8,616)	(11,346)	(15,841)	(19,150)	(25,468)	(47,738)
N obs	50000	49778	49514	49353	49174	49817	49497	49062	48681	47710
N grupos	1085	1083	1085	1084	1083	1078	1082	1080	1077	1072
R^2	0.003	0.001	0.001	0.001	0.001	0.003	0.012	0.016	0.020	0.024

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

Table 15 : Dependent variable: *Interest_rate $_{t+N}$ -Interest_rate $_{t-1}$* †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*
size	.84**	.5	.86**	.88**	1.1**	1.2***
	(.42)	(.35)	(.36)	(.38)	(.44)	(.4)
liquidity	-.98	-.3	-1.5	-.33	-4.1***	-1.3
	(1.4)	(1.3)	(1.3)	(1.3)	(1.5)	(1.4)
Δselic	-.3	1***	.21	-.031	-.46	-.12
	(.52)	(.24)	(.29)	(.29)	(.34)	(.48)
Δtotal_ratio	11	18	-4	8.8	34**	35*
	(10)	(13)	(9.7)	(18)	(15)	(18)
size x liquidity	-.18	.0065	.27	.22	.25	.033
	(.58)	(.5)	(.51)	(.49)	(.58)	(.55)
size x Δselic	.46**	.24***	.098	.36***	.23**	.45***
	(.18)	(.075)	(.099)	(.095)	(.11)	(.16)
size x Δtotal_ratio	4.8	7.4*	9.6***	9.5*	2.8	-.67
	(3.4)	(4.2)	(3.6)	(5.5)	(4.5)	(5.5)
liquidity x Δselic	-7.4	-.0068	1	-2	-2.4	-4.8
	(5.2)	(1.4)	(2.2)	(2.2)	(2.4)	(4.5)
liquidity x Δtotal_ratio	-114	49	-52	-19	68	84
	(77)	(85)	(71)	(123)	(91)	(112)
size x liquidity x Δselic	2.6	.3	-.23	.81	.39	2.6
	(2.1)	(.48)	(.85)	(.81)	(.86)	(1.8)
size x liquidity x Δtotal_ratio	17	-28	-9.2	14	-29	-38
	(28)	(28)	(28)	(43)	(34)	(36)
N obs	29797	29410	29285	29317	28994	29561
N grupos	812	807	806	807	818	814
R^2	0.003	0.003	0.001	0.002	0.001	0.002

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

Results in table 14 show that size is an important feature determining the way new loans react to monetary policy, but again in the opposite direction one would expect if there was a banking lending channel. Liquidity alone is again important in explaining new loans reaction in the cumulated windows, in the direction banking lending would predict. Finally, the interaction between size and liquidity, another potential important characteristic, have significant impact on new loans reaction to Selic and total ratio, again in the "right" direction according to the banking lending channel view.

Results in table 15 show that only size has a significant impact on the credit interest response to monetary policy, in the opposite direction banking lending channel would predict.

To sum up, results in this section and in the previous one show mixed evidence concerning banking lending channel. The effect of the size on the way banks react to monetary policy was the opposite what banking lending channel would predict, while the effect of liquidity and the interaction of size and liquidity on the way new loans respond to monetary policy in the cumulated windows was in accordance with banking lending channel view. However, given the lack of robustness of new loans results to the window used in the estimation and that credit interest rate reaction depends on size but not on liquidity and his interaction with size, we believe that in general the results did not show robust evidence of banking lending channel in Brazil, but instead present a robust evidence of an opposite effect of what the banking lending channel would predict.

IV.E Size and ownership

As we saw in the previous results, size is an important characteristic explaining differences in the credit variables sensibilities. Another characteristic used in literature is the ownership of the bank. Arena et al (2007) point out that foreign banks may have smaller sensibility to the basic interest rate since they have access to a larger deposit base outside the country. Therefore, foreign banks would be less likely to be financially restricted in the debt market. Another type of bank that could have different sensibility would be state-owned banks. There are at least two reasons for this to happen in the Brazilian case: state-owned banks deposit base is more stable and less costly (more

regulated), giving them an advantage in responding to deposit shocks. Second, public banks could have in their objective function the smoothing of monetary policy shocks[24].

