CHRISTIANO A. COELHO
JOÃO M. P. DE MELLO
MÁRCIO G. P. GARCIA

Identifying the Bank Lending Channel in Brazil through Data Frequency

Monetary policy affects economic activity through different channels. One mechanism is the credit channel, that is, how monetary policy influences the real sector through its effect on the functioning of credit markets.[1] There are two types of credit channels: the broad credit channel and the bank lending channel. The former is the channel through which monetary policy affects the balance sheet of lenders and borrowers in the economy. With regard to the latter, banks fund a significant part of their operations through deposits, as these are normally the cheapest source of funding. Because deposits and other sources of funding are less-than-perfect substitutes, monetary policy will shift the supply schedule of bank credit, insofar as it affects the amount of deposits in the banking system. This transmission mechanism is known as the bank lending channel.

Bernanke and Blinder first tried to identify the bank lending channel by looking at the relationship between monetary policy shocks and future amounts of loans.[2] Interpretation of their empirical results is blurred by the fact that aggregate lending changes several months ahead of a monetary policy shock, because of both supply (bank lending channel) and demand factors (changes in investment and consumption decisions). In other words, one cannot disentangle demand and supply reactions to monetary policy with low frequency data (quarterly in the case of Bernanke and Blinder). Kashyap, Stein, and Wilcox also use quarterly data, but they explore the impact of monetary

Coelho is with the Central Bank of Brazil and the Catholic University of Rio de Janeiro (PUC-Rio). De Mello and Garcia are with PUC-Rio.

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1. Bernanke and Blinder (1988); Bernanke and Gertler (1989); Bernanke, Gertler, and Gilchrist (1999); Kiyotaki and Moore (1997).

2. Bernanke and Blinder (1992).

policy on commercial paper, a substitute for bank loans.[3] Contractions in monetary policy are associated with increases in future quantities of commercial paper, supporting the idea of a supply shock. However, identification remains unsatisfactory. Focusing the empirical analysis on quantities does not exclude the possibility that the demand for bank credit and the demand for commercial paper react differently to shocks in monetary policy.

Dissatisfaction with identification based on aggregate data led researchers to use bank-level data. In a seminal work, Kashyap and Stein use bank characteristics to identify the bank lending channel.[4] They assume that smaller banks have more difficulty raising funds in money markets than larger banks. In this case, differences in the reactions of small and large banks to changes in monetary policy may be interpreted as evidence of the bank lending channel. Arena, Reinhart, and Vázquez also use this strategy.[5]

Kashyap and Stein and Arena, Reinhart, and Vázquez rely on theoretical arguments that bank characteristics are informative about the bank's ability to substitute away from deposits.[6] Thus, they always test a joint hypothesis of the bank lending channel plus a better ability on the part of larger banks to substitute deposits. Furthermore, even if this theory is correct, banks with different characteristics serve different clients.[7] Large banks tend to serve large corporations, while smaller banks tend to supply credit to small and medium-sized enterprises (SMEs). Large corporations have better access to capital markets than SMEs. Consequently, large corporations have a more elastic credit demand than SMEs, and large banks would lose market share to bond markets if they tighten credit in response to a shock in monetary policy.[8] In this case, differences in bank market structure for SMEs and corporations explain the results in Kashyap and Stein without the bank lending channel being operative.[9]

We contribute to the empirical understanding of the bank lending channel by employing a sharper identification strategy. We use very high frequency bank-level data on loans to isolate supply shocks driven by monetary policy.

3. Kashyap, Stein, and Wilcox (1993).
4. Kashyap and Stein (1994).
5. Arena, Reinhart, and Vázquez (2007). See also Kashyap and Stein (2000).
6. Kashyap and Stein (1994, 2000); Arena, Reinhart, and Vázquez (2007).
7. Berger and others (2005).
8. If shocks to monetary policy increase the cost of raising capital in all funding markets (equity, bond, and bank credit) commensurately, then corporations and SMEs would have equal bank credit demand elasticities.
9. Kashyap and Stein (1994, 2000).

Our method bypasses both concerns with Kashyap and Stein's identification strategy. We have daily bank-level data on interest rate and quantity. The high frequency of the data allows us to isolate supply from demand shocks. The key identifying assumption is that supply reacts faster than demand to monetary shocks. Demand for credit depends on investment and consumption decisions that do not react immediately to changes in monetary policy (our estimation window is very short, at just a few days). In contrast, banks' costs of funds increase immediately (on the following working day) in response to an increase in the basic interest rate, especially for short-maturity loans such as working capital and some types of consumer credit. Thus, by looking at a short window around the Monetary Policy Committee meeting, we hold demand constant. This is our identification assumption. We can thus interpret reduced-form estimates of the impact of changes in the monetary policy on equilibrium amounts and interest rates as supply shifts.

Other features of our data help in identifying the bank lending channel. First, we use data on both new loans and interest rates, an innovation in this literature. Shifts in credit demand and supply caused by monetary policy have, in theory, opposite effects on credit interest rate. Through the demand channel, a tightening of monetary policy reduces the equilibrium rate. Through the supply channel, interest rates increase. Hence, we corroborate our identification strategy by looking at the sign of the reduced form impact of monetary policy on lending rates. Second, we use data on several types of loans. The literature's goal (ours included) is to estimate a shift in supply by computing before and after quantities (and, in our case, interest rates). However, this object is conditional on demand elasticity. Therefore, the bank lending channel could be very different for different types of credit. When we decompose the response to monetary policy by bank size, quantity responses may differ because demand elasticities are different. Then, by looking at the same product across banks, we are able to estimate the decomposition according to bank characteristics without confounding different demand elasticities. Third, estimation by product type is also important for clean identification based on high frequency. Identification is cleanest for products with a short maturity because their relevant cost of funds is strongly linked to short-term rates.

We make two important findings. First, we document the bank lending channel directly. Credit volume and interest rate respond strongly to monetary policy changes in the direction one would expect if we were estimating a supply response: after basic rate increases, the bank interest rate increases and credit volume contracts. Second, we investigate whether bank structure

matters for the transmission of monetary policy. In sharp contrast with existing literature, we find that, in Brazil, larger banks react more strongly to monetary policy than smaller banks. Responses are similar among foreign- and domestic-owned banks and private versus government-owned banks.

Decomposing the impact of monetary policy according to bank size is interesting for two reasons. First, it is an important policy question per se, in light of recent changes in bank market structure. In particular, mergers in Brazil and other countries have produced larger banks, which suggests that monetary policy should be more powerful now. The second reason is identification. Part of the empirical literature typically assumes (without showing empirically) that large banks have better access to deposit substitutes because of informational and monitoring factors.[10] These papers then proceed to investigate whether large and small banks respond differently to shocks in monetary policy. They typically find that larger banks are less sensitive than small ones and interpret this as evidence in favor of the theory. We emphasize that, if supply is assumed to react faster than demand to shocks in monetary policy, it is not necessary to resort to assumptions about how size determines the ability to solve informational and monitoring problems. Epistemologically, all we need is our assumption to be more convincing than the one in Kashyap and Stein or Arena, Reinhart, and Vázquez, a bar we believe we pass.[11]

Why are bank-size results different in Brazil and the United States? We cannot answer this question definitively, but we may speculate. As we saw, the empirical literature typically assumes as a valid hypothesis that large banks have better access to deposit substitutes for informational reasons. In Brazil, larger banks are not necessarily more transparent than smaller banks. Several small banks are publicly traded and receive wide coverage from sell-side analysts, whereas some of the largest banks are not publicly traded (or the Brazilian operation is not listed separately), including Caixa Econômica Federal, HSBC, SAFRA, and until very recently Santander. Moreover, in contrast to the U.S. banks, smaller banks do not necessarily suffer more informational problems. Numbers also make a difference. The Brazilian bank market has some 230 players (versus more than 7,000 in the United States). Large institutional depositors may be able to monitor a large proportion of small and mid-sized banks in Brazil. In addition, in Brazil, small banks have a more concentrated deposit base than large banks. It is therefore unclear whether

10. Kashyap and Stein (2000); Arena, Reinhart, and Vázquez (2007).
11. Kashyap and Stein (2000); Arena, Reinhart, and Vázquez (2007).

moral hazard problems plague smaller or larger banks. In summary, the informational content of the bank lending channel may still be operative, but it may well work the other way around in Brazil.

