The reaction of bank lending to monetary policy in Brazil

Resumo

Este trabalho avalia o "canal de empréstimos bancários" na transmissão da política monetária. A análise foca os dados mensais desagregados do balanço patrimonial dos bancos brasileiros de dezembro de 1994 a dezembro de 2001. Em adição à taxa básica de juros de curto prazo, esse estudo considera os efeitos de um outro instrumento de política, representado pelos recolhimentos compulsórios sobre todos os depósitos à vista, de poupança e a prazo. Tais recolhimentos compulsórios são muito usados pela autoridade monetária no Brasil. A partir de técnicas de análise de dados em painel dinâmico, os resultados dos testes sugerem que o impacto da política monetária é mais forte sobre os empréstimos dos grandes bancos. Esse achado decorre de taxas de recolhimentos compulsórios de caráter progressivo, que afeta mais fortemente os bancos com maiores volumes de depósitos.

Abstract

This paper evaluates the relevance of the "bank lending channel" of the monetary policy transmission in Brazil. Disaggregated monthly data of Brazilian banks balance sheets from December 1994 to December 2001 are analyzed. In addition to the short-term interest rate, we consider the effects of another policy instrument represented by reserve requirements on overall deposits – demand, savings, and time deposits. Reserve requirements have been widely used by the monetary authority in Brazil. Dynamic panel data techniques are employed. Our results suggest that the impact of monetary policy is stronger for the loans of the larger banks. This finding results from progressive reserve requirement rates, which affect, to a greater extension, banks with larger deposit volumes.

Keywords: monetary policy transmission, reserve requirements, bank lending channel.

JEL classification: E44, E52.

1. Introduction

Between 1994 and 2001, total credit in Brazil reduced from 37% of GDP to 27%. Even without considering such fall, the credit-to-GDP ratio in Brazil was historically very low when compared to other emergent economies. For example, in Chile this ratio amounted to 58.76 % between 1998 and 2001 while in Mexico bank credit reached 50.62% of GDP between 1994 and 2000.

Such low credit/GDP ratio has been mentioned as a possible reason to ignore the existence of a potential credit channel in the monetary policy transmission mechanism for Brazil (Bogdanski *et al.* 2000). The issue of the monetary policy transmission mechanisms in the country and, in special, the relevance of the credit channel has been receiving great attention from the domestic literature. Souza Sobrinho & Nakane (2002) evaluate the empirical relevance of the credit channel by studying aggregate data reaching the conclusion that bank credit works as a monetary policy transmission in Brazil. By contrast, Graminho & Bonomo (2002), following Kashyap & Stein (2000)'s methodology, make use of disaggregated data for Brazilian banks to conclude that rises in the short-term interest rate relax liquidity constraints in balance sheets of the Brazilian financial institutions. The authors attribute such result to the positive link between interest rate variations and bank profits. Based on such evidence, the authors conclude that the credit channel does not operate in Brazil.

The purpose of this paper is to revisit the evidence on the bank lending channel of monetary policy transmission in Brazil. We study monthly data on banks' balance sheets from December 1994 to December 2001. For industrialized countries, the monetary policy indicator is usually a short-term interest rate under the Central Bank control. This is also the indicator used by Graminho & Bonomo (2002). We argue that the short-term interest rate only partially captures the stance of the monetary policy in Brazil. When we consider a broader indicator of monetary policy to encompass all the required reserves on different types of deposits (demand, savings, and time deposits) we show that there is evidence for a transmission mechanism working through bank lending.

The paper is structured as follows. Section two makes the argument in favor of a broader monetary policy indicator for Brazil. Section three presents the basic model. Section four discusses data issues. Section five shows the empirical results. The final section concludes the paper.

2. Monetary policy indicators

The usual monetary policy indicator found in the literature a short-term interest rate under the Central Bank's control. The short-term interest rate used in this paper is the overnight *selic* interest rate.

However, another important monetary policy instrument in Brazil is the required reserve ratio on demand deposits. When the stabilization Real plan was launched in July 1994, such ratio was set to 100% at the margin. After some reductions, it reached 45% by December 2001. In addition, required reserves were also set for time deposits, savings deposits, other bank liabilities, and even for some operations on bank assets. The rates on such required reserves are frequently changed by the Central Bank for

liquidity control purposes.[1] Thus, it seems natural to consider the effects of such required reserves on the variations of bank credit in the country.

