Economía
LACEA Journal

This is not America: The Credit Channel of Monetary Policy in Brazil

RESEARCH

LAURA ELIAS
BERNARDO GUIMARAES
*Author affiliations can be found in the back matter of this article

LSE Press

ABSTRACT

We estimate the monetary policy pass-through to lending rates in Brazil and the United States using the same methodology and obtain very different results. In the United States, the pass-through tends to be larger than 1:1. In Brazil, we find a 1:1 pass-through only in the case of non-earmarked credit for corporations and no evidence of transmission for households and earmarked credit. Owing to lower pass-through and credit/GDP, the effect of monetary policy through the credit channel in Brazil appears to be an order of magnitude smaller than in the United States.

CORRESPONDING AUTHOR:
Bernardo Guimaraes
Sao Paulo School of Economics – FGV, BR
bernardo.guimaraes@fgv.br

KEYWORDS:
monetary policy; pass-through; lending rates; earmarked credit

JEL CLASSIFICATION CODES:
E43; E52

TO CITE THIS ARTICLE:
Elias, Laura, and Guimaraes, Bernardo. 2024. "This is not America: The Credit Channel of Monetary Policy in Brazil." *Economía LACEA Journal* 23(1): 137–174. DOI: https://doi.org/10.31389/eco.391

DOI: 10.31389/eco.391

1 INTRODUCTION

The credit channel of monetary policy is present in most conventional macroeconomic models and defines how aggregate demand is affected by changes in credit costs. There is robust evidence that this channel is empirically relevant in the United States. But what about emerging economies?

A body of research suggests that the credit channel might not work so well in emerging countries. Policy discussions echo this concern and relate this to the banking sector.[1] However, empirical results are not so clear-cut. Estimates of the monetary policy transmission to lending rates seem to vary widely among countries.

Financial frictions are often blamed for the weak monetary policy transmission to lending rates. Brazil is a country with abnormally high interest-rate spreads and earmarked credit. This paper investigates whether this weakens monetary policy transmission in Brazil.

We assess the credit channel of monetary policy by regressing several lending rates on a measure of monetary surprise for Brazil and the US, which serves as a benchmark. We use the same methodology and the same type of data for both countries. For Brazil, we consider earmarked and non-earmarked credit to firms and households (where spreads are typically higher).

We use interest rate futures to compute exogenous monetary shocks. For Brazil, we obtain a surprise series from the Interbank Deposit Futures (DI) changes around Monetary Policy Committee (Copom) meetings between 2003 and 2019. For the United States, we use the shock series from Jarociński and Karadi (2020). The surprises are calculated within a 30-minute window around the Federal Open Market Committee (FOMC) announcement between 1994 and 2016.

Whereas Copom and FOMC meetings occur on different dates, most credit series released by the Central Bank of Brazil and the Federal Reserve are monthly. To turn the surprise and credit series compatible and completely isolate the effects of each monetary shock on the lending rates, we use the method in Sax and Steiner (2013). First, we interpolate each credit series to daily frequency, such that the mean or last value of the resulting high-frequency series matches its counterpart in the low-frequency one. We then take averages of lending rates between each monetary policy decision. Our dependent variables are the changes in those lending rates.

In the United States, changes in Fed fund rates are followed by changes in lending rates of different loan types and maturities. The monetary policy pass-through is often larger than 1. The results confirm previous findings by Gertler and Karadi (2015) and others.

In contrast, in Brazil, only a subset of credit types seems to react to Central Bank decisions. Interest rates on non-earmarked credit to firms seem to react 1:1 to monetary shocks. Earmarked credit to firms—particularly those granted by BNDES—does not seem to respond at all to changes in the policy rate.

Interestingly, interest rates on some types of earmarked credit to households do react to monetary policy—although less than one-to-one. This is the case with rural and real estate loans. Due to the Brazilian institutional environment, monetary policy seems to affect credit allocation between real state funding and other types of loans.

Moreover, we don't find evidence that non-earmarked credit to households reacts to monetary shocks. This result might seem strange at first but becomes less puzzling once we realize how large spreads on these types of loans are.

Total credit in the United States is around 150 percent of GDP, and we find that lending rates often amplify monetary shocks. In contrast, non-earmarked credit for corporations in Brazil—the only one that significantly responds to changes in the policy rate—accounts for less than 20 percent of GDP. Hence, the effect of monetary policy through the credit channel in Brazil appears to be an order of magnitude smaller than in the United States.

1 For example, Blanchard (2014) highlights the role of banking in driving different monetary policy transmissions in developed and developing countries. Fischer (2015) relates shallow interbank markets in developing countries with the limited effects of changes in the policy rate on lending rates and the economy.