Our results are important in terms of policy implications. With the caveat of external validity in mind, we find that large banks are more sensitive to monetary policy than smaller ones. With bank concentration increasing over time (a phenomenon not particular to Brazil), our results suggest that monetary policy will have more power through the credit channel in the future.

The paper is organized as follows. The next section provides an overview of the recent evolution of the Brazilian credit market and the description of our data set. The paper then highlights our empirical strategy, with emphasis on the identification strategy. Results are presented next, and a final section concludes with a discussion about policy implications.

Background: The Credit Market in Brazil and Monetary Policy Framework

The performance of Brazilian credit markets is still poor by international standards. Spreads are high and credit volume is low, even when compared to other emerging markets. Gelos calculates that the average interest rate margin in Brazil was 8.9 percent, versus 5.0 percent for the emerging economies as a whole and 8.0 percent for Latin American countries.[12] Gelos further shows that the ratio of private-sector credit to GDP in Brazil was the sixth smallest in a sample of sixteen countries, below those of Chile, Bolivia, Costa Rica, and Honduras.[13]

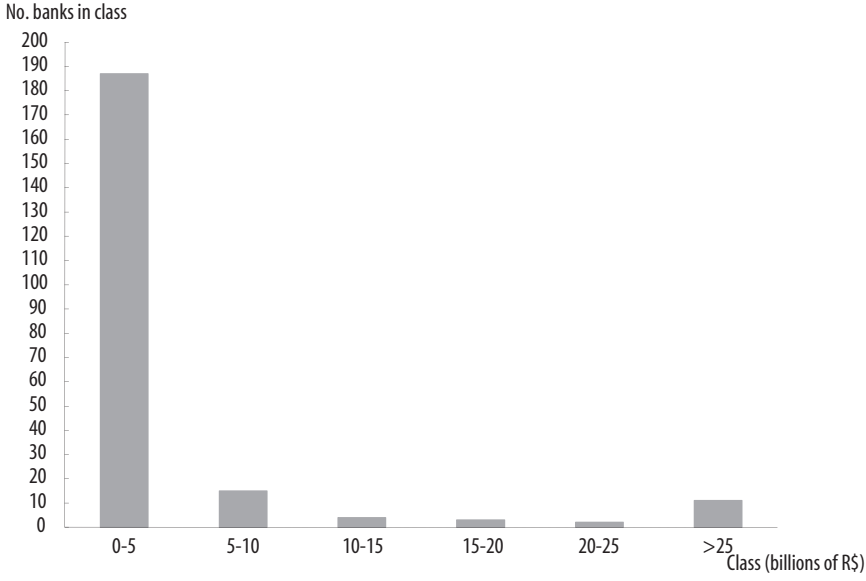
Figure 1 depicts the distribution of the banks in our sample by total assets. During the sample period, a large number of small banks (specifically, 187 banks with less than R$5 billion in assets) represented less than 14 percent of the industry's total assets.[14] In contrast, the large banks (with average total assets of more than R$25 billion, or U.S.$9.25 billion) owned no less

12. Gelos (2006). In table 1 of that paper, the interest rate margins, measured as total bank interest rate income minus total interest rate expense divided by the sum of total interest bearing assets, were 6.6 percent for Mexico, 5.5 percent for Chile, and 4.0 percent for Colombia.

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

14. The average exchange rate in the sample period (November 2001 to December 2006) was 2.7019 reais to the U.S. dollar, so R$5.00 billion corresponds to US$1.85 billion. Volatility was very high during the sample period, however, including a sudden stop episode in late 2002, when the exchange rate hit 4 reais to the dollar.

FIGURE 1. Distribution of Banks, by Total Assets



Source: Central Bank of Brazil, bank balance sheet accounts (COSIF).

than two-thirds of the industry's assets.[15] The twenty-four medium-sized banks accounted for 20.6 percent of the system total assets. A couple of important features for our empirical strategy emerge from figure 1. First, bank size varies considerably, so we are able to test if large and small banks react differently to monetary policy shocks. Second, the pass-through of marginal cost to prices depends on market power, and the industry is rather concentrated.[16] Table 1 shows the liability side of the balance sheet of the banking sector. Time deposits are the largest category and represent about 20.2 percent of the industry's liabilities.

The Brazilian banking industry has several peculiarities.[17] The first is the prominent presence of the public sector in financial intermediation. Govern-

15. Of these, three are government-owned banks (the first, second, and eleventh largest banks) and represent 29.6 percent of total system assets. Three are foreign banks and represent 12.4 percent of the total system assets. The remainder are domestic private banks and represent 58 percent of the total system assets. One of the banks in this group is not a retail bank, but instead specializes in wealth management, catering to rich clients and large companies.

16. Panzar and Rosse (1987).

17. We are grateful to Arturo Galindo for calling our attention to this point.

TABLE 1. Decomposition of the Liability Side of Brazilian Banks' Balance Sheets[a]
Percent

Item	*Share (%)*
Equity	11.7
Demand deposits	7.6
Time deposits	20.2
Saving deposits	13.0
Repurchase agreements	17.7
Foreign loans	4.8
Earmarked funds from domestic official institutions	5.0
Other	20.0

Source: Central Bank of Brazil.
a. Average over the period from November 2001 to December 2006.

ment participation in the banking sector is high. Two of the three largest commercial banks in Brazil are state owned (Banco do Brasil and Caixa Econômica Federal).[18] In 2006, they represented roughly 23 percent of all outstanding credit in the banking system. The federal government also owns a very large development bank (BNDES) that alone was responsible for another 11 percent of all credit outstanding in 2006. In general, state-owned banks have preferential or exclusive access to cheaper, more stable funding sources.[19] Some of these funds are earmarked to targeted sectors, such agricultural working capital loans, housing loans, and trade finance for exports and imports. The rest is market-based credit. BNDES, the large development bank, funds working capital loans to SMEs through private banks using low-cost funding from payroll deductions (see earmarked funds from domestic official institutions in table 1). In 2006, earmarked lending represented 15.1 percent of total lending, and it has been growing since then. Finally, the Brazilian banking system relies little on time, demand, and savings deposits by international standards (41 percent of banks' liabilities). In terms of external validity, our results are contingent on intermediation with low reliance on deposits.

Brazil's monetary policy framework is based on an inflation-targeting regime, which was adopted after the real was allowed to float in January

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

19. One example is judicial litigation deposits, which are deposits for civil suit settlements that are not final. By law they have to be deposited in public banks, with a regulated rate of 6 percent in real annual terms, which used to be low for Brazil (see below). Another important source is workers' unemployment insurance funds.