Figure 1. Exchange rate, selic interest rate, and inflation rate

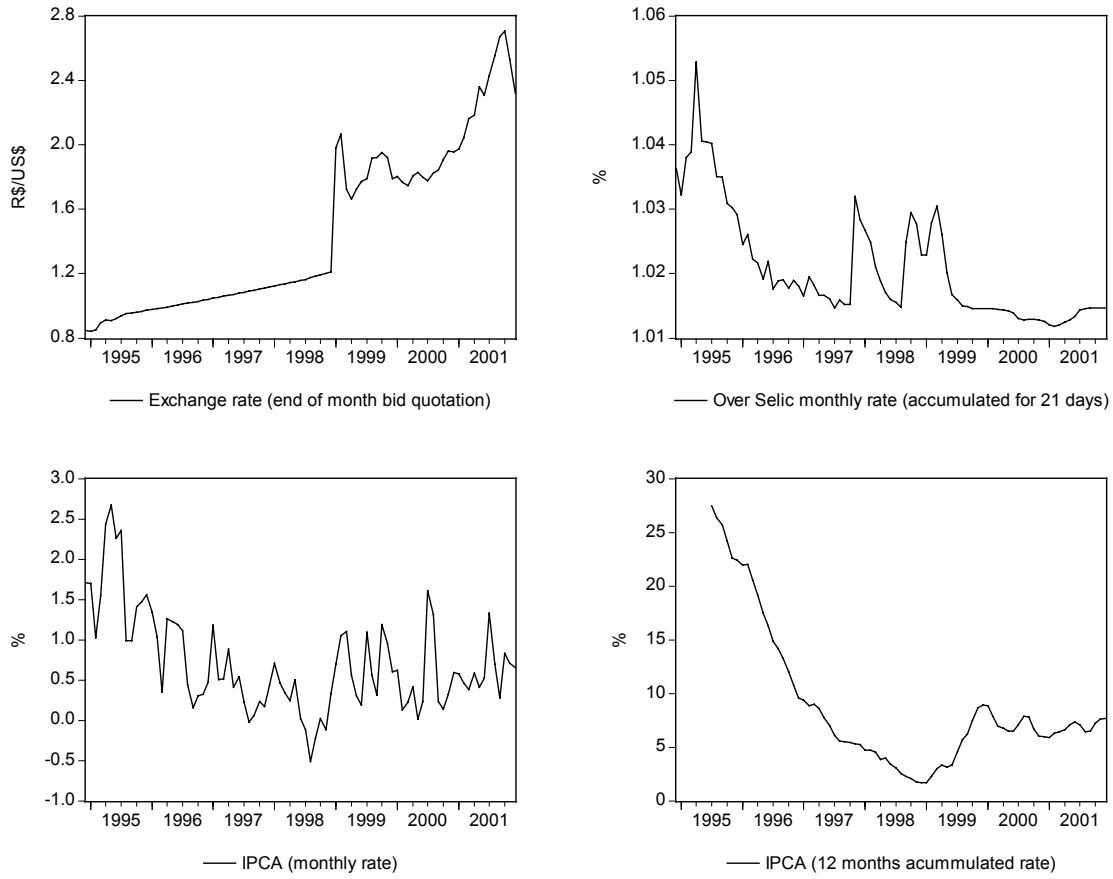


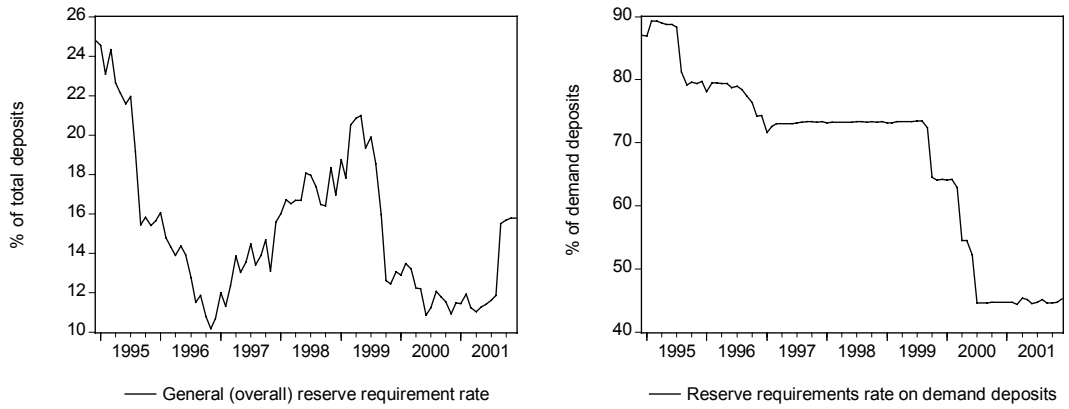
Figure 1 shows the evolution of the R$/US$ exchange rate, of the overnight selic interest rate, of the inflation rate as measured by the monthly variation of the IBGE's IPCA, and of the 12-month accumulated inflation rate. Brazil was under two different monetary policy regimes during the studied period: (i) the regime of exchange rate crawling peg, from March 1995 to December 1998; and (ii) the inflation targeting regime from July 1999 onwards. One can notice that during both regimes, the selic interest rate was a widely used instrument. One can verify that during the first period, discrete jumps in the selic rate worked to sustain the exchange rate regime during periods of foreign financial market crises (the Mexican crisis in March 1995, the Southeast Asia crisis in October 1997, and the Russian crisis in August 1998). The jump in the selic rate observed in March 1999 was primarily aimed at reverting negative

[1] Kashyap & Stein (2000) observe that required reserves on demand deposits are relatively low in the US (around 10%) and argue that such low ratios coupled with the process of bank deregulation could put some doubt on the empirical relevance of a bank lending channel for the US. In Brazil, by contrast, required reserves are not only quite high but also very actively used by the monetary authority. For more details on the various required reserves in effect during the first months of the Real plan, see Melo & Teles (1998, Annex IV). For the changes in the required reserves rates in the last years, see Banco Central do Brasil (2000 and 2001, Table: Medidas Propostas, Adotadas e em Andamento).

inflationary expectations following the flotation of the exchange rate after January 1999. One can also observe that, after the adoption of the inflation targeting regime in July 1999, the volatility of the selic rate has greatly reduced whereas the exchange rate volatility has increased.