DOI: 10.31389/eco.391

Our results thus suggest that the credit channel of monetary policy may be barely working in countries with very large interest rate spreads and excessive earmarked credit. This raises questions about the conduct of monetary policy in these economies.

The remainder of this introduction discusses the related literature. Section 2 shows and discusses data on earmarked credit and interest rate spreads in Brazil. Section 3 describes the data and explains the empirical methodology. Section 4 presents the results. Section 5 concludes.

1.1 RELATED LITERATURE

In conventional "frictionless" models, credit costs depend entirely on the expected path of the policy instrument (Gertler & Karadi 2015). However, frictions and changes in the credit market structure can modify this transmission. Some market imperfections amplify the transmission to the borrowing rates and, thus, the effects on the economy (Bernanke & Gertler 1995), but other types of frictions can obstruct the channels and compromise monetary policy efficiency.

Due to different market structures, monetary policy transmission may indeed vary among countries. Mishra et al. (2014) study the transmission of monetary shocks to lending rates in a large sample of advanced, emerging, and low-income countries between 1978 and 2013. They find that the response of lending rates to monetary shocks is very heterogeneous across the sample, but advanced and, to a lesser extent, emerging economies have a stronger transmission.[2] Limited pass-through to lending rates, however, is not an issue of low-income countries only. Many studies account for an incomplete transmission to lending rates in the Euro Area, with heterogeneity across countries and types of loans.[3]

Our work contributes to this literature on how conventional transmission channels might be obstructed or even inoperative. Most studies on this subject use vector autoregressive models to estimate the impact on lending rates and aggregate demand. We take a different approach and explore exogenous shifts in monetary policy.

Several other papers have studied the pass-through of monetary policy to lending rates in Brazil. Examples include Alencar (2003), Coelho et al. (2010), de Mello and de Castro (2012), and Divino and Haraguchi (2020). However, in these articles only data on non-earmarked credit is used. Our work considers both earmarked and non-earmarked credit in the analysis.[4]

Closest to our paper are those from Bonomo and Martins (2016) and Perdigao (2018), who also look at earmarked credit. Bonomo and Martins (2016) use firm-level data to analyze the effects of government-driven loans on monetary policy efficiency between 2006 and 2012. They find that the credit channel has indeed less effect on firms with access to government-driven loans, with smaller impact on number of loans, lending rates and employment.

Perdigao (2018) employs a factor-augmented VAR to study how earmarked credit affects the monetary policy transmission. He also finds that a larger share of earmarked credit weakens the response of loan rates, output, and employment to a monetary shock.

While Bonomo and Martins (2016) and Perdigao (2018) study how monetary policy affects employment and output, our paper looks only at the effect on market interest rates. Although more limited in scope, our paper has two important advantages over theirs. First, we have a cleaner identification of the monetary shock. Bonomo and Martins (2016) employ annual data, hence monetary shocks are mixed up with endogenous changes in interest rates, and Perdigao (2018) uses VAR identification, whereas we have a clean measure of the monetary shock and a reasonably accurate measure of market interest rate changes. Second, we estimate how monetary shocks

2 Mishra and Montiel (2013) survey the failure of distinct empirical approaches in yielding consistent and convincing evidence of an effective monetary transmission in low-income countries.

3 Examples include Aristei & Gallo (2014), Avouyi-Dovi et al. (2017), Belke et al. (2013), Hristov et al. (2014), and Leroy & Lucotte (2016).

4 The Central Bank of Brazil also has studies about the pass-through to lending rates. The Inflation Report of March 2020 shows estimates of the pass-through to lending rates from an error correction model. The results are broadly consistent with ours.

DOI: 10.31389/eco.391

affect interest rates on different types of credit, which allows us to better understand monetary policy transmission to market interest rates.

An extensive set of literature on monetary policy in the United States uses high-frequency identification of shocks. Usually, these studies calculate the monetary shock as the change in Fed funds futures in a tight window around the monetary policy decision. Examples include Kuttner (2001), Gurkaynak et al. (2005), Campbell et al. (2012), Gertler and Karadi (2015), Nakamura and Steinsson (2018), and Jarociński and Karadi (2020). We take a similar approach to compute the monetary surprises in Brazil. Indeed, there is strong evidence that the market anticipates, at least in part, monetary policy decisions, and that unanticipated monetary policy shocks affect the term structure of interest rates.

2 THE BRAZILIAN CREDIT MARKET

Earmarked credit represents a large share of total outstanding credit in Brazil. There was a substantial expansion in earmarked credit between 2006 and 2016, as shown in Figure 1, with the federal government using the National Bank for Economic and Social Development (BNDES), *Caixa Econômica Federal* and *Banco do Brasil* to finance private investment, housing and rural sectors, respectively. In some years, earmarked credit was as large as non-earmarked credit.