Tables 16 and 17 show the main estimated parameters of this model:

Table 16 : Dependent variable: $New\_loans_{t+N} - New\_loans_{t-1}$ †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*	*N=3 and N=4*	*N=3,4 and 5*	*N=1 to 5*	*N=1 to 8*
federal public banks *x* Δselic	950**	230	-607*	109	2.8	1,033**	1,884***	1,983***	2,938***	6,267***
	(396)	(180)	(352)	(217)	(402)	(473)	(583)	(598)	(1,029)	(2,307)
local public banks *x* Δselic	8.5	-69*	3.7	-49	68	26	27	118	303*	646**
	(50)	(41)	(44)	(46)	(56)	(65)	(75)	(91)	(158)	(310)
domestic private banks *x* Δselic	-190***	-51**	144***	-4.7	-.29	-257***	-346***	-305***	-407***	-1,001***
	(47)	(26)	(53)	(41)	(48)	(62)	(73)	(85)	(145)	(301)
foreign banks *x* Δselic	-29	-29	2.9	-70*	-4.6	-108**	-85	-115	-198	-371
	(30)	(24)	(25)	(36)	(49)	(51)	(59)	(91)	(166)	(301)
domestic private banks with foreign capital *x* Δselic	-164*	-30	69	-57	-99	-256**	-180*	-97	-46	-473
	(87)	(53)	(74)	(74)	(117)	(122)	(106)	(125)	(166)	(410)
size *x* federal public banks *x* Δselic	-680***	-205	418*	-117	-18	-782**	-1,362***	-1,424***	-2,101***	-4,471***
	(258)	(125)	(227)	(152)	(263)	(312)	(369)	(373)	(650)	(1,461)
size *x* local public banks *x* Δselic	-111***	-30	129***	5.2	-65	-164**	-241***	-210***	-331***	-863***
	(36)	(24)	(49)	(31)	(45)	(64)	(58)	(65)	(113)	(228)
size *x* domestic private banks *x* Δselic	-166***	-45**	96**	-7.5	-12	-192***	-326***	-345***	-495***	-1,067***
	(41)	(21)	(46)	(33)	(42)	(53)	(63)	(73)	(123)	(259)
size *x* foreign banks *x* Δselic	-76**	-85***	64**	-1	-22	-165***	-241***	-257***	-324***	-782***
	(31)	(24)	(33)	(31)	(38)	(39)	(45)	(58)	(95)	(168)
size *x* domestic private banks with foreing capital *x* Δselic	6.6	-10	151	108	101	7.8	-94	-87	-59	-98
	(78)	(50)	(105)	(81)	(105)	(196)	(111)	(83)	(112)	(291)
federal public banks *x* Δtotal_ratio	36,520*	-7,918	15,892	23,133	11,920	25,516	58,574*	104,456***	177,981***	329,303***
	(21,430)	(16,284)	(14,363)	(17,976)	(25,035)	(25,253)	(34,852)	(39,490)	(49,845)	(98,781)
local public banks *x* Δtotal_ratio	1,871	-170	-2,113	-2,980	-230	1,281	1,844	-176	-1,629	-3,887
	(2,147)	(2,236)	(2,312)	(3,155)	(2,070)	(2,575)	(2,968)	(3,720)	(6,182)	(11,009)
domestic private banks *x* Δtotal_ratio	2,166***	-174	435	-930	430	879	3,425***	5,260***	7,147**	11,128**
	(766)	(533)	(559)	(931)	(741)	(954)	(1,114)	(1,687)	(2,925)	(5,314)
foreign banks *x* Δtotal_ratio	4,209	-1,229	-973	-7,769**	2,153	2,034	6,890	10,638	16,266	28,715
	(3,464)	(2,844)	(2,408)	(3,652)	(3,873)	(3,145)	(4,739)	(8,604)	(13,714)	(25,786)
domestic private banks with foreing capital *x* Δtotal_ratio	8,599	3,564	-18,818	-13,102	-937	43,002*	19,647	10,033	-13,510	28,050
	(11,118)	(7,986)	(13,174)	(13,912)	(12,253)	(23,897)	(15,935)	(19,814)	(18,655)	(46,570)
size *x* federal public banks *x* Δtotal_ratio	-23,667*	5,892	-9,212	-15,100	-10,127	-15,901	-39,358*	-70,188***	-122,644***	-229,841***
	(12,901)	(10,126)	(8,855)	(11,089)	(15,304)	(15,215)	(20,856)	(23,448)	(29,157)	(58,629)
size *x* local public banks *x* Δtotal_ratio	-1,624	9.6	2,124	-3,102	-4,267**	-6,179**	-6,030**	-8,260**	-19,481***	-45,782***
	(2,027)	(1,346)	(2,413)	(2,647)	(1,904)	(2,919)	(2,839)	(3,292)	(4,583)	(9,034)
size *x* domestic private banks *x* Δtotal_ratio	-5,152**	2,922*	-1,050	-1,737	-3,830*	-1,792	-9,826**	-18,488***	-33,555***	-65,267***
	(2,242)	(1,676)	(2,083)	(2,598)	(2,218)	(3,182)	(3,896)	(4,709)	(6,575)	(12,767)
size *x* foreign banks *x* Δtotal_ratio	-4,601	-671	-4,132**	-1,002	-5,838**	-4,170	-10,731***	-20,776***	-33,891***	-63,660***
	(2,833)	(1,927)	(1,955)	(2,378)	(2,825)	(3,085)	(3,518)	(4,788)	(6,959)	(12,472)
size *x* domestic private banks with foreing capital *x* Δtotal_ratio	-6,203	-2,831	10,765	5,764	-1,061	-25,633*	-14,956	-11,330	432	-32,114
	(6,118)	(4,796)	(8,182)	(8,370)	(7,391)	(14,452)	(9,098)	(11,123)	(9,431)	(24,206)
N obs	49978	49756	49493	49331	49152	49796	49475	49041	48660	47690
N groups	1084	1082	1084	1083	1082	1077	1081	1079	1076	1071
R^2	0.005	0.001	0.002	0.001	0.001	0.003	0.011	0.013	0.016	0.022