Figure 2 shows the evolution of reserve requirement ratios on demand deposits, and on overall deposits. One can see that the reserve requirement rate on demand deposits shows a decreasing trend with discrete jumps. A different picture emerges from the observation of the reserve requirement rate on overall deposits. This indicator shows greater variability with periods of tightness being generally associated to turbulent periods in financial markets.

Figure 2. Reserve requirement rates



The consideration of reserve requirement rates as additional policy instruments has one great advantage over the short-term interest rate. The literature on the bank lending channel has called the attention for a possible identification problem related to the direct impact of the coefficient on interest rate on bank loan equations: rather than capturing the effect on the supply of loans, which is the interpretation favored by the bank lending channel advocates, one could also interpret such coefficient as reflecting a loan demand effect.[2] But, since reserve requirements are levied solely on banks, the identification problem is much less acute for this instrument. In other terms, even the direct coefficient associated to this instrument can safely be interpreted as capturing a loan supply effect.

3. The model

The empirical test of the lending channel in Brazil takes Erhmann *et al*. (2001)'s model as a benchmark. Their model is adapted to the case where there is more than one policy instrument.

[2] Kashyap & Stein (2000) suggest the inclusion of interaction terms between the policy instrument and bank individual characteristics to identify the bank lending channel. This strategy will also be followed in our paper.

The market for deposits is given by just an equilibrium relationship, where deposits (D) are taken to be equal to money (M) with both being functions of the interest rate i set by the monetary authority, as follows:

$$M = D = -\psi i + \chi, \quad \text{where } \chi \text{ is a constant} \tag{1}$$

Bank i faces a loan demand (L^{d}_{i}) that depends on economic activity (y), on the inflation rate ($infl$), and on the loan interest rate (i_L):

$$L^{d}_{i} = \phi_1 y + \phi_2 infl - \phi_3 i_L \tag{2}$$

The loan supply by bank i (L^{s}_{i}) is a function of the available amount of money (or deposits), of the loan interest rate, and of the monetary policy instrument(s) (z), where the instrument can either be the interest rate set by the Central Bank or the reserve requirements rate on deposits (σ) or both. The direct impact of the policy interest rate represents the opportunity costs for banks when banks make use of the interbank market as a liquidity source.[3] Thus, loan supply is given by:

$$L^{s}_{i} = \mu_i D_i + \phi_4 i_L - \phi_5 z \tag{3}$$

In addition, it is assumed that not all banks are equally dependent on deposits. In particular, the model considers that the impact of a change in deposits is smaller the lower the bank characteristic related to size or liquidity (x_i) is:[4]

$$\mu_i = \mu_0 - \mu_1 x_i \tag{4}$$

The equilibrium condition in the lending market plus equations (1) e (4) result in the following reduced form for the model:

$$L_i = \frac{\phi_1\phi_4 y + \phi_2\phi_4 infl - (\phi_5 + \mu_0\psi)\phi_3 z + \mu_1\psi\phi_3 z x_i + \mu_0\phi_3\chi - \mu_1\phi_3\chi x_i}{\phi_3 + \phi_4} \tag{5}$$

Expression (5) can be more concisely expressed as:

$$L_i = ay + binfl - c_0 z + c_1 z x_i - dx_i + \text{constant} \tag{6}$$

The coefficient $c_1 = \frac{\mu_1\psi\phi_3}{\phi_3 + \phi_4}$ relates the reaction of bank i's loans to the monetary policy interacting with its characteristic. Under the model assumptions, a significant c_1 coefficient implies that the monetary policy affects the supply of loans. An implicit identifying assumption is that the interest rate loan demand elasticity does not depend on the bank characteristic (x_i), i.e. that ϕ_3 are the same for all banks.

[3] Souza Sobrinho & Nakane (2002) provide empirical evidence from aggregate data for the reaction of bank interest rates to the monetary policy in Brazil.

[4] Another bank characteristic usually investigated in the literature is its degree of capitalization (net worth to assets). However, due to the accounting legislation in Brazil, commercial banks have to report full income statements only twice a year, in July and in December. Since such statements are required to calculate the bank's net worth coupled with the fact that the empirical estimates use monthly observations, we decided not to use banks' capitalization ratios.