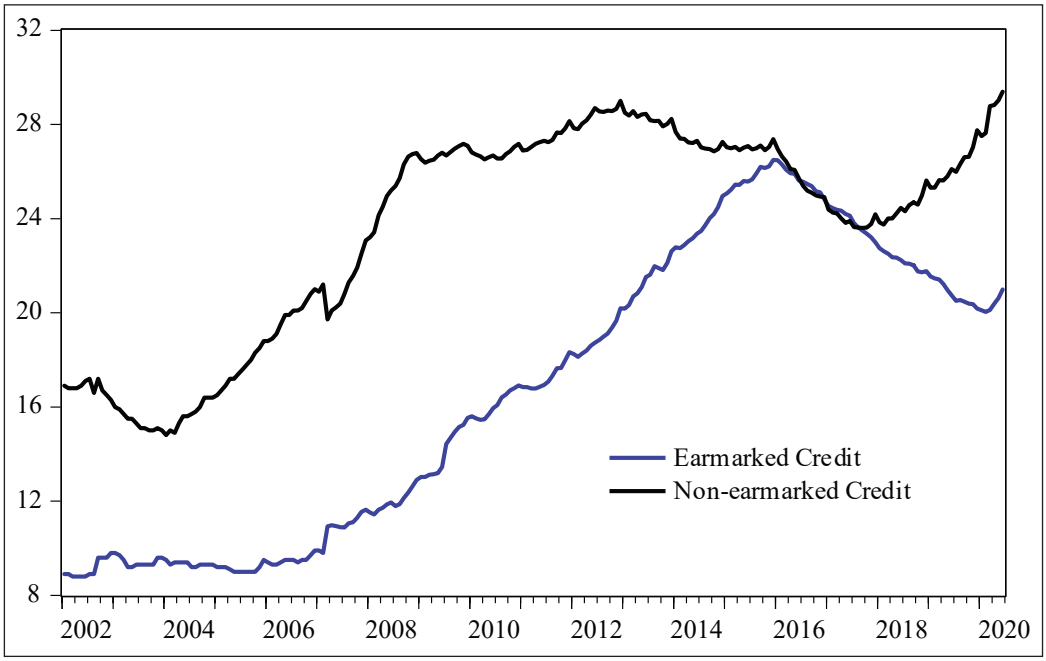

Figure 1 Credit (percent of GDP).
Source: BCB.

Although development banks are a common feature in several economies, BNDES stands out. It has a dominant role in long-term financing, lends to firms in virtually any sector of the economy, and charges much-below market rates (World Bank 2017).[5] Interest rates on earmarked loans are typically below market rates and usually do not fully respond to changes in the policy rate.

Another issue that hinders monetary policy transmission in Brazil is the degree of market concentration, which is directly related to high lending spreads. Figure 2 illustrates how Brazil stands out globally for its very high interest rate spreads: It is an outlier even among low and middle-income economies. For some loan categories, the Selic rate might be a very small part of the lending cost.[6]

5 Perdigão (2018) shows that monetary policy indeed loses power in sectors with a higher share of earmarked loans. His findings endorse the view that BNDES hampers the credit channel of monetary policy transmission.

6 Many studies explore how an incomplete pass-through is related to banking concentration and the resulting mark-ups. Examples include Alencar et al. (2020), Gambacorta et al. (2014), Joaquim et al. (2019), and Van Leuvensteijn et al. (2013).