1999. The two-year-ahead inflation target is set every year (in early July) by the Monetary Policy Council, a committee composed of the Finance Minister, the Planning Minister, and the Central Bank Governor. The target is supposed to reflect society's preferences toward inflation. The Central Bank of Brazil has thus far been de facto independent in carrying out the implementation of monetary policy to achieve the inflation target. The Monetary Policy Committee currently meets every six weeks (initially, it was every four weeks) to decide on the basic interest rate (the SELIC rate).

Data and Descriptive Statistics

Our main data source is a unique call-report database from the Central Bank of Brazil.[20] Call reports contain daily information, including the bank and type of loan, on interest rates and volume of new loans, our two dependent variables. On a monthly basis, banks have to report data on maturity and default rates. The data set contains only non-earmarked credit. Data run from June 2000 through December 2006.

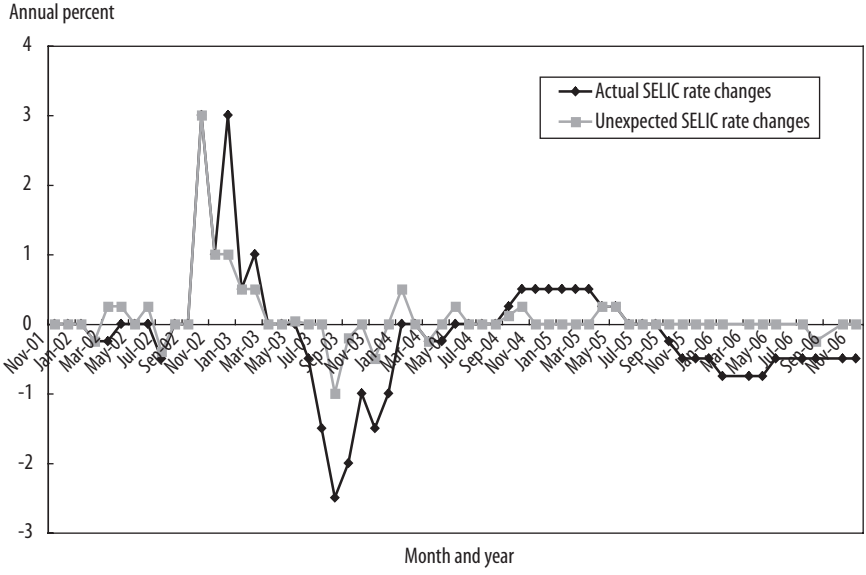
Loans are classified into six categories of consumer lending and eleven types of credit to firms. Categories differ along several dimensions, such as the presence of collateral, type of borrower, length of the loan, and whether rates are fixed or adjustable.

The main explanatory variable is the unexpected change in the basic interest rate, which is defined as the difference between the target set for the basic interest rate (hereafter, the SELIC) and the median of the market players' expectations the day before the meeting (the so-called Focus survey, which is the equivalent of the market consensus), both of which are publicly available. Expected changes in monetary policy should also have an impact on the credit market. However, our identification strategy relies crucially on high-frequency responses to changes in monetary policy. Since it is hard to determine when the expected component was priced in, we work with the unexpected component only for identification reasons. The Focus survey began in November 2001, so our final sample period is November 2001 through December 2006.

Figure 2 depicts the actual and unexpected SELIC changes. It shows large unexpected changes by the end of 2002, a period of macroeconomic instability that preceded the inauguration of President Luiz Inácio "Lula" da Silva. In the first meetings under the new administration, the market consensus

20. Data are not publicly available for bank privacy reasons.

FIGURE 2. Actual and Unexpected Changes in the SELIC Rate



Source: Central Bank of Brazil.

(median) underestimated the increases in the SELIC, reflecting the central bank's attempt to gain reputation. In the second semester of 2003, the market underestimated the cuts in the SELIC. In 60 percent of the Monetary Policy Committee meetings, the consensus forecasts were right. Thus, variation is available to estimate the impact of surprises on the equilibrium quantity of loans and interest rates.

Tables 2 and 3 present pairwise correlations between changes in lending interest rates and the SELIC (unexpected and actual) and changes in new loans and the SELIC (unexpected and actual). Correlations suggest that it takes two days for changes in the basic rate to affect lending rates and quantities: three and four days after the meeting, the correlation between unexpected changes in SELIC and lending rates (quantities) has the expected positive (negative) sign.

Following the literature, we decompose the impact of monetary policy by bank size, and different categories have distinct funding profiles. Consider the size taxonomy of figure 1. Table 4 shows deposits as a proportion of total liabilities for the three bank size categories (large, medium-sized, and small).

Clear differences in funding strategies emerge. Large banks have the highest percentage of their liabilities in deposits, although small banks have more

TABLE 2. Correlations between the SELIC and Lending Interest Rates[a]

Bank size and lending rate	*Unexpected SELIC variation*	*Actual SELIC variation*
Large banks		
$Interest_{t+1}$	−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
Medium-sized banks		
$Interest_{t+1}$	−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
Small banks		
$Interest_{t+1}$	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

Source: Authors' calculations based on data from the Central Bank of Brazil.

a. The variables are defined as follows: $Interest_{t+1}$ is the difference between the average annual interest rate on loans 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 annual interest rate on loans two days after the monetary policy committee meeting and the average interest rate one day before the meeting; and so on.

deposits than medium-sized banks. This is true for both subcategories of deposits (time and demand), but demand deposits are only relevant for large banks. Savings deposits monotonically decrease with size.

Some of the facts presented in table 4 are unsurprising. Banks must have branches all over the country to be able to compete for demand and saving deposits. The time deposit market is segmented between large denomination certificates of deposit (CDs) and the retail market targeting individuals. Small and medium-sized banks are able to get funding in the wholesale CD market.

Empirical Strategy

Identifying the banks' lending reactions is akin to the standard problem of estimating demand and supply relations in microeconometrics. The bank lending channel refers to the supply side of the credit market, but we typically observe only equilibrium values. Following a monetary policy shock, not

TABLE 3. Correlations between the SELIC and New Loans[a]

Bank size and volume of new loans	*Unexpected SELIC variation*	*Actual SELIC variation*
Large banks		
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-sized banks		
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		
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: Authors' calculations based on data from the Central Bank of Brazil.

a. The variables are defined as follows: New_loans$_{t+1}$ is the difference between the average volume of loans one day after the monetary policy committee meeting and the average interest rate one day before the meeting; New_loans$_{t+2}$ is the difference between the average volume of loans two days after the monetary policy committee meeting and the average interest rate one day before the meeting; and so on.