The assumption of a homogeneous reaction of the loan demand is crucial for the identification of the monetary policy effects on loan supply. This assumption rules out the cases where, for example, small or large bank customers are more sensitive to interest rate changes. Such assumption seems reasonable for Brazil in view of the fact that bank loans are the main source of finance in Brazil, with few substitutes available, even for large firms.[5]

In addition, the empirical model allows for asymmetric responses of bank loans to changes in the economic activity and in the inflation rate by interacting such variables with bank characteristics.[6] The model also allows for dynamic adjustments and the estimation is done for the variables in first-differences due to non-stationarities.[7] The regression model is specified as follows:[8]

$$\Delta \log(L_{it}) = \sum_{j=1}^{m} a_j \Delta \log(L_{it-j}) + \sum_{j=0}^{m} b_j \Delta r_{t-j} + \sum_{j=0}^{m} c_j \Delta \log(y_{t-j}) + \sum_{j=0}^{m} d_j \Delta infl_{t-j}$$
$$+ e\, x_{it-1} + \sum_{j=0}^{m} f_{1j} x_{it-1} \Delta r_{t-j} + \sum_{j=0}^{m} f_{2j} x_{it-1} \Delta \log(y_{t-j}) + \sum_{j=0}^{m} f_{2j} x_{it-1} \Delta infl_{t-j} + \varepsilon_{it} \qquad (7)$$

with $i = 1,..., N$ and $t = 1,..., T_i$. N denotes the number of banks and m is the number of lags. L_{it} is the amount of loans by bank i in period t , Δr_t represents the first difference of the short-term nominal interest rate, $\Delta\log(y_t)$ is the growth rate of the economic activity indicator, and $\Delta infl_t$ is the first difference of the inflation rate. The individual bank characteristics are denoted by x_{it}.

The asymmetric effects of monetary policy are captured by significant coefficients for the interaction terms. The literature has found that smaller (Kashyap & Stein, 1995 and 2000), less liquid (Kashyap & Stein, 2000; Ehrmann *et al*., 2001), or less capitalized (Peek & Rosengren, 1995) banks react more to changes in monetary policy. These results imply *positive* coefficients for the interaction terms.

A better understanding about the sign of the interaction term coefficient can be gauged by examining the relevant terms in equation (6), reproduced below:

$$\ln(L_i) = ... + b \ln(r) + c\, x_i \ln(r) + ...$$

where L_i is the amount of loans by bank i, r is the short-term interest rate controlled by the Central Bank, b is the coefficient on the direct impact of monetary policy, x_i is the characteristic x for bank i, and c is the coefficient of the interaction between the characteristic x for bank i and $\ln(r)$.

It seems reasonable to suppose that $\frac{\partial \ln(L_i)}{\partial \ln(r)} = b + c\, x_i < 0$, implying that the amount of bank i loans reduces with increases in the interest rate. If the x_i bank

[5] In a similar study, Worms (2001) introduces a proxy for the loan demand, which allows him to model differences in loan demand across banks.

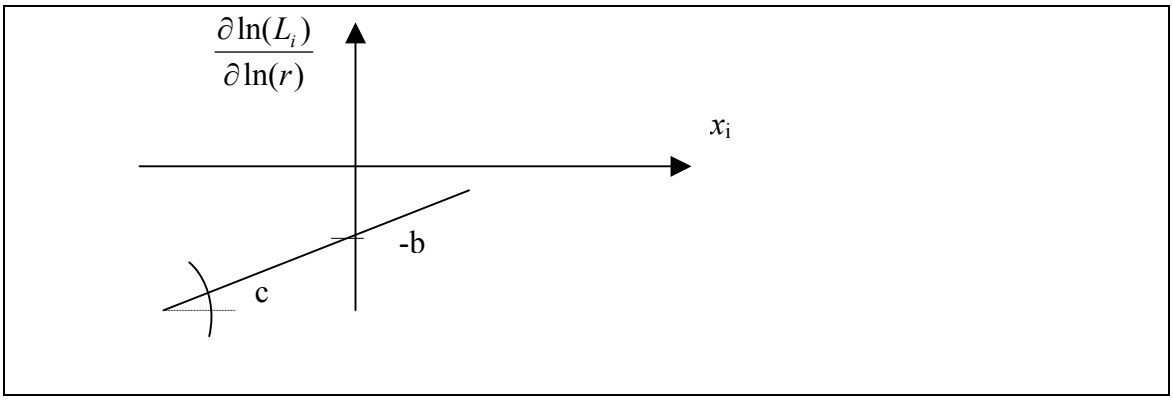
[6] In other terms, different values for ϕ_1 and for ϕ_2 among banks with different sizes, liquidity or any other characteristic (x_i) are allowed.

[7] The dynamic specification accounts for the fact that banks react to policy changes by adjusting the concession of new loans.

[8] When the monetary policy indicator is the reserve requirements on deposits (σ), Δr is replaced by $\Delta\sigma$ in equation (7).

characteristic represents liquidity, size or capitalization, then one expects to find $b < 0$ and $c > 0$.

Figure 3. Sign of the interaction coefficient between bank characteristic and monetary policy instrument



Suppose, for example, that x_i represents the bank *i* liquidity position. A positive *c* coefficient implies that more liquid banks respond less to a monetary policy contraction represented by an increase in the interest rate.[9] Figure 3 illustrates this situation.