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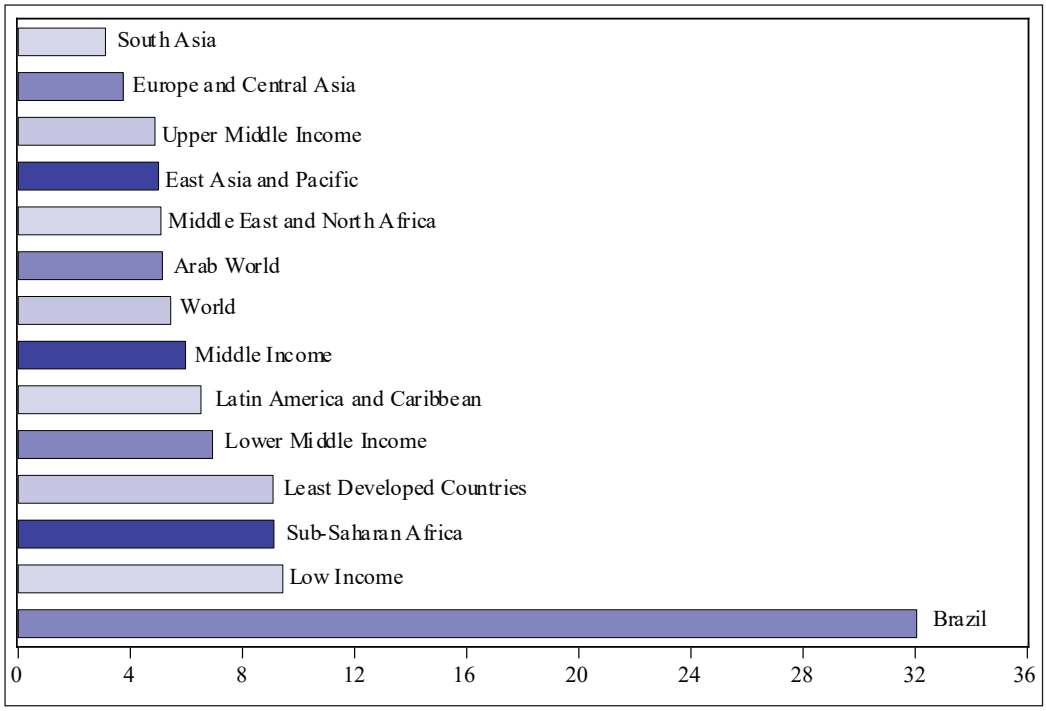

Figure 2 Interest Rate Spread.
Source: World Bank (2018/19).

High spreads may impair monetary policy transmission in two different ways. First, they might disrupt the transmission from policy rate to lending rates. Second, credit demand at the margin might be substantially more inelastic. Even if the transmission to lending rates were fully functioning, credit quantities (and, thus, aggregate demand) could still not respond much to monetary policy.

3 DATA AND METHODOLOGY

We set up similar databases for Brazil and the United States and apply the same methodology to estimate the pass-through of monetary policy to lending rates in these economies.

3.1 DATA

The key variables in our data sets are monetary shocks and interest rates from new credit operations.

As explained in Section 3.2, monetary shocks are computed based on changes in interest rate futures around policy decisions. For the monetary shocks in the United States, we used the Jarociński and Karadi (2020) surprises series in the three-month fed funds futures. Federal funds futures are traded on the Chicago Board of Trade and the authors use intraday data to compute the surprises within a 30-minute window around the FOMC announcement. The final series consists of 194 FOMC meetings between 1994 and 2016.[7]

We adapted the high-frequency identification methodology to Brazil and used Brazilian One-Day Interbank Deposit Future. We collected data on every contract expiring in each month between September 2003 and December 2019, which resulted in 140 surprises.[8] Closing and opening prices are available on daily periodicity and all data are accessible from Bloomberg terminals.

Regarding the credit series, both the Central Bank of Brazil (CBB) and the Federal Reserve release data on a wide range of lending rates. The CBB releases the average interest rate from new credit operations, where each rate is weighted by the value of operations. There is data on earmarked and non-earmarked loans of different types, and all data is available on Time Series Management System. The data are available monthly in Brazil.

7 Originally, the series covered 240 FOMC meetings from 1990 to 2016, but we restricted the sample to start in 1994. Before 1994, the FOMC did not issue press releases and the market had to infer the policy decision based on open market operations the day after the meeting. After 1994, financial markets and professional forecasters increased their ability to predict monetary decisions as a result of enhanced transparency and this altered the transmission of policy surprises (Coibion & Gorodnichenko 2012).

8 We start on September 2003 because that is when the Central Bank began to systematically announce policy decision after market closure.

DOI: 10.31389/eco.391

For the United States, we obtained credit data from the following datasets published by the Federal Reserve: H.8 (Assets and Liabilities of Commercial Banks), H.15 (Selected Interest Rates) G.19 (Consumer Credit), and Z.1 (Financial Accounts). The remaining can be found on the Fred website (Fed St. Louis). We also used a spread measure developed by Gilchrist and Zakrajsek (2012). Descriptive statistics are presented in the appendix, as well as plots of all series.

One key challenge is that the time between monetary policy decisions does not coincide with the months or quarters for which we have data on lending rates. We explain how we deal with this problem in Section 3.3.

3.2 MONETARY SHOCKS

Identifying causal relationships in macroeconomics is challenging. To overcome the well-known endogeneity problems and estimate the impact of monetary policy, we follow the literature on high-frequency identification. We use the movements of interest rate futures contracts around monetary policy decisions as a source of exogenous variation. The monetary shock is the unexpected component of the Central Bank decision. One advantage of using interest rate futures is that they are very liquid in the United States and Brazil.