TABLE 4. Deposit Funding as a Share of Total Liabilities, by Bank Size[a]

Bank size	*Total deposits/ Liabilities*	*Demand deposits/ Liabilities*	*Time deposits/ Liabilities*	*Saving deposits/ Liabilities*
Large banks				
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-sized banks				
Average	20.7	2.5	14.0	4.6
Median	18.1	0.7	11.0	0
Minimum	0	0	0	0
Maximum	65.2	9.0	38.0	29.1
Small banks				
Average	33.8	3.5	29.0	1.2
Median	25.5	0.5	20.0	0
Minimum	0	0	0	0
Maximum	98.1	67.0	98.0	37.3

Source: Authors' calculations based on banks' balance sheet accounts (COSIF, Central Bank of Brazil).

only the supply of credit, but also demand for credit could shift, a problem first recognized by Kashyap and Stein.[21]

Existing empirical literature uses bank characteristics to isolate demand factors.[22] The key identifying assumption is that banks differ in their abilities to substitute away from deposits. Furthermore, observable characteristics determine the ability to move to and from deposits. In this case, one may interpret different reactions to monetary policy as evidence of the bank lending channel. Typically, one assumes that larger, more liquid, and foreign-owned (in emerging countries) banks are better equipped to move to and from deposits. The theoretical motivation behind these assumptions is as follows. The presence of deposit insurance makes deposits free of informational asymmetries, which makes them the cheapest and more stable way to fund bank credit operations. When forced to raise equity, long-term debt, and short-term wholesale debt, banks have to pay dearly for informational asymmetries and noncontractibility. In this context, large banks pay less than small banks when substituting away from deposits to these more expensive instruments, perhaps because of a too-big-to-fail effect or because they are easier to monitor.[23] The same would apply for foreign banks in emerging countries. Liquidity also matters because if banks have very liquid instruments on the asset side of the balance sheet, they may sell positions when facing a funding shortage. Finally, banks follow distinct strategies for funding. In Brazil, as table 4 shows, large banks have a stronger reliance on deposits than small banks, although the industry as a whole relies little on deposits by international standards.[24]

Regardless of the empirical validity of such theoretical arguments, banks with different characteristics serve different clientele. Consequently, the equilibrium reaction to monetary policy may differ for demand reasons: different borrowers may react differently to monetary policy shocks. For example, middle-market banks specialize in receivables discounting for small and medium-sized enterprises (SMEs). Large universal banks, in addition to discounting, provide short- and medium-term working capital loans for larger firms. Large firms could conceivably reduce their working capital demand in

21. Kashyap and Stein (1994).

22. Kashyap and Stein (2000); Arena, Reinhart, and Vázquez (2007).

23. See Kashyap and Stein (2000); Stein (1998).

24. Among Latin American countries, the Brazilian banking system has the lowest deposits-to-liabilities ratio, at 41 percent. The average is 65 percent. We kindly thank Arturo Galindo for pointing this out and sending out the data on different Latin American countries.

response to monetary tightening, but SMEs will not cut their demand for discounting so quickly. Furthermore, consumer credit is highly concentrated in large banks, and consumption and investment may react very differently to monetary policy.

In contrast with the literature, our main identification strategy is data driven. A well-established fact in monetary economics is that output and inflation are only slowly affected by the traditional monetary policy mechanism.[25] In the short run, consumption and investment decisions have some inertia. Since monetary policy immediately affects banks' marginal cost for several products, credit supply should react faster to monetary policy than credit demand. By using daily data and focusing on the few days before and after the Monetary Policy Committee meetings, we are confident that we are recovering only systematic supply shifts. In addition to high frequency, we have information about flows, that is, new loans. This is crucial for the success of our strategy because stocks hardly move much in the very short run. Another advantage vis-à-vis the literature is that we have data on interest rates, which is useful for corroborating that we capture supply shocks: supply and demand shocks to monetary policy have similar implications for quantities, but opposite implications for interest rates. Finally, we also follow the literature and decompose the response to monetary policy by bank characteristics, namely, size, ownership, and liquidity.

In the event study, we compare the amount of new loans issued and interest rates charged during the few days before and after a Monetary Policy Committee meeting to set a new target for the basic interest rate. We use only the surprise of the announcement, that is, the difference between the median expected change in the basic interest rate (on the day before the meeting) and the actual change.[26] In doing so, we mitigate the possibility that most of the effects of a policy announcement may have occurred well before the meeting.

We estimate the following equations:

$$\text{(1A)} \qquad \text{New\_loans}_{ijt+N} - \text{New\_loans}_{ijt-1} = c_{ij} + \beta_1 \text{Characteristic}_{it} + \beta_2 \text{Unexpected\_SELIC}_t + \text{Controls}_{ijt} + \varepsilon_{ijt};$$

25. See Christiano, Eichenbaum, and Evans (1999), among many others. As Friedman (1972) famously noted, monetary policy works with "long and variable lags."

26. As a robustness test, we also used the actual interest rate changes. Results are available on request.

$$(1B)\quad \text{New\_loans}_{ijt+N} - \text{New\_loans}_{ijt-1} = c_{ij} + \beta_1 \text{Characteristic}_{it} + \beta_2 \text{Unexpected\_SELIC}_t + \beta_3 \text{Characteristic}_{it} \text{Unexpected\_SELIC}_t + \text{Controls}_{ijt} + \omega_{ijt};$$

$$(2A)\quad \text{Interest}_{ijt+N} - \text{Interest}_{ijt-1} = c_{ij} + \gamma_1 \text{Characteristic}_{it} + \gamma_2 \text{Unexpected\_SELIC}_t + \text{Controls}_{ijt} + \mu_{ijt};$$

$$(2B)\quad \text{Interest}_{ijt+N} - \text{Interest}_{ijt-1} = c_{ij} + \gamma_1 \text{Characteristic}_{it} + \gamma_2 \text{Unexpected\_SELIC}_t + \gamma_3 \text{Characteristic}_{it} \text{Unexpected\_SELIC}_t + \text{Controls}_{ijt} + \eta_{ijt}.$$

The subscript *i* refers to the bank, *j* the type of credit, and the dimension *t* the period surrounding an event (that is, a meeting of the Monetary Policy Committee). In other words, $t + N$ means *N* days after the day the committee announced the new rate. Correspondingly, $t - 1$ is the day before the meeting. Thus, New_loans_{ijt+N} is the amount of new loans on the *N*th day after the committee meeting. In some specifications, we include fixed-effects dummies for the bank-loan pair. The coefficients of interest are β_2, β_3, γ_2, and γ_3. The coefficients β_2 and γ_2 are expected to be negative and positive, respectively, if they are to capture a supply effect. The signs of β_3 and γ_3 are less clear-cut. For example, the standard assumption in the literature is that large banks are less restricted in their funding options. In this case, we would expect β_3 and γ_3 to be negative and positive, respectively. We also estimated the models with two different dependent variables: $\log(\text{New\_loans}_{t+N}/\text{New\_loans}_{t-1+N})$ and the percentage change in new loans. The results are similar and are available on request.[27]

One legitimate concern with the specification is whether changes in the SELIC (whether expected or unexpected) truly reflect the changes in the cost of funds. The SELIC is a short-term rate, and some loans have a longer maturity. In theory, we should look at the whole yield curve. We deal with this problem empirically. Our results, which are available on request, show two

27. We use several observations of different types of credit for the same bank-event pair. Errors might therefore be correlated. We cluster errors at the bank-event level for the baseline model, and the results are slightly more precise than when we use only robust standard errors. Results are shown in the appendix.