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

[24] Historically in Brazil there was a "fight" between Banco do Brasil and Central bank. In the time that in practice Banco do Brasil could print money there were many episodes of expansion of the money created by Banco do Brasil in times of monetary policy tightening by the Central bank. Today this is not possible, since Banco do Brasil can not print money anymore. But it still can increase the credit supply more than it normally would in times of monetary policy tightening. If this effect does exist depends on political variables.

Table 17 : Dependent variable: *Interest_rate* $_{t+N}$ *-Interest_rate* $_{t-1}$ †

	N=3	*N=4*	*N=5*	*N=6*	*N=7*	*N=8*
federal public banks *x* Δselic	.14	1.4***	.15	.00043	-.36	.41
	(.48)	(.49)	(.57)	(.44)	(.63)	(.57)
local public banks *x* Δselic	1.7**	3.6***	.0035	.86	-.18	1.5**
	(.8)	(.86)	(.74)	(.89)	(1)	(.61)
domestic private banks *x* Δselic	.2	1.1***	.2	-.014	-.24	.18
	(.32)	(.29)	(.28)	(.29)	(.35)	(.4)
foreign banks *x* Δselic	-.58	-.12	-.95	.27	-1.3**	-.33
	(.54)	(.53)	(.61)	(.5)	(.65)	(.7)
domestic private banks with foreign capital *x* Δselic	.64	1.2	.39	.39	.86	-.037
	(1.2)	(.79)	(.73)	(1)	(1.1)	(1.2)
size *x* federal public banks *x* Δselic	.2	.11	.24*	.36*	.23	.41**
	(.14)	(.14)	(.14)	(.19)	(.16)	(.2)
size *x* local public banks *x* Δselic	-.19	-.48**	.13	.074	.19	-.11
	(.21)	(.23)	(.22)	(.27)	(.28)	(.21)
size *x* domestic private banks *x* Δselic	.33**	.29***	-.016	.33***	.14	.32**
	(.13)	(.1)	(.11)	(.1)	(.12)	(.15)
size *x* foreign banks *x* Δselic	.57***	.42**	.47**	.23	.48**	.43*
	(.17)	(.18)	(.21)	(.16)	(.24)	(.23)
size *x* domestic private banks with foreing capital *x* Δselic	.085	.14	.2	.25	.042	.13
	(.23)	(.2)	(.18)	(.21)	(.24)	(.21)
federal public banks *x* Δtotal_ratio	-55***	-25	-86***	-9.4	39	7.9
	(18)	(23)	(25)	(28)	(37)	(42)
local public banks *x* Δtotal_ratio	-31	-5.5	-31	33	-42	85
	(29)	(31)	(39)	(26)	(32)	(61)
domestic private banks *x* Δtotal_ratio	19**	9.8	7.9	12	33**	27*
	(7.9)	(11)	(7.6)	(14)	(13)	(15)
foreign banks *x* Δtotal_ratio	55	35	-48*	-34	28	23
	(36)	(28)	(26)	(54)	(18)	(36)
domestic private banks with foreing capital *x* Δtotal_ratio	141	93	36	19	19	-54
	(113)	(76)	(96)	(133)	(124)	(65)
size *x* federal public banks *x* Δtotal_ratio	20***	12*	23***	12	3.5	4.6
	(6.3)	(6.6)	(7.6)	(7.9)	(9.6)	(11)
size *x* local public banks *x* Δtotal_ratio	7.5	6.3	4.6	-.5	18**	-21
	(7.9)	(7.9)	(11)	(8.4)	(8.3)	(22)
size *x* domestic private banks *x* Δtotal_ratio	2	4.6	5.7	2.1	1.5	-1.9
	(3.1)	(3.3)	(4.4)	(4.5)	(3.7)	(4.9)
size *x* foreign banks *x* Δtotal_ratio	-4	11	28***	30*	8.8	8.4
	(11)	(9.8)	(9.5)	(17)	(7.6)	(12)
size *x* domestic private banks with foreing capital *x* Δtotal_ratio	-28	11	5.6	9.8	7.9	32*
	(30)	(20)	(25)	(33)	(33)	(19)
N obs	29797	29410	29285	29317	28994	29561
N groups	812	807	806	807	818	814
R^2	0.002	0.004	0.001	0.002	0.002	0.002