A sizable literature uses changes in federal funds futures rates around FOMC days to identify monetary shocks in the United States.[9] The FOMC announces its decision when the markets are open, so it is possible to use intraday information. Here, we use the Jarociński and Karadi (2020) surprise series, plotted in Figure 3. They use data on three-month fed funds futures to measure forward guidance as well, which is particularly important in times where the zero-lower bound matters.[10]

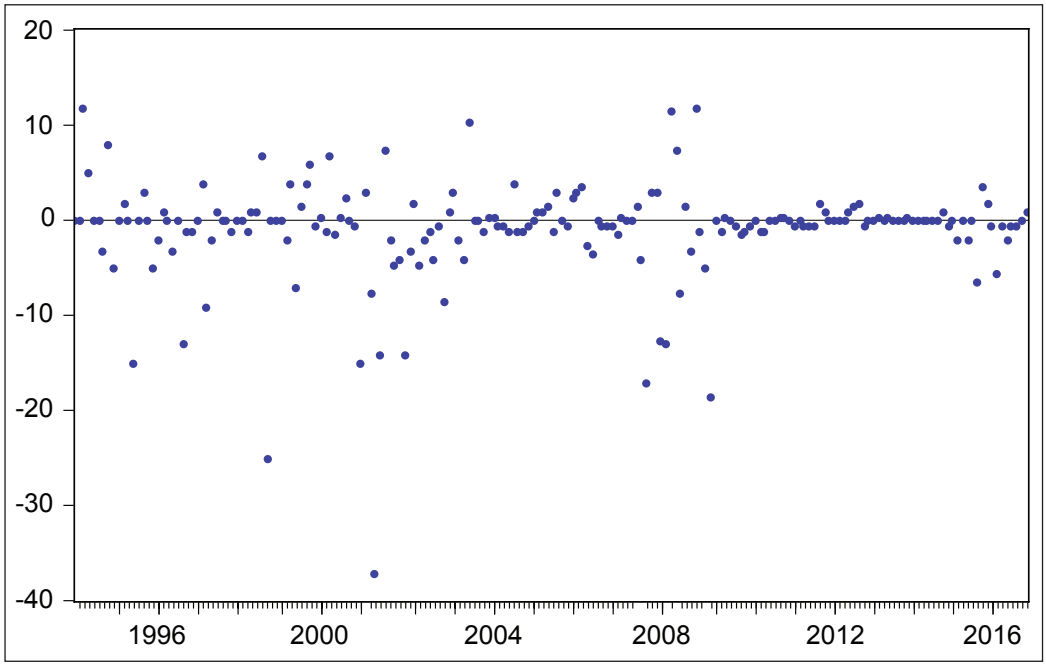

Figure 3 Surprises in the 3-month Fed Funds future (bps).
Source: Jarociński and Karadi (2020).

9 We also use interest rate data around Central Bank announcements as a source of monetary shocks. A literature discusses whether these shocks contain important information about the economic outlook and, consequently, are not pure monetary disturbances (see, e.g., Bauer and Swanson (2020), Jarociński and Karadi (2020), and Nakamura and Steinsson (2018)). This issue is not so critical to our paper because (i) here we compare the effects of shocks identified in the same way in two different countries, and different types of credit within the same country; and (ii) with well-functioning credit markets, the direct channel linking policy rates and lending rates is likely to be very important, so the information effect is likely to play a minor role.

10 They calculate the monetary surprises in a half-hour window around the FOMC announcements

$$m = i(\tau + 20 \text{ min}) - i(\tau - 10 \text{ min})$$

where i is the trading interest rate on futures interest rate contracts and τ is the time of central bank announcement. In such a tight interval, other shocks are unlikely to happen.

DOI: 10.31389/eco.391

We take a similar approach to compute the monetary shocks for Brazil. We use the Brazilian One-Day Interbank Deposit Future (DI futures, henceforth), with settlement dates in every month's first business day. The underlying asset of this contract is the interest rate compounded until the contract's expiration date. The price of a contract that expires in month *h* is:

$$P_t^h = \frac{100{,}000}{\left(1+\frac{i_t^h}{100}\right)^{n/252}} \tag{1}$$

where i_t^h is the interest rate until maturity and *n* is the number of business days until the contract maturity.[11]

Between trading days, DI future prices are corrected using the interbank rate (CDI_t):

$$P_t^{h^{adj}} = P_t^{h^{last}} \times (1 + CDI_t) \tag{2}$$

In Brazil, the decision of the Monetary Policy Committee (Copom henceforth) is announced after the stock market closes. Therefore, our measure of monetary shock is

$$s_t = i_{t+1}^{h\ open} - i_t^{h^{adj}} \tag{3}$$

Where *t* is a date with Copom meeting, $i_{t+1}^{h\ open}$ is the interest rate implied by DI-future prices when the market opens at $t + 1$, and i_t^{hadj} is the interest rate implied by DI-future prices when the market closes at *t*, adjusted by the interbank rate as in (2).