TABLE 5. Effect on New Loans and Interest Rates without Decomposition[a]

Dependent and explanatory variables	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans				
ΔUnexpected_SELIC	0.17***	0.01	−0.29***	−0.11***
	(0.05)	(0.03)	(0.05)	(0.02)
No. observations	45,532	45,480	45,255	45,030
No. groups	1,090	1,087	1,085	1,083
B. Interest rates				
ΔUnexpected_SELIC	−0.64***	−0.69***	0.63***	1.40***
	(0.2)	(0.19)	(0.18)	(0.18)
No. observations	27,060	27,097	27,022	26,633
No. groups	810	812	811	803

*** Statistically significant at the 1 percent level.

a. In panel A, the dependent variable is $\text{New\_Loans}_{t+N} - \text{New\_Loans}_{t-1}$. In panel B, the dependent variable is $\text{Interest}_{t+N} - \text{Interest}_{t-1}$. Robust standard deviations are in parentheses.

things. First, the average maturity of loans in Brazil is short, at seven months, so short-term rates seem appropriate. Second, maturities are heterogeneous among different types of loans. If the estimates are not sensitive to the type of loan considered, the SELIC is not a bad measure of the cost of funds.

Results

We begin this section with a presentation of the main estimates of the general effects of monetary policy. Table 5 shows the results for equations 1A and 2A, that is, the models without any decomposition. The results show that unexpected changes in the SELIC rate have a negative and statistically significant effect on new loans and a positive and statistically significant effect on lending interest rates on the third and fourth days after the committee meeting. The results are reversed on the first and second days. We prefer the results for days 3 and 4 for four reasons. First, they are more consistent than the results for days 1 and 2. In fact, on day 2, the impact on quantity is zero. Second, banks may hesitate to move on the very first days, to avoid moving alone. This is particularly important for small banks, which may act as followers. When we decompose observations by size, results for days 1 and 2 for larger banks are inconsistent for prices and quantities (as discussed below). Third, there is a delay between the contract date and the fund release date. For example, the contract date could be one day after the meeting, but the actual release of the funds occurs two or three days later. The same kind of effect

could influence new loans one and two days after the meeting: some of the loans were actually contracted on the day of the meeting (or even earlier), so they do not reflect the new information about the basic interest rate. Finally, the results for days 3 and 4 have theoretical support: they represent a supply shift. In contrast, it would be hard to interpret the results for days 1 and 2 even if they were consistent because they are compatible with demand, not supply, and demand should not respond this quickly. Thus, throughout the discussion, we focus on days 3 and 4.

In quantitative terms, an unexpected increase of the SELIC rate of 1 percent per year implies a drop in average daily new loans by R$290,000 (U.S.$107,000), or about 11 percent of the average value of the new loans in the sample.[28] For the industry as a whole, this means an impact of R$57.7 million (U.S.$21.3 million), or approximately 2.7 percent of the average value of the industry new loans in the sample.[29]

The effect of the SELIC on credit interest rates is positive and statistically significant in windows 3 and 4. The estimated pass-through in the three-day window is less than one, which means that not all of the SELIC's variation is passed on to credit interest rates. This stickiness is compatible both with market power and with adverse selection in credit markets.[30] The signs and magnitudes of our estimated responses to changes in the SELIC in the three- and four-day windows are compatible with supply but not demand shifts, which corroborates our identification strategy.

Figure 1 showed that our sample contains only a few large banks. Because we weight the banks equally, the documented differences come mostly from differences between small and medium-sized banks. To check the robustness of our results, we weight observations by bank size. The results are similar (see table A1 in the appendix).

Our results could also be driven by crisis periods, considering that 2002 was a year of economic turmoil in Brazil (see figure 2). We therefore reestimated the model excluding all events from 2002. The results, which are similar, are presented in table A2 in the appendix.

Another important issue concerns the possibility of hoarding. If the dates of the announcements are known in advance, lenders (or banks) may hoard

28. These calculations use the results for the three-day window.

29. We use several observations of several different types of credit for the same bank-event pair. Errors might therefore be correlated. However, when we cluster errors at the bank-event level for the baseline model, the results are slightly more precise than when we use only robust standard errors. Results are shown in the appendix.

30. Panzar and Rosse (1987); Stiglitz and Weiss (1981).

loan applications until the uncertainty is resolved. Hoarding would only affect quantities, not interest rates. We take steps to address the possibility that hoarding mechanically produces the results for quantities. If hoarding is empirically relevant, then new loan concessions should be lower in the days immediately preceding the Monetary Policy Committee meetings than, say, seven to ten days before the meeting. Our tests confirmed this is not the case. This is irrespective of whether the surprise in SELIC rates is up or down.

Size Decomposition

In this subsection, we follow the literature in estimating models 1B and 2B with a decomposition of the monetary policy impact by bank size. The intuition is that because larger banks have more collateral to offer, they will probably find it easier to substitute deposits with other kind of debts. Furthermore, investors could be more willing to buy the shares of larger banks if they thought the government perceived them as too big to fail. We use the log of assets as a measure of bank size. Table 6 shows the results for new loans and interest rate.[31] In line with our previous estimates, banks' reactions to changes in monetary policy are again compatible with a supply response: they increase lending interest rates and decrease new loans after a monetary policy contraction.

Results on the interaction term contrast sharply with the existing literature. If large banks were better equipped to substitute away from deposits, they should respond less strongly to changes in monetary policy. In fact, they respond more strongly. Using estimates in table 6, table 7 reports the average response for the three groups of banks: small, medium-sized, and large. In general, small banks do not respond to shocks in monetary policy. Among large banks, a one percentage point unexpected increase in the SELIC rate causes an average daily reduction of R$1.24 million (U.S.$459,000), which means an average aggregate daily reduction of R$13.6 million (U.S. $5.03 million), or approximately 8.8 percent of the average value of the large banks' new loans in the sample. Accordingly, the interest rates charged by small banks are insensitive to unexpected changes in monetary policy, while a one percentage point unexpected increase in the SELIC rate causes

31. The results using size could be generated by the larger number of small and medium-sized banks in our sample. To address this possible problem, we estimated the same model with weights based on the sample average size of each bank. The results are not qualitatively different from those of table 6 (see table A1 in the appendix).

TABLE 6. Effect on New Loans and Interest Rates, by Bank Size[a]

Dependent and explanatory variables	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans				
Size	0.23***	0.34***	0.51***	0.26***
	(0.07)	(0.06)	(0.07)	(0.05)
ΔUnexpected_SELIC	−2.00***	−0.004	3.60***	1.30***
	(0.60)	(0.40)	(0.70)	(0.30)
ΔUnexpected_SELIC × Size	0.10***	0.002	−0.18***	−0.06***
	(0.03)	(0.20)	(0.03)	(0.02)
No. observations	45,442	45,404	45,181	44,956
No. groups	1,090	1,087	1,085	1,083
B. Interest rates				
Size	−0.09	−0.22	0.78*	0.41
	(0.31)	(0.30)	(0.34)	(0.30)
ΔUnexpected_SELIC	−3.70*	−5.50***	−6.30***	−3.50**
	(2.20)	(1.90)	(2.10)	(1.70)
ΔUnexpected_SELIC × Size	0.14	0.22**	0.32***	0.23***
	(0.10)	(0.08)	(0.09)	(0.07)
No. observations	27,006	27,048	26,976	26,584
No. groups	810	811	811	803

Source: Central Bank of Brazil.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. In panel A, the dependent variable is $New\_Loans_{t+N} - New\_Loans_{t-1}$. In panel B, the dependent variable is $Interest_{t+N} - Interest_{t-1}$. Robust standard deviations are in parentheses.