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
† Source: Central Bank of Brazil

As in the previous estimations results in the table 16 show that for all type of ownership, with exception of domestic private banks with foreign capital, new loans response to monetary policy (Selic and total ratio) is increasing on size, in absolute terms. Table 17 shows that interest rate response to Selic depends on size for federal public, domestic private and foreign banks, but not for local public and domestic private with foreign capital banks. Interest rate response to total ratio depends on size for federal

public banks and in a less extension for foreign banks, but not for domestic private, with and without foreign capital, and local public banks.

Tables 18 to 21 show two hypotheses tests of the Selic and total ratio sensibilities for new loans and lending interest rates. The tests are made for various sample sizes[25]. The first test is if domestic private banks response to monetary policy is equal of federal public banks response. As we said above, state-owned banks have access to regulated funds that are more stable and less costly. Besides that, state-owned banks could internalize the objective of monetary policy smoothing. Both reasons could rationalize federal state-owned banks reacting less to monetary policy than domestic private ones. The second one is if domestic private response is equal to foreign response. This test has the same spirit of that in Arena at al. (2007).

[25] We used the following sample moments of the normalized size: percentile 25% (-1.26), percentile 50% (0.61), average (0.56), percentile 75% (2.01), percentile 90% (3.72) and percentile 95% (4.4).

Table 18 - Testing differences in the new loans sensibilities to Selic†

H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=0.81	F-statistic=3.1*	F-statistic=7.4***	F-statistic=0.001	F-statistic=7.5***	F-statistic=0.001
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=5.5**	F-statistic=0.5	F-statistic= 4.6**	F-statistic= 0.9	F-statistic= 4.4**	F-statistic=0.96
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic= 6.2**	F-statistic=2.1	F-statistic= 10.5***	F-statistic=2.6	F-statistic=10.2***	F-statistic=2.6
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=0.3	F-statistic=0.15	F-statistic = 1.6	F-statistic=1	F-statistic=2	F-statistic=1.2
H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=8	*N=3 and 4*	*N=8*	*N=3 and 4*	*N=8*	*N=3 and 4*
F-statistic=2.3	F-statistic=3.1*	F-statistic=2.4	F-statistic=6.1**	F-statistic=2.4	F-statistic=6.3***
Percentile 75		Percentile 90		Percentile 95	
N=8	*N=3 and 4*	*N=8*	*N=3 and 4*	*N=8*	*N=3 and 4*
F-statistic=1.1	F-statistic=3.8*	F-statistic= 0.7	F-statistic=2.7*	F-statistic= 0.6	F-statistic= 2.5
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=8	*N=3 and 4*	*N=8*	*N=3 and 4*	*N=8*	*N=3 and 4*
F-statistic= 5.6**	F-statistic= 11.6***	F-statistic= 9.3***	F-statistic= 17***	F-statistic=9.1***	F-statistic=16.8***
Percentile 75		Percentile 90		Percentile 95	
N=8	*N=3 and 4*	*N=8*	*N=3 and 4*	*N=8*	*N=3 and 4*
F-statistic=0.2	F-statistic=0.2	F-statistic = 1.4	F-statistic = 3.4*	F-statistic=1.8	F-statistic=4.2**
H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=1 to 5	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*
F-statistic=0.001	F-statistic=0.6	F-statistic=1.2	F-statistic=2.1	F-statistic=1.2	F-statistic=2.1
Percentile 75		Percentile 90		Percentile 95	
N=1 to 5	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*
F-statistic=1.4	F-statistic=1.6	F-statistic= 1.4	F-statistic= 1.4	F-statistic= 1.3	F-statistic= 1.3
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=1 to 5	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*
F-statistic= 8.5***	F-statistic=7.9***	F-statistic= 11.9***	F-statistic=11.7***	F-statistic=11.8***	F-statistic=11.5***
Percentile 75		Percentile 90		Percentile 95	
N=1 to 5	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*
F-statistic=0.04	F-statistic=0.1	F-statistic = 2.9*	F-statistic=2.4	F-statistic=3.5*	F-statistic=3*