We use data on DI futures due in one and three months. The monetary shocks are illustrated in Figures 4 and 5. The one-month contract depends basically on the policy rate chosen at the Copom meeting. Shocks to the three-month contract also capture changes to the future path of short rates.

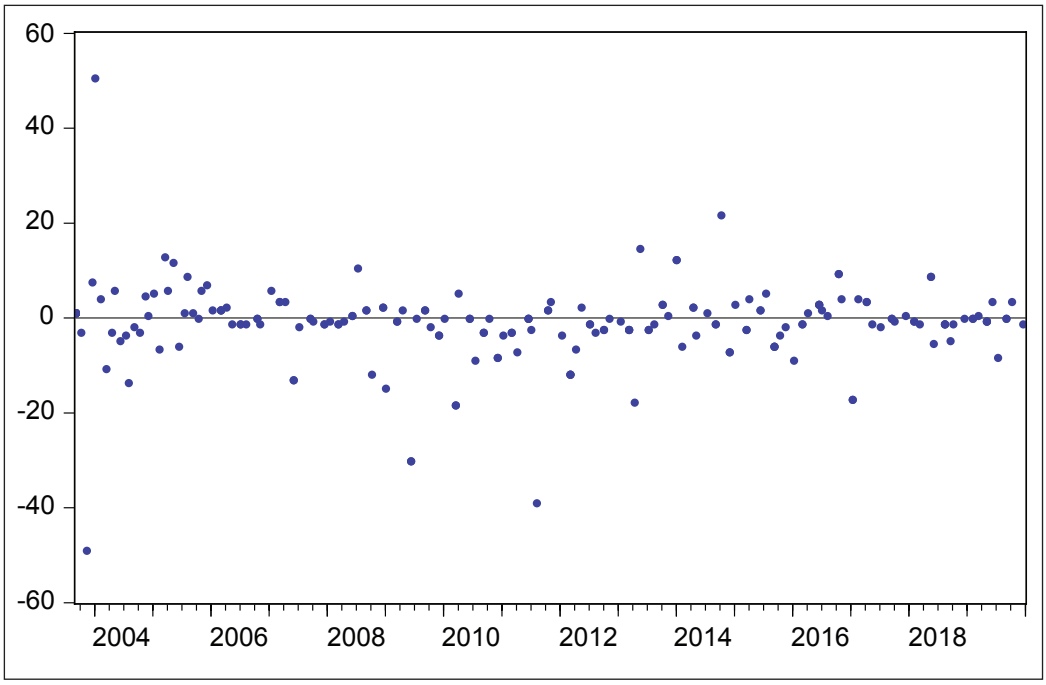

Figure 4 Surprises in the 1-month DI future (bps).

Since it is impossible to compute monetary shocks in Brazil using a tight window, endogeneity concerns may arise. One might argue that our measure might be affected by news or events that happen overnight and affect markets (in Brazil or worldwide). As a result, the opening interest rates would be "contaminated" with unrelated factors to the Brazilian economy, and the estimates would be biased. We have two answers to this point.

11 The available data at Bloomberg is the trading interest rate i_t^h, so we must use the referred transformation to get the trading price.