TABLE 7. Estimates of New Loans and Interest Rates, by Size[a]

Dependent variable and bank size	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans				
Smallest size	−0.39	0.02	0.76	0.27
	(<0.01)	(0.79	(<0.01)	(<0.01)
Average size	0.16	0.03	−0.23	−0.08
	(<0.01)	(0.22	(<0.01)	(<0.01)
Largest size	0.73	0.04	−1.24	−0.43
	(<0.01)	(0.76	(<0.01)	(<0.01)
B. Interest rates				
Smallest size	−1.53	−2.09	−1.34	0.07
	(0.03)	(<0.01)	(0.06)	(0.98)
Average size	−0.85	−0.91	0.38	1.30
	(<0.01)	(<0.01)	(0.06)	(<0.01)
Largest size	−0.01	0.30	2.13	2.56
	(0.93)	(0.36)	(<0.01	(<0.01)

a. The *p* values of the *F* test are in parentheses.

TABLE 8. Estimates of New Working Capital Loans and Interest Rates by Size[a]

Dependent variable and bank size	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New working capital loans				
Smallest size	−0.03	−0.05	0.45	0.13
	(0.79)	(0.70)	(<0.01)	(0.28)
Average size	0.04	0.03	−0.15	−0.03
	(0.13)	(0.40)	(<0.01)	(0.4)
Largest size	0.13	0.12	−0.81	−0.21
	(0.44)	(0.57)	(<0.01)	(0.30)
B. Interest rates on working capital loans				
Smallest size	−0.88	−0.18	0.98	1.17
	(0.22)	(0.82)	(0.18)	(0.12)
Average size	−0.22	0.12	1.50	1.16
	(0.56)	(0.55)	(<0.01)	(<0.01)
Largest size	0.53	0.45	2.07	1.14
	(0.24)	(0.30)	(<0.01)	(0.06)

a. The *p* values of the *F* test are in parentheses.

an increase of 2.13 percentage points in the interest rate charged by large banks.[32]

Decomposition by Type of Loan

Banks of different sizes serve different clienteles. Our identification strategy is tailored to isolate supply shocks, but identification would be cleanest if we could restrict our attention to a homogeneous class of borrowers. Furthermore, by focusing on a homogeneous class of borrowers, we would estimate the supply shock for the same demand elasticity. We have no data on the borrower side, but we do have information on the type of credit, which is a good proxy for type of borrower. Tables 8 and 9 are analogous to table 7, but the sample is restricted to working capital (table 8) and consumer loans (table 9). Results are similar to those in table 7, which uses all types of loans.[33]

32. Figure 2 shows that five unexpected changes in the SELIC occurred in 2002, a year of economic crisis in Brazil. To ensure that the results are not confined to a crisis period, we reestimated the model of this section excluding 2002. Table A2 in the appendix has the results, which are qualitatively similar to those in table 6.

33. We omit the analogous versions of table 6 (all types of credit) for working capital and consumer credit. The results, which are very similar to those in table 6, are available on request.

TABLE 9. Estimates of New Consumer Loans and Interest Rates by Size[a]

Dependent variable and bank size	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New consumer loans				
Smallest size	−0.25	−0.13	0.91	0.44
	(<0.01)	(0.30)	(<0.01)	(<0.01)
Average size	1.31	0.08	−0.23	−0.13
	(<0.01)	(0.05)	(<0.01)	(<0.01)
Largest size	3.01	0.30	−1.48	−0.75
	(<0.01)	(0.15)	(<0.01)	(<0.01)
B. Interest rates on consumer loans				
Smallest size	−2.27	−3.21	−2.34	−0.10
	(0.09)	(<0.01)	(0.06)	(0.96)
Average size	−1.50	−1.81	−0.22	1.40
	(<0.01)	(<0.01)	(0.54)	(<0.01)
Largest size	−0.65	−0.28	2.11	3.04
	(0.39)	(0.80)	(<0.01)	(<0.01)

a. The *p* values of the *F* test are in parentheses.

Liquidity

The second decomposition is by asset liquidity. Banks with more liquid assets (say, government bonds) have better collateral to post, allowing them to substitute away from deposits if they become too expensive. In addition, banks may sell liquid assets if conditions get too tight. We use the following measure of liquidity:

$$\text{Liquidity}_{it} = \frac{\text{Cash}_{it} + \text{Securities}_{it} + \text{Interbank}_{it}}{\text{Total\_assets}_{it}}.$$

Table 10 presents the results. Contrary to theoretical arguments, estimates show that liquidity does not appear to influence the transmission of monetary policy through the bank lending channel.

Deposits and Earmarked Funds

The credit channel of monetary policy operates mainly through its impact on the cost of funds to banks. Deposits, a form of short-term debt, are immediately affected by changes in the basic rate. Thus, the impact of monetary policy should depend on the proportion of deposits that different banks hold in their liabilities. As table 4 shows, larger banks rely more on demand deposits

TABLE 10. Effect on New Loans and Interest Rates by Bank Liquidity[a]

Dependent and explanatory variables	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans				
Liquidity	0.01	0.26**	0.37***	0.18
	(0.20)	(0.13)	(0.13)	(0.12)
ΔUnexpected_SELIC	0.22***	0.05	−0.31***	−0.09***
	(0.06)	(0.04)	(0.06)	(0.03)
ΔUnexpected_SELIC × Liquidity	−0.37***	−0.20	0.14	−0.12
	(0.14)	(0.13)	(0.19)	(0.11)
No. observations	45,442	45,404	45,181	44,956
No. groups	1,090	1,087	1,085	1,083
B. Interest rates				
Liquidity	−0.12	−0.39	−1.8	−0.12
	(1.20)	(1.30)	(1.30)	(1.40)
ΔUnexpected_SELIC	−0.19	0.19	1.10***	1.20***
	(0.35)	(0.30)	(0.35)	(0.25)
ΔUnexpected_SELIC × Liquidity	−3.30	−6.80***	−3.70	1.50
	(2.50)	(2.10)	(2.90)	(1.20)
No. observations	27,006	27,048	26,976	26,584
No. groups	810	811	811	803

Source: Central Bank of Brazil.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. In panel A, the dependent variable is $\text{New\_Loans}_{t+N} - \text{New\_Loans}_{t-1}$. In panel B, the dependent variable is $\text{Interest}_{t+N} - \text{Interest}_{t-1}$
Robust standard deviations are in parentheses.

than smaller ones. Consequently, the results of our decomposition by size may be due to differences in liability composition. Table 11 tests this conjecture.

Table 11 reveals that banks that rely more on deposits for their funding respond more strongly to changes in monetary policy than banks that have a broader range of funding sources. This is true for both interest rates and loan concessions at both the three- and four-day windows. Since small and large banks differ in their funding strategies, it is important to check whether the results in table 6 are robust to controlling for difference in funding strategy (see tables 14 and 15 below).

Also on the liability side, banks receive funding from government programs. BNDES funds earmarked for working capital to small and medium-sized firms is the largest component of this kind of funding. These loans have variable but regulated rates and, by construction, should respond less to monetary policy shocks. Table 12 presents the estimates of models 1B and 2B decomposed by BNDES funding as a percentage of liabilities.