* 0.05<p-value<0.10; ** 0.01<p-value<0.05; ***p-value<0.01

† Source: Central Bank of Brazil

Table 19 - Testing differences in the new loans sensibilities to total ratio†

H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=0.03	F-statistic=0.4	F-statistic=0.7	F-statistic=1.6	F-statistic=0.7	F-statistic=1.5
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=0.3	F-statistic=3.4*	F-statistic= 0.1	F-statistic= 2.9*	F-statistic= 0.1	F-statistic=2.8*
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic= 2.3	F-statistic=0.2	F-statistic= 2.8*	F-statistic=0.3	F-statistic=2.8*	F-statistic=0.3
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=0.2	F-statistic=0.1	F-statistic = 1.5	F-statistic=0.02	F-statistic=1.6	F-statistic=0.03
H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=8	*N=3 and 4*	*N=8*	*N=3 and 4*	*N=8*	*N=3 and 4*
F-statistic=0.3	F-statistic=0.2	F-statistic=0.01	F-statistic=0.5	F-statistic=0.001	F-statistic=0.5
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=3 and 4*	*N=3*	*N=3 and 4*	*N=3*	*N=3 and 4*
F-statistic=0.2	F-statistic=0.03	F-statistic= 0.3	F-statistic=0.001	F-statistic= 0.3	F-statistic= 0.001
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=8	*N=3 and 4*	*N=8*	*N=3 and 4*	*N=8*	*N=3 and 4*
F-statistic= 0.9	F-statistic= 2.3	F-statistic= 1	F-statistic= 2.7*	F-statistic=1	F-statistic=2.7*
Percentile 75		Percentile 90		Percentile 95	
N=8	*N=3 and 4*	*N=8*	*N=3 and 4*	*N=8*	*N=3 and 4*
F-statistic=0.2	F-statistic=0.1	F-statistic = 0.7	F-statistic = 1.4*	F-statistic=0.7	F-statistic = 1.7
H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=1 to 5	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*
F-statistic=0.2	F-statistic=0.1	F-statistic=0.6	F-statistic=0.7	F-statistic=0.6	F-statistic=0.7
Percentile 75		Percentile 90		Percentile 95	
N=1 to 5	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*
F-statistic=0.3	F-statistic=0.5	F-statistic= 0.07	F-statistic= 0.2	F-statistic= 0.05	F-statistic= 0.1
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=1 to 5	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*
F-statistic= 10.7***	F-statistic=9.3***	F-statistic= 12.2***	F-statistic=11.1***	F-statistic=12.2***	F-statistic=11.1***
Percentile 75		Percentile 90		Percentile 95	
N=1 to 5	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*	*N=1 to 5*	*N=1 to 8*
F-statistic=0.2	F-statistic=0.1	F-statistic = 5.9**	F-statistic=4.9**	F-statistic=6.6**	F-statistic=5.5**