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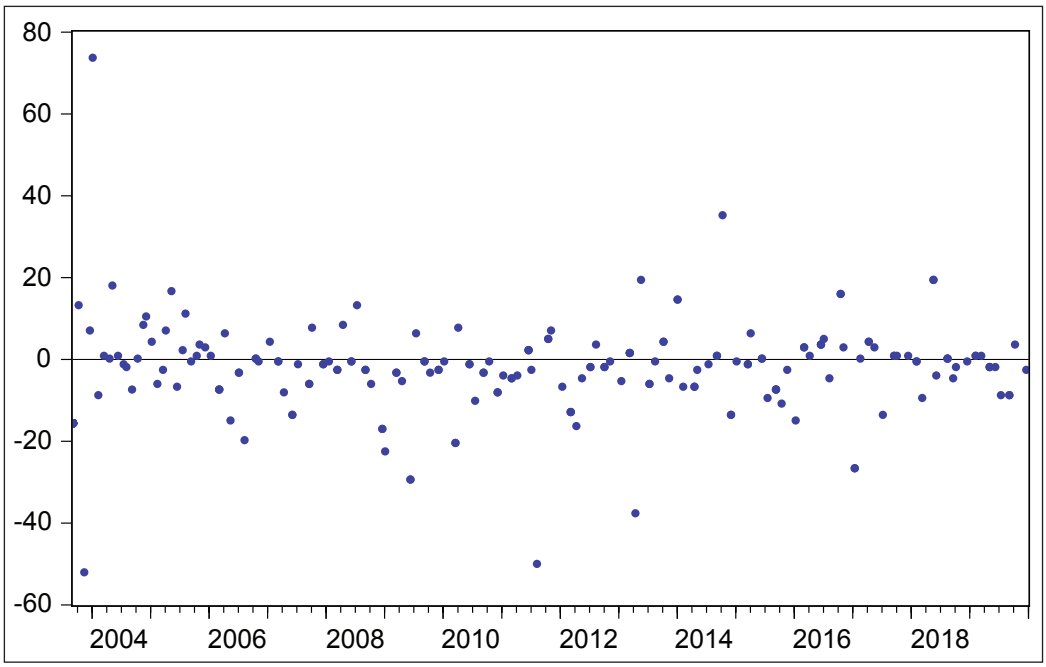

Figure 5 Surprises in the 3-month DI future (bps).

First, this potential endogeneity bias is towards finding a pass-through. An overnight shock would typically push base interest rates and lending rates to move in the same direction. Hence, we would overestimate the real impact of monetary policy on lending rates. However, we are finding small effects, and our conclusions would only be stronger if our estimates were interpreted as upper bounds.

Second, our surprise measure is uncorrelated with changes in the VIX index, which typically affect emerging markets.[12] Figure 6 plots our monetary policy shocks with changes on the VIX index around Copom days, comparing closing values at t with opening values at $t + 1$. The scatter plot does not show any relationship between monetary shocks and VIX changes, and the R^2's of the corresponding regressions are almost zero.

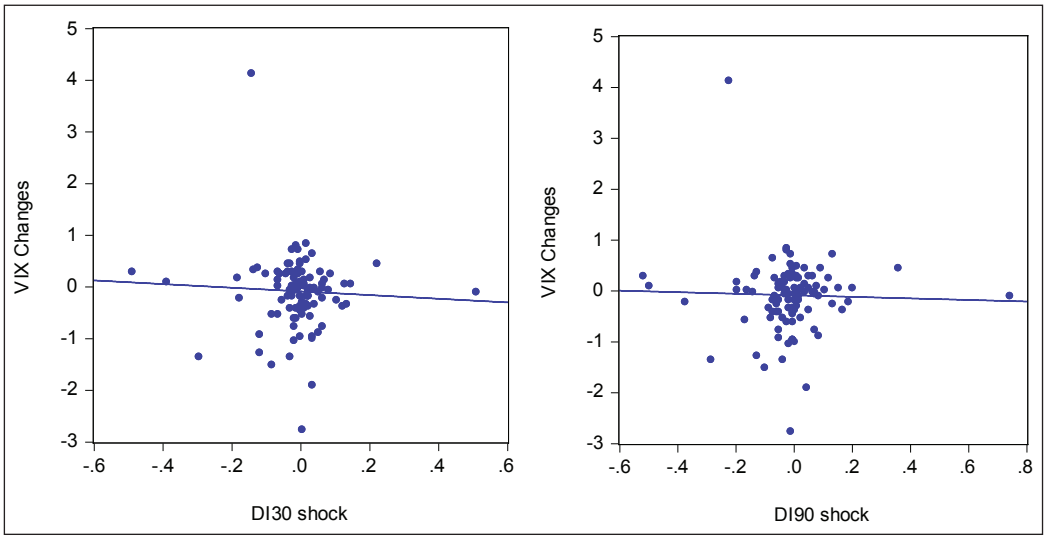

Figure 6 VIX changes and DI surprises.

This result might seem unsurprising since there is little scope to affect short-term base interest rates after the monetary policy decision has been taken. For our purposes, it is reassuring that the measure of monetary shocks for the Brazilian economy seems to be clean enough.

12 Chicago Board Options Exchange's CBOE Volatility Index is a measure of volatility expectation by the market based on S&P 500 index options.

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3.3 TEMPORAL DISAGGREGATION

The Brazilian Central Bank publishes several monthly series of average interest rates from new credit operations. Likewise, many credit series in the United States are released monthly and even quarterly, although there are a few in higher frequency. Some series released by the Fed refer to the average or last value observed in the month. Since committee meetings are held every forty-five days and can take place on any day of the month, we need to make lending rates data compatible with the timings of monetary policy decisions.