TABLE 11. Effect on New Loans and Interest Rates by Demand Deposits[a]

Dependent and explanatory variables	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans				
% Demand deposits	−0.02	0.31	0.06	−0.28
	−0.35	−0.30	−0.32	−0.28
ΔUnexpected_SELIC	0.10***	0.0007	−0.21***	−0.09***
	(0.03)	(0.02)	(0.03)	(0.02)
ΔUnexpected_SELIC × % Demand deposits	1.30***	0.28	−1.50***	−0.39**
	(0.43)	(0.26)	(0.44)	(0.20)
No. observations	45,442	45,404	45,181	44,956
No. groups	1,090	1,087	1,085	1,083
B. Interest rates				
% Demand deposits	−0.66	2.10	1.40	−6.20*
	(3.20)	(3.80)	(3.20)	(3.30)
ΔUnexpected_SELIC	−0.69**	−0.61***	0.55**	1.00***
	(0.27)	(0.24)	(0.24)	(0.22)
ΔUnexpected_SELIC × % Demand deposits	1.10	−1.40	1.30	5.40***
	(2.10)	(1.60)	(1.70)	(1.80)
No. observations	27,006	27,048	26,976	26,584
No. groups	810	811	811	803

Source: Central Bank of Brazil.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. In panel A, the dependent variable is $New\_Loans_{t+N} - New\_Loans_{t-1}$. In panel B, the dependent variable is $Interest_{t+N} - Interest_{t-1}$. Robust standard deviations are in parentheses.

In line with expectations, banks with a large share of earmarked BNDES funds are less sensitive to changes in monetary policy. Again, banks differ in their reliance on earmarked funds. Thus, as previously emphasized, it is important to check whether the results in table 6 are robust to controlling for differences in earmarked funding (see tables 14 and 15 below).

Ownership

The previous literature finds that ownership matters for the credit channel. Arena, Reinhart, and Vázquez argue that foreign banks may be less sensitive to changes in the basic interest rate because they have access to a larger deposit base outside the country.[34] Foreign banks would thus be less likely than domestic banks to be financially restricted in the debt market. State-owned banks may also respond differently than privately owned banks for

34. Arena, Reinhart, and Vázquez (2007).

TABLE 12. Effect on New Loans and Interest Rates by Earmarked Funds[a]

Dependent and explanatory variables	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans				
% Earmarked funds	−0.02	−0.07	−0.24	−0.21
	(0.22)	(0.22)	(0.22)	(0.20)
ΔUnexpected_SELIC	0.18***	0.01	−0.31***	−0.12***
	(0.05)	(0.03)	(0.05)	(0.03)
ΔUnexpected_SELIC × % Earmarked funds	−0.16*	0.006	0.31***	0.14***
	(0.09)	(0.06)	(0.09)	(0.05)
No. observations	45,442	45,404	45,181	44,956
No. groups	1,090	1,087	1,085	1,083
B. Interest rates				
% Earmarked funds	0.38	2.40	2.80	3.60
	(2.50)	(2.30)	(2.40)	(2.30)
ΔUnexpected_SELIC	−0.65***	−0.84***	0.55***	1.40***
	(0.21)	(0.21)	(0.21)	(0.19)
ΔUnexpected_SELIC × % Earmarked funds	0.40	2.80***	1.40	0.36
	(1.20)	(1.00)	(1.10)	(1.00)
No. observations	27,006	27,048	26,976	26,584
No. groups	810	811	811	803

Source: Central Bank of Brazil.

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. In panel A, the dependent variable is $New\_Loans_{t+N} - New\_Loans_{t-1}$. In panel B, the dependent variable is $Interest_{t+N} - Interest_{t-1}$. Robust standard deviations are in parentheses.

two reasons. First, their deposit base is more stable and less costly (namely, savings accounts, whose interest rates are regulated), which gives them an advantage in responding to deposit shocks. Second, state-owned banks are likely to have a different objective function. Table 13 estimates models 1B and 2B decomposed by ownership.

As suggested by previous results, banks respond (at days 3 and 4) to an increase in the SELIC by reducing new loans and increasing interest rates. Interestingly, government-owned banks respond somewhat more strongly than private banks (both domestic and foreign), although the difference is not statistically significant. Government-owned banks are larger than average, making it crucial to check whether the size effect is not an ownership effect.

Combining All Decompositions

So far, our results suggest that only size matters. Here we estimate one big model incorporating all the decompositions to provide a clearer picture of which characteristics are most important. Tables 14 and 15 present the results.

TABLE 13. Effect on New Loans and Interest Rates, by Bank Ownership[a]

Dependent and explanatory variables	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans				
ΔUnexpected_SELIC × Foreign	0.15**	0.03	−0.20***	−0.17***
	(0.07)	(0.06)	(0.06)	(0.05)
ΔUnexpected_SELIC × Private	0.11**	0.03	−0.22***	−0.04*
	(0.05)	(0.03)	(0.05)	(0.02)
ΔUnexpected_SELIC × State-owned	0.5**	−0.10	−0.88***	−0.28**
	(0.25)	(0.14)	(0.28)	(0.13)
No. observations	45,442	45,404	45,181	44,956
No. groups	1,090	1,087	1,085	1,083
B. Interest rates				
ΔUnexpected_SELIC × Foreign	−0.62**	−0.63**	0.86***	1.10***
	(0.31)	(0.31)	(0.31)	(0.30)
ΔUnexpected_SELIC × Private	−0.61*	−0.73***	0.37	1.30***
	(0.31)	(0.27)	(0.27)	(0.26)
ΔUnexpected_SELIC × State-owned	−0.76***	−0.64	1.10***	2.30***
	(0.29)	(0.42)	(0.31)	(0.36)
No. observations	27,006	27,048	26,976	26,584
No. groups	810	811	811	803

Source: Central Bank of Brazil.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. In panel A, the dependent variable is $New\_Loans_{t+N} - New\_Loans_{t-1}$. In panel B, the dependent variable is $Interest_{t+N} - Interest_{t-1}$. Robust standard deviations are in parentheses.

When we combine all explanations, the results are somewhat similar to those we get when estimating the models separately. We find that large banks respond more strongly than small banks, with a steeper drop in new loans and a bigger increase in their interest rates. Banks that rely more on deposits for funding increase their interest rates more, as expected, but we find no results on quantities. The results are thus inconclusive. A higher proportion of earmarked funds is associated with a lower response in quantities, but no response in interest rates. This is precisely as expected: earmarked funds are passed on with regulated rates, so prices should not respond much.

Conclusion

This paper has studied the monetary policy transmission mechanism that works through bank credit in Brazil: namely, the bank lending channel. We

TABLE 14. Effect on New Loans: All Decompositions[a]

Explanatory variable	*N = 1*	*N = 2*	*N = 3*	*N = 4*
Size	0.23***	0.35***	0.5***	0.26***
	(0.07)	(0.06)	(0.07)	(0.05)
Liquidity	0.05	0.24*	0.30**	0.16
	(0.20)	(0.13)	(0.14)	(0.12)
% Demand deposits	0.16	0.59**	0.57*	−0.07
	(0.35)	(0.30)	(0.31)	(0.28)
% Earmarked funds	0.12	0.20	0.18	−0.01
	(0.22)	(0.22)	(0.23)	(0.20)
ΔUnexpected_SELIC × Size	0.11***	0.009	−0.19***	−0.06***
	(0.03)	(0.02)	(0.03)	(0.02)
ΔUnexpected_SELIC × Liquidity	−0.56**	−0.12	0.39	−0.06
	(0.25)	(0.13)	(0.28)	(0.11)
ΔUnexpected_SELIC × % Demand deposits	0.99**	0.48	−1.00**	−0.18
	(0.43)	(0.34)	(0.42)	(0.23)
ΔUnexpected_SELIC × % Earmarked funds	−0.10	0.03	0.21*	0.12**
	(0.11)	(0.07)	(0.11)	(0.06)
ΔUnexpected_SELIC × Foreign	−2.10***	−0.18	4.00***	1.20***
	(0.74)	(0.52)	(0.73)	(0.38)
ΔUnexpected_SELIC × Private	−2.00***	−0.14	3.70***	1.20***
	(0.65)	(0.46)	(0.65)	(0.34)
ΔUnexpected_SELIC × State−owned	−1.90**	−0.32	3.50***	1.10***
	(0.72)	(0.54)	(0.69)	(0.37)
No. observations	45,442	45,404	45,181	44,956
No. groups	1,090	1,087	1,085	1,083