* 0.05<p-value<0.10; ** 0.01<p-value<0.05; ***p-value<0.01

† Source: Central Bank of Brazil

Table 20 - Testing differences in the interest rate sensibilities to Selic†

H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=1.5	F-statistic=2.68	F-statistic=1.5	F-statistic=4.5**	F-statistic=1.5	F-statistic=4.4**
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=0.7	F-statistic=5.1**	F-statistic= 0.04	F-statistic=1.8	F-statistic= 0.2	F-statistic=1
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic= 0.02	F-statistic=0.7	F-statistic= 0.08	F-statistic=0.3	F-statistic=0.07	F-statistic=0.3
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=0.8	F-statistic=0.001	F-statistic = 1.5	F-statistic=0.3	F-statistic=1.5	F-statistic=0.5
H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=8		*N=8*		*N=8*	
F-statistic=0.3		F-statistic=0.4		F-statistic=0.4	
Percentile 75		Percentile 90		Percentile 95	
N=8		*N=8*		*N=8*	
F-statistic=0.3		F-statistic= 0.02		F-statistic= 0.001	
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=8		*N=8*		*N=8*	
F-statistic= 0.02		F-statistic=0.2		F-statistic=0.2	
Percentile 75		Percentile 90		Percentile 95	
N=8		*N=8*		*N=8*	
F-statistic=0.7		F-statistic = 0.7		F-statistic=0.6	

* 0.05<p-value<0.10; ** 0.01<p-value<0.05; ***p-value<0.01

† Source: Central Bank of Brazil

Table 21 - Testing differences in the interest rate sensibilities to total ratio†

H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=0.8	F-statistic=0.2	F-statistic=1.1	F-statistic=1.3	F-statistic=1	F-statistic=1.2
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=1.4	F-statistic=3.3*	F-statistic= 0.4	F-statistic= 3.3*	F-statistic= 0.1	F-statistic=2.8*
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic= 13***	F-statistic=1.8	F-statistic= 14.4***	F-statistic=1.9	F-statistic=14.4***	F-statistic=1.9
Percentile 75		Percentile 90		Percentile 95	
N=3	*N=4*	*N=3*	*N=4*	*N=3*	*N=4*
F-statistic=8.1***	F-statistic=1.4	F-statistic = 0.09	F-statistic=0.1	F-statistic=0.1	F-statistic=0.001
H_0: domestic private banks sensibility=foreign banks sensibility					
Percentile 25		Percentile 50		Average	
N=8		*N=8*		*N=8*	
F-statistic=0.1		F-statistic=0.01		F-statistic=0.001	
Percentile 75		Percentile 90		Percentile 95	
N=8		*N=8*		*N=8*	
F-statistic=0.4		F-statistic= 1.1		F-statistic= 1.1	
H_0: domestic private banks sensibility=federal public banks sensibility					
Percentile 25		Percentile 50		Average	
N=8		*N=8*		*N=8*	
F-statistic= 0.2		F-statistic= 0.1		F-statistic=0.1	
Percentile 75		Percentile 90		Percentile 95	
N=8		*N=8*		*N=8*	
F-statistic=0.04		F-statistic = 0.04		F-statistic=0.2	

* 0.05<p-value<0.10; ** 0.01<p-value<0.05; ***p-value<0.01
† Source: Central Bank of Brazil

The results in the table 18 show that for the 3-day window the new loans sensibility to Selic for foreign banks is statistically smaller, in absolute terms, than for domestic banks in almost all sample sizes analyzed. However, for the 4-day window the new loans sensibilities of the two types of banks were not statistically different and actually the point estimates show a larger sensibility, in absolute terms, for the foreign banks. The results for the cumulated windows are mixed too. While for the 3 and 4-day windows, foreign banks have a sensibility statistically smaller, for the windows of 1 to 5 days and 1 to 8 days the two types of banks do not present statistical differences. Concerning private versus state-owned banks tests, we can see that federal public banks of smaller sizes (25%, 50% and average) have smaller new loans sensibility than domestic private banks[26].

[26] Calculating the sensibilities from the estimates table one can see that the new loans sensibility point estimates are smaller for the federal public banks than domestic banks, in the percentiles 25%, 50% and average. Despite the fact that federal public banks are large banks (Banco do Brasil e Caixa Econômica Federal), there are some local public banks in the sample that were "federalized" before privatization. These are the small federal public banks in our sample.