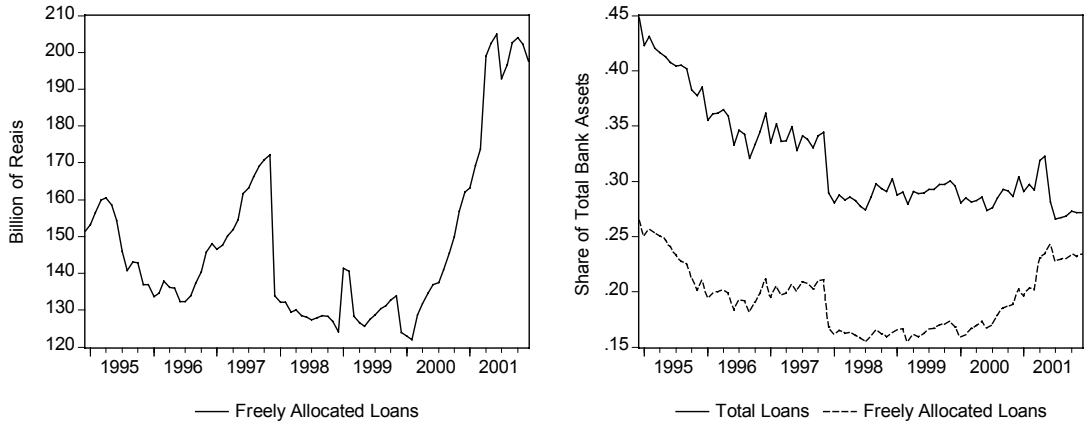
4. Variable descriptions

The dependent variable in this study is represented by freely allocated bank loans. Such loans refer to the portion of total bank loans that are granted at market interest rates. These are the loans that are, presumably, more sensitive to changes in the monetary policy.[10] Two main sub-accounts are subtracted from total bank loans to form the group of freely allocated loans, namely rural and real estate bank loans. Figure 4 pictures the evolution of freely allocated loans (in constant value, left picture) as well as the share of both total loans and freely allocated loans on total assets (right picture). There is an upward trend in freely allocated loans both in absolute terms as well as a share of total loans.

[9] Observe that the same observations about the sign of the *c* coefficient remain valid when one takes the reserve requirement rate as the monetary policy instrument.

[10] Nakane & Takeda (2002) estimate vector auto-regressions (VARs) to study the impact of monetary policy on bank balance sheet using aggregate data for Brazilian banks over the period Dec/1994 to Aug/2002. The authors found that overall bank credit do not respond to shocks in the monetary policy instruments (selic interest rate and reserve requirement rate on demand deposits). However, the found that freely allocated bank loans shows a negative and significant response to positive shocks in the selic interest rate.

Figure 4. Freely allocated bank loans, and total bank loans



Both rural and real estate bank loans are excluded because they are more related to official policies aiming at directing credit to some economic sectors at subsidized rates.[11] Two state-owned banks are the main financial agents used by the federal government to implement its credit policies devoted to the rural and real estate sectors, namely Banco do Brasil (BB) for rural loans, and Caixa Econômica Federal (CEF) for real estate loans. Table 1 shows that Banco do Brasil is reducing its market share in rural bank loans, which came down from levels above 70% in 1994 and 1995 to 45.3% in 2001. However, as shown in the top of the table, rural bank loans have also been reducing in the aggregate as share of bank assets. This share was close to 5% in 1994 and 1995,and was then reduced to 3.1% in 2001.

Table 1. Rural and real estate bank loans

	End-of-year account positions							
	1994	1995	1996	1997	1998	1999	2000	2001
Total bank system	Share of total bank assets[1] (%)							
Rural loans	4.9	4.9	3.5	3.5	3.8	3.4	3.7	3.1
Real estate loans	11.3	11.4	10.3	9.2	10.2	9.3	7.9	2.7
	Share of total rural bank loans (%)							
Banco do Brasil								
Rural loans	72.9	73.8	67.1	61.8	62.9	58.7	56.0	45.3
	Share of total real estate loans (%)							
Caixa Econômica Federal								
Real estate loans	68.9	68.3	73.2	76.9	78.9	79.3	80.9	57.5

Source: Sisbacen/Cosif, Brazilian Central Bank

[1] Total bank assets = Current plus non-current bank assets. Fixed bank assets are excluded.

[11] For the same reason, we also exclude loans from BNDES, a state-owned development bank. BNDES grants both direct loans and loans from a network of accredited financial institutions.

Table 1 also shows that Caixa Econômica Federal (CEF) owns the largest share in the market for real estate bank loans. Such share reached 80.9% in 2000. In 2001, part of the CEF real estate loans was transferred to the Treasury as part of a capitalization of state-owned federal banks program. Such transfer was immediately reflected in a large fall of real estate bank loans as a share of total bank assets.