Source: Central Bank of Brazil.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. The dependent variable is $New\_Loans_{t+N} - New\_Loans_{t-1}$. Robust standard deviations are in parentheses.

had access to a unique data set that includes all bank credit concessions (above a threshold) in Brazil, to both firms and people. The data include the loan amount and the interest rate charged. We use the daily frequency of the new loans and interest rate information to identify bank credit supply responses to monetary policy shocks (that is, unexpected basic interest rate changes) in a cleaner way than in the previous literature.

In contrast to the existing empirical literature for other countries, Brazil's larger banks respond more to monetary policy shocks than smaller banks. We do not interpret this result as evidence contrary to the theoretical mechanism behind the bank lending channel. The empirical literature typically uses U.S. data and assumes—reasonably for the United States—that informational

TABLE 15. Effect on Interest Rates: All Decompositions[a]

Explanatory variable	*N = 1*	*N = 2*	*N = 3*	*N = 4*
Size	−0.08	−0.17	0.87**	0.43
	(0.32)	(0.30)	(0.35)	(0.30)
Liquidity	0.006	−0.18	−1.70	0.37
	(1.20)	(1.30)	(1.30)	(1.40)
% Demand deposits	−1.00	1.80	2.80	−6.00*
	(3.20)	(3.90)	(3.30)	(3.30)
% Earmarked funds	0.35	2.30	3.90	4.30*
	(2.50)	(2.30)	(2.50)	(2.40)
ΔUnexpected_SELIC × Size	0.16*	0.23***	0.31***	0.24***
	(0.09)	(0.08)	(0.09)	(0.07)
ΔUnexpected_SELIC × Liquidity	−3.60	−8.20***	−5.40	0.42
	(3.10)	(2.70)	(3.60)	(1.40)
ΔUnexpected_SELIC × % Demand deposits	1.40	−1.90	−0.35	4.40***
	(2.20)	(1.50)	(1.50)	(1.60)
ΔUnexpected_SELIC × % Earmarked funds	0.08	1.60	0.71	0.99
	(1.10)	(0.99)	(1.00)	(1.00)
ΔUnexpected_SELIC × Foreign	−3.90*	−4.90***	5.50***	4.80***
	(2.00)	(1.80)	(1.80)	(1.70)
ΔUnexpected_SELIC × Private	−3.60*	−4.70***	5.50***	4.00**
	(1.90)	(1.80)	(1.80)	(1.70)
ΔUnexpected_SELIC × State−owned	−3.60*	−3.70*	4.50**	3.90**
	(1.90)	(2.00)	(1.80)	(1.90)
No. observations	27,006	27,048	26,976	26,584
No. groups	810	811	811	803

Source: Central Bank of Brazil.
* Statistically significant at the 10 percent level.
** Statistically significant at the 5 percent level.
*** Statistically significant at the 1 percent level.
a. The dependent variable is $\text{Interest}_{t+N} - \text{Interest}_{t-1}$. Robust standard deviations are in parentheses.

asymmetries and moral hazard problems plague smaller banks more than large ones.[35] In Brazil, this assumption is much less obviously true.

Our results have potentially important implications for the conduct of monetary policy in Brazil. The impact of changes in the basic interest rate (SELIC) is transmitted more strongly by larger banks, which hold the largest share of loans in the economy. This heightens the power of monetary policy. Furthermore, market structure has been changing. In particular, consolidation has increased the size of a typical bank. Our results suggest that the power of monetary policy through the credit channel will increase over time.

35. Kashyap, Stein, and Wilcox (1993); Kashyap and Stein (2000).

Appendix: Supplemental Tables

TABLE A1. Effect on New Loans and Interest Rates by Size with Weights[a]

Dependent and explanatory variables	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans				
Size	0.26***	0.40***	0.58***	0.30***
	(0.08)	(0.07)	(0.09)	(0.06)
ΔUnexpected_SELIC	−2.30***	0.01	4.20***	1.40***
	(0.74)	(0.49)	(0.79)	(0.38)
ΔUnexpected_SELIC × Size	0.12***	0.001	−0.21***	−0.07***
	(0.04)	(0.02)	(0.04)	(0.02)
No. observations	45,442	45,404	45,181	44,956
No. groups	1,090	1,087	1,085	1,083
B. Interest rates				
Size	−0.08	−0.23	0.78**	0.4
	(0.29)	(0.28)	(0.32)	(0.28)
ΔUnexpected_SELIC	−3.7*	−5.3***	−5.9***	−3.4**
	(2.1)	(1.8)	(2)	(1.6)
ΔUnexpected_SELIC × Size	0.14	0.21***	0.31***	0.22***
	(0.09)	(0.08)	(0.09)	(0.07)
No. observations	27,006	27,048	26,976	26,584
No. groups	810	811	811	803

Source: Central Bank of Brazil.

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. In panel A, the dependent variable is $\text{New\_Loans}_{t+N} - \text{New\_Loans}_{t-1}$. In panel B, the dependent variable is $\text{Interest}_{t+N} - \text{Interest}_{t-1}$. Weights were defined as the sample average of the logarithm of total assets. Robust standard deviations are in parentheses.

TABLE A2. Effect on New Loans and Interest Rates, by Size, Excluding 2002

Dependent and explanatory variables	*N = 1*	*N = 2*	*N = 3*	*N = 4*
A. New loans[a]				
Size	0.38***	0.48***	0.66***	0.37***
	(0.1)	(0.08)	(0.1)	(0.07)
ΔUnexpected_SELIC	2.3**	0.34	6.3***	2.9***
	(1)	(1)	(1.3)	(0.97)
ΔUnexpected_SELIC × Size	−0.12**	−0.02	−0.32***	−0.15***
	(0.05)	(0.05)	(0.07)	(0.05)
No. observations	34,599	34,586	34,352	34,132
No. groups	1,080	1,077	1,076	1,073
B. Interest rates				
Size	0.17	0.05	0.93**	0.58
	(0.36)	(0.35)	(0.44)	(0.37)
ΔUnexpected_SELIC	1.4	−6.8*	−8.7**	−7.8*
	(5.1)	(3.8)	(4.1)	(4.3)
ΔUnexpected_SELIC × Size	−0.04	0.31*	0.44**	0.4**
	(0.22)	(0.17)	(0.18)	(0.19)
No. observations	20,691	20,783	20,592	20,346
No. groups	786	788	787	774

Source: Central Bank of Brazil.

* Statistically significant at the 10 percent level.

** Statistically significant at the 5 percent level.

*** Statistically significant at the 1 percent level.

a. In panel A, the dependent variable is $New\_Loans_{t+N} - New\_Loans_{t-1}$. In panel B, the dependent variable is $Interest_{t+N} - Interest_{t-1}$. Robust standard deviations are in parentheses.