Results in table 19 show evidence that new loans sensibilities to total ratio of small federal public banks are smaller than those of small domestic private banks (percentiles 25%, 50% and average) for the cumulated windows (1 to 5 days and 1 to 8 days) and large federal public banks show more sensibility to total ratio than large domestic private banks (percentiles 75%, 90% and 95%).

Results in table 20 show that lending interest rate response to Selic does not depend on the ownership.

Finally, results in table 21 show that lending interest rate sensibility of small federal state-owned banks is smaller than for the small domestic private banks. For some windows and sizes federal public banks react in the opposite direction, decreasing interest rate after increases of total ratio. This evidence is compatible with state-owned banks smoothing monetary policy.

To sum up, there is no robust evidence that domestic private banks and foreign or federal state-owned banks react in a different way to monetary policy than other banks. Again, this is evidence against banking lending channel in Brazil.

V. Conclusion

This paper contributes to the understanding of the transmission channels of monetary policy in Brazil by estimating bank lending reactions to monetary policy. Using unique features of our database, the daily frequency and information about new loans and interest rate, we performed an event-study estimation of credit bank reaction around monetary policy committee meeting and reserve requirement announcements, and interpreted the reduced form coefficients estimated as supply effects.

Results did not support the existence, in Brazil, of the banking lending channel of monetary policy. Despite the fact that our estimations were significant and had the expected sign of supply responses for both new loans and interest rate, they did not behave as one would expect if banking lending channel were operative. Smaller and/or domestically owned banks do not react more to monetary policy changes than larger and/or foreign banks. Our results suggest that, if anything, the opposite is true. Thus, the reactions estimated capture other responses of credit supply, probably linked to the change in the opportunity cost of the bank credit after a change in monetary policy.

The results presented were robust to the characteristics used to define restricted banks in the debt market, to the monetary policy instrument used and to the basic interest rate measure used. Results are the same when we used size, liquidity, ownership and combinations of them as the feature defining banks financially restricted. They are the same irrespective of the monetary policy instrument – basic interest rates or reserve requirement –, and of the basic interest rate variation used, actual or surprise changes.

References:

Arena, Marco, Carmen Reinhart and Francisco Vasquez, "The lending channel in emerging economies: are foreign banks different?", IMF working paper, WP/07/48, Feb., 2007.

Bernanke, B. S.. and Alan S. Blinder, "The Federal Funds rate and the channels of monetary policy transmission", *The American Economic Review*, Vol. 82, No. 4 , pp. 901-921, Sept., 1992.

BIS, "Monetary policy framework and central banks operations", April 2008.

Christiano, Laurence J., Martin Eichenbaum and Charles L. Evans, "Monetary policy shocks: what have we learned and to what end?", Handbook of Macroeconomics, Vol. 1, Part A, pp. 65-148, 1999.

Costa, Ana Carla A. and Márcio I. Nakane, "Revisitando a metodologia de decomposição do spread bancário no Brasil", in: XXVI Encontro brasileiro de econometria, João Pessoa, 2004.

Costa, Ana Carla A. and Márcio I. Nakane, "Spread bancário: os problemas da comparação internacional", (pdf), 2005.

Fachada, Pedro, Figueiredo, Luiz Fernando and Lundberg, Eduardo, “Sistema judicial e mercado de crédito no Brasil”, Notas técnicas do Banco Central do Brasil, No. 35, May, 2003.

Gelos, R. Gaston, “Banking spreads in latin america”, IMF working paper, WP/06/44,Feb., 2006.

Kashyap, Anil K. and Jeremy C. Stein, “The impact of monetary policy on bank balance sheets”, NBER working paper series No. 4821, August, 1994.

Kashyap, Anil K. and Jeremy C. Stein, “What do a million of observations on banks say about the transmission of monetary policy?”, *The American Economic Review*, Vol. 90, No. 3, pp. 407-428, Jun., 2000.

Kashyap, Anil K. , Jeremy C. Stein and David W. Wilcox. “Monetary policy and credit conditions: evidence from the composition of external finance”, *The American Economic Review*, Vol. 83, No. 1, pp. 78-98, Mar., 1993.

Takeda, Tony , Márcio I. Nakane and Fabiana Rocha, “The reaction of banking lending to monetary policy in Brazil”, RBE, 50(1):107–126, Jan/Mar 2005.

Stiglitz, J. E. and A. Weiss, “Credit rationing in markets with imperfect information”, American Economic Review, 71(3), 1981.