As discussed in section 2, two policy instruments are considered in the paper, namely a short-term interest rate and reserve requirements on deposits. The short-term interest rate is given by the selic overnight interest rate where the daily rates were capitalized and adjusted for a fixed 21-day period.[12]

The reserve requirement rate on overall deposits is taken as the sum of required reserves (in cash and in securities) plus Central Bank compulsory withdrawals (*recolhimentos obrigatórios no BC*) over total deposits.[13]

Economic activity is proxied by the monthly industrial output as calculated by IBGE. Inflation rate is measured by the monthly variation of IPCA calculated by IBGE, which is also the official inflation targeting indicator (since 1999).

Two bank characteristics are considered in the paper, namely bank size (*Size*) and liquidity (*XLiq*), defined as follows:

$$Size_{it} = \log A_{it} - \frac{1}{N_t}\sum_i \log A_{it}$$

$$XLiq_{it} = \frac{Liq_{it}}{A_{it}} - \frac{1}{T}\sum_t \left(\frac{1}{N_t}\sum_i \frac{Liq_{it}}{A_{it}} \right)$$

Bank size is measured by the logarithm of total bank assets, A_{it} where total bank assets are the sum of current and non-current bank assets. The liquidity index is defined as the ratio of liquid assets (Liq_{it}) to total bank assets. Liquid assets are the sum of free securities and bonds and liquidity inter-bank operations (*aplicações interfinanceiras de liquidez*) less securities resales to liquidate (*revendas a liquidar*).

Both bank characteristics are normalized with respect the mean calculated over the respective banks in the sample. Thus, the sample mean on the interaction term $x_{it-1}\Delta r_{t-j}$ in equation (7) is zero. The c_j coefficients in this equation can therefore be directly interpreted as measuring the overall impact of monetary policy on bank loans for the average bank in the sample. With regard to bank size, the normalization was done with respect to each time period. This procedure removes undesirable nominal trends in this variable.

Some outliers were removed from the sample in the econometric estimations. The outliers were identified as the values below (above) the 5th (95th) percentile for the distribution of the first difference of free allocated bank loans, of total bank assets, and of total bank deposits. This procedure was adopted due to the strong adjustment in the banking industry following the launching of the stabilization plan (*Plano Real*) in July

[12] The Central Bank monetary policy committee (Copom) establishes the target for the annual selic interest rate. As an operational procedure, one can see that the Central Bank aims at targeting the daily selic rate given by (1+Annual selic rate) $^{1/252}$, considering therefore a year with 252 days in 12 months, or a month with 21 days.

[13] This ratio encompasses the reserve requirement rate on demand deposits.

1994. The cut-off levels used in the paper smoothes the effects of adjustments in bank portfolios due to bankruptcies, mergers and acquisitions, and privatizations that occurred in the period.

Tables 2 and 3 provide a concise picture of Brazilian banks by partitioning all the commercial banks operating in the country by December 2001 according to quartiles defined over the distribution of free allocated bank loans to total assets.[14]

Table 2 Bank assets when banks are classified according to free-allocated loans (December 2001)

	Distribution by free allocated loans to total assets (1)				**Total**
	Up to 25th	25th to 50th	50th to 75th	Above 75th	
Number of banks	45	44	45	45	179
Mean of assets (in million of R$)	1,156	9,599	7,559	685	4,723
Median of assets (in million of R$)	272	2,057	1,245	183	661

(1) Ranking of the five largest banks (by assets) (centile in square brackets):
2nd quartile: Caixa Econômica Federal (CEF), [25th] and Banco do Brasil (BB), [39th].
3rd quartile: Banco Itaú, [53rd], Bradesco, [61st] e Unibanco, [66th].

Table 3. Liquidity, reserve requirements and selected indicators - banks classified by free allocated loans (December 2001)

	Distribution by free allocated loans to total assets								Share of total Assets (%)
	Up to 25th		25th to 50th		50th to 75th		Above 75th		
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	
Assets	6.2	100	50.0	100	40.2	100	3.6	100	100
Free allocated loans	0.5	1.7	29.2	13.7	58.1	33.7	12.3	78.5	23.4
Time + Interbank deposits	4.5	15.4	46.5	19.8	38.3	20.2	10.7	62.5	21.2
Securities and derivatives	9.8	75.0	54.1	50.8	34.9	40.6	1.2	15.9	46.9
Liquidity	10.4	36.6	59.2	25.6	29.0	15.5	1.4	8.5	21.6
Reserve requirements	1.5	1.6	60.3	8.2	36.6	6.2	1.6	3.0	6.8
Net worth	16.1	30.9	33.7	8.0	45.2	13.3	5.1	16.4	11.8

(1) share on total banking system (%)
(2) share on group assets, within each quartile (%)

The following comments can be made after observing tables 2 and 3:

1) The banks above the 75th percentile, which characterize the group of banks that lend more, are relatively small. These banks accounted only for 3.6% of total bank assets in December 2001, with mean assets of R$ 685 million, the smallest of the four groups. Free allocated loans accounted for 78.5% of their total assets and, despite their small size, their loans accounted for 12.3% of the total loans by the banking sector, a share 3.4 times larger than their share of total assets;

[14] The overall picture for other time periods is similar. In tables 8 and 9 the bank characteristics are not adjusted to the overall sample mean. Outliers are also not excluded.