We overcome this problem by adjusting the credit series to the periods between monetary policy committee meetings. We use the procedure proposed by Sax and Steiner (2013), which guarantees that the average or last value of a resulting high-frequency series matches the low-frequency observation. With disaggregated time series, we can separate the values of lending rates before and after each monetary shock.[13] The time span between meetings is sufficiently large to capture significant and persistent changes in lending rates, without bringing to much noise to the estimation.

Figure 7 illustrates the methodology. The released data—usually the average or last value of the reference month—is represented by the orange horizontal double arrows. Monetary policy meetings, represented by green vertical lines, are held eight times per year and can occur on any day within the month. The procedure obtains a high-frequency series (blue) curve that matches the original data (orange arrows). We can then calculate averages between meetings (horizontal green double arrows). The difference between averages computed before and after each meeting is the dependent variable of our regression.

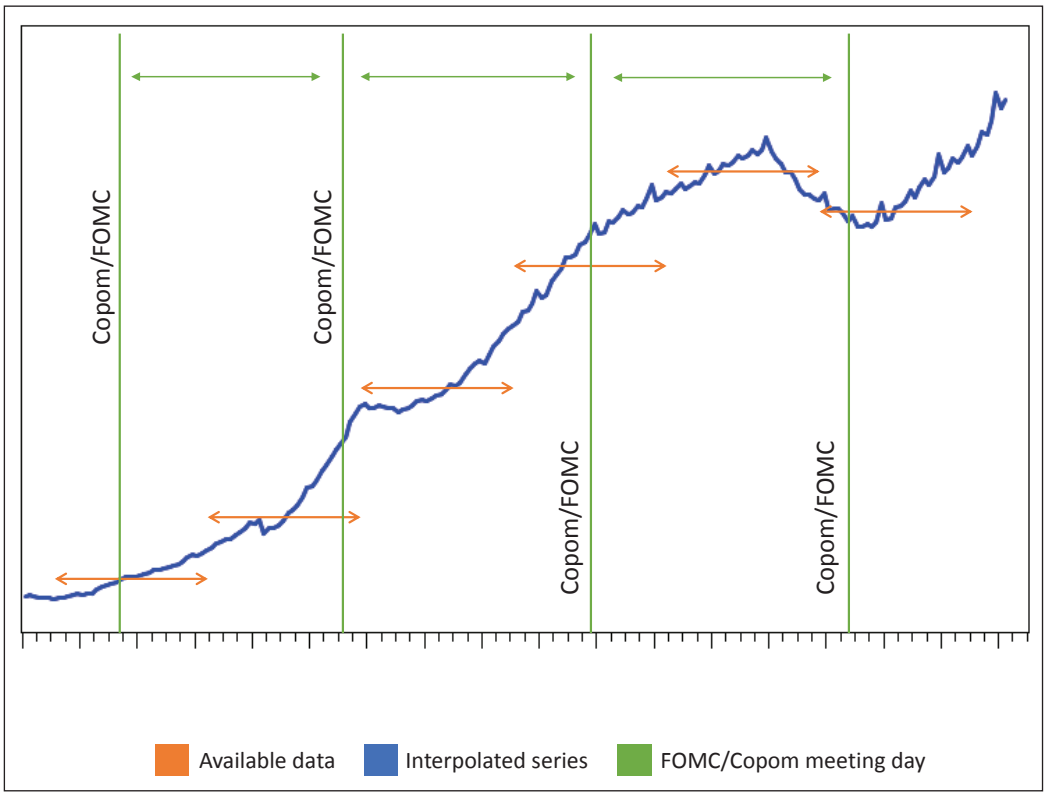

Figure 7 Temporal Disaggregation.

We use the R package "tempdisagg," created by Christoph Sax and Peter Steiner, to perform the temporal disaggregation of our credit series. The package can handle irregular conversions—

13 Since 2012, the Brazilian Central Bank releases a weekly dataset that contains five-day moving weighted averages of some lending rates for non-financial firms and households by financial institutional and type of credit. However, this data base has no information on earmarked credit, which is crucial for us. Moreover, the surprises were quite small in this period, with the base rate unchanged for a long time in those years.

DOI: 10.31389/eco.391

that is, each low-frequency period does not need to have the same number of high-frequency observations—and fulfill the aggregation constraint. Appendix B briefly explains the methodology.

To evaluate the method, we pick series that are released on a daily and monthly basis: 3-month AA financial commercial paper in the United States and Moody's seasoned Baa corporate bond. With the methodology described above, the monthly series are disaggregated into daily values that can be compared to the actual observed daily data. Figures 8 and 9 show that the original high-frequency data and the interpolated series from monthly data are very similar.