2) This group of banks had a liquidity index of 8.5% in December 2001, the smallest of the four groups. This feature may indicate that liquidity constraint is not a significant factor in the determination of the response of loan supply to monetary policy changes, a hypothesis to be tested in the next section;

3) On the liability side, the main sources of funds for the group of banks that lend more are time and interbank deposits. These two kinds of deposits reached 62.5% of the group's total assets, the largest of the four groups. Within interbank deposits, the largest share comes from banks that do not belong to the same financial conglomerate (not shown in the tables). This fact may indicate that this group of banks may not find very hard to raise funds even though they are small banks;

4) There is another group of relatively small banks, which is the group of banks that belong to the first quartile, i.e. a group of banks with low lending levels. The important feature of this group of banks is their large holdings of securities and derivatives, which accounted for 75% of the group's total assets. Due to this fact, their liquidity index is the largest among the four groups;

5) Large banks are distributed in the two intermediary quartiles, representing average levels of lending. An important characteristic of this group of banks is the heavier burden represented by reserve requirements. Reserve requirements have a progressive rate schedule due to some exemptions for small banks.

5. Estimation results

The presence of the lagged dependent variable in the set of regressors required the estimation of a dynamic panel data. We used the GMM technique due to Arellano & Bond (1991). The instruments for the lagged dependent variable are their own lagged values in levels with a one-lag window. The other explanatory variables are taken to be exogenous. The selected equations refer to those whose over identifying restrictions are not rejected by the Sargan test (in the second step estimation) and also to those that reject the first-order serial correlation test[15] (both in the first and in the second step estimations).

The unrestricted model has four lags of all terms in equation (7) that admit lagged values. Heteroscedastic robust standard errors are calculated for inference purposes. Inference is always based on the first step estimations, following Arellano & Bond (1991)'s recommendation. Non-significant coefficients are progressively excluded from the model. Reported results refer to the sum of the significant coefficients. All regressions were estimated with the variables in first-differences since they are all non-stationary in levels.[16]

We present two sets of results. Table 4 shows the results when the policy instruments are the selic interest rate (*selic*) and the reserve requirement rate on demand deposits (*resdem*). Table 5 shows the results when the policy instruments are the selic interest rate and the reserve requirement rate on overall deposits (*resdep*).

[15] See Arellano & Bond (1991) or Arellano, Bond & Doornik (2001) for an explanation of why first-order serial correlation is expected to be found in the model.
[16] Results are available from the authors upon request.

Table 4. Impact on free-allocated bank loans – policy instruments are selic interest rate (*selic*) and reserve requirement rate on demand deposits (*resdem*)

	Variables	Sum of estimated coefficients	Robust standard-errors
in 1st differences	Log(L)	0.8907***	0.0715
	Selic	-0.0165***	0.0038
	Log(y)	0.0484*	0.0249
	Infl	-0.0166***	0.0037
	XLiq1	0.0174***	0.0040
	XLiq1*Δselic	-0.0322*	0.0176
	Size1*Δselic	0.0037***	0.0011
	Size1*Δresdem	-0.0423**	0.0183
	Xliq1*Size1*Δresdem	0.2008**	0.0939
	p-val Sargan	0.178	
	p-val ma1, ma2	0.000	0.438
	Number of banks, obs.	247	9394

* / ** / *** denotes significance at 10 / 5 / 1%

(1) It shows the sum of the coefficients that remained significant at 5% in the final model.

In table 4, the direct impact of changes in the short-term interest rate is negative and significant. On the other hand, there is no evidence that reserve requirements on demand deposits have a direct impact on bank loans and therefore, at least for the average bank, one can reject the hypothesis that the banking lending channel of monetary policy transmission works through this policy instrument. The variables related to economic activity and inflation rate are also significant and with the expected signs.

The direct impact of liquidity is positive, implying that more liquid banks also lend more. With respect to the interaction terms, there is a positive coefficient on the interaction between bank size and the selic interest rate. This positive coefficient indicates that smaller banks react stronger to variations in the short-term interest rate. The negative coefficient on the interaction between bank liquidity and the selic interest rate could be interpreted as indicating that a monetary policy tightening relax the liquidity constraints faced by the Brazilian banks. This is precisely the result found and the interpretation given by Graminho & Bonomo (2002). We do not prescribe to this interpretation due to two reasons: first, the significance level of the coefficient is relatively high; and, second, and most important, the results reported in Table 5 show that this outcome is not robust.

One of the most interest results we obtain is the *negative* sign on the interaction between bank size and reserve requirements on demand deposits. In other words, larger banks react more to changes in reserve requirement rates than smaller banks[17].

[17] One possible reason for this finding is associated to the progressive nature of reserve requirements in Brazil, penalizing larger banks more, as noted in section 4.

Table 5 reports the results when the reserve requirement rate on demand deposits is replaced by the reserve requirement rate on overall deposits (*resdep*) as an additional policy instrument.

Table 5. Impact on free-allocated bank loans – policy instruments are selic interest rate (*selic*) and reserve requirement rate on overall deposits (*resdep*)

	Variables	Sum of estimated coefficients	Robust standard-errors
in 1st differences	Log(L)	0.7202***	0.0825
	Selic	-0.0027	0.0044
	Resdep	-0.2927***	0.1098
	Log(y)	0.1611***	0.0297
	Infl	-0.0212***	0.0041
	Xliq1	0.0150***	0.0044
	Size1*Δselic	0.0002	0.0017
	Size1*Δresdep	-0.0807***	0.0310
	p-val Sargan	0.427	
	p-val ma1, ma2	0.000	0.929
	Number of banks, obs.	247	9381

(1) see the observations in Table 4.

With this new policy instrument, both the direct as well as the indirect effects associated to changes in the short-term interest rate cease to be significant. In other words, reserve requirements on overall deposits dominate the policy effects. Thus, the direct impact of this policy instrument on bank loan decisions is now negative and significant. For the average bank, a variation of 1.2% in the reserve requirement rate on overall deposits, corresponding to a one-standard deviation change in this variable, leads to a long-term contraction of bank loans by 1.26%.

The interaction between bank size and reserve requirements is still negative and highly significant, indicating that this policy instrument affects more the larger banks. On the other hand, there is no evidence of significant interactive effects of liquidity with the policy instruments, despite the fact that liquidity has a direct positive effect on bank loans. Therefore, the finding of a negative effect for this interaction in Table 4 does not seem to be robust. One possible explanation for this lack of significance can be attributed to the fact that positive interest rate shocks have positive impacts on the amount of overall deposits.[18] Such increase in the bank deposits work to smooth the liquidity constraint imposed by the rise in the interest rate.

Thus, there is no evidence that bank loans from less liquid banks react more to interest rate variations. This conclusion is at odds with analogous tests performed for other countries where the effects of the interaction between liquidity and monetary policy indicators are in general very important [Kashyap & Stein (2000), Ehrmann *et al*. (2001)]. The difference in our results can be attributed to the existence of relatively high

[18] The result that positive shock in the selic interest rate has positive impacts on the amount of overall deposits can be found in Nakane & Takeda (2002).

levels of liquidity in the bank balance sheets due to increased holdings of public bonds in the last years. Such high liquidity levels can cushion the impacts of monetary policy tightenings reducing the effects on bank loans.

Summing up, this paper studied monthly bank-level balance sheets from December 1994 to December 2001 to study the relevance of the bank lending channel in the monetary policy transmission in Brazil. We find evidence that the bank lending channel works mainly through reactions to reserve requirement changes on overall deposits. The effect of policy changes is stronger over large banks. This fact is due to the progressive nature of reserve requirements in Brazil, which affect more banks with larger amounts of deposits.

6. Conclusions

The monetary policy transmission mechanism through bank loan decisions has recently received great attention in the literature. Kashyap & Stein (2000) show evidence to corroborate the existence of this channel for the US and reach the conclusion that the effects are mostly driven through small banks with less liquid balance sheets. Similar results are found by Erhmann *et al*. (2001) who report evidence that loan supply of less liquid banks are more severely affected by monetary policy in several European countries.

The aim of this article was to evaluate the relevance of the bank lending channel in Brazil by looking at micro data from bank balance sheets and by considering other monetary policy instruments in addition to a short-term interest rate. Our results indicate that there is evidence to support the validity of the bank lending channel for Brazil. When the effects of changes in the short-term interest rate and in the reserve requirement rate on overall deposits are jointly tested, one finds that only the last policy instrument has an impact on bank lending decisions. Moreover, this impact is stronger for larger banks.

Graminho & Bonomo (2002) also study the impact of interest rate variations on lending decisions for a sample of Brazilian banks. They conclude, however, that interest rate rises relax the liquidity constraints on bank balance sheets and therefore that there is no evidence of a bank lending channel for Brazil. Their conclusion seems to be unwarranted though for several reasons. First, they do no account for possible outliers in their sample as a consequence of the banking sector adjustments in the aftermath of the banking crisis following the launching of the stabilization plan in 1994. Many banks were liquidated, merged, privatized or sold to foreign financial institutions over the period. Second, their liquidity indicator does not net out the holdings of public bonds that are not available at short notice, as we do. Third, their estimated coefficients are probably biased due to the estimation of a dynamic panel data (with the endogenous lagged variable as a explanatory variable) through standard fixed effects model, creating a correlation between the set of regressors and the disturbance. Fourth, the result they found is not robust to the inclusion of another policy instrument in the form of the reserve requirement rate on overall deposits, as we show in section 5.

One possible extension of the current paper is to evaluate bank level data on the bank loan *granting* decisions as opposed to our measure.[19] This extension can complement the results of studies with aggregate data for bank loan concession that

[19] We proxy de flow of bank loans granted in a given month by the first difference of the stock of outstanding loans in the bank balance sheet.

found evidence in favor of the validity of the bank lending in Brazil (Souza Sobrinho & Nakane, 2002).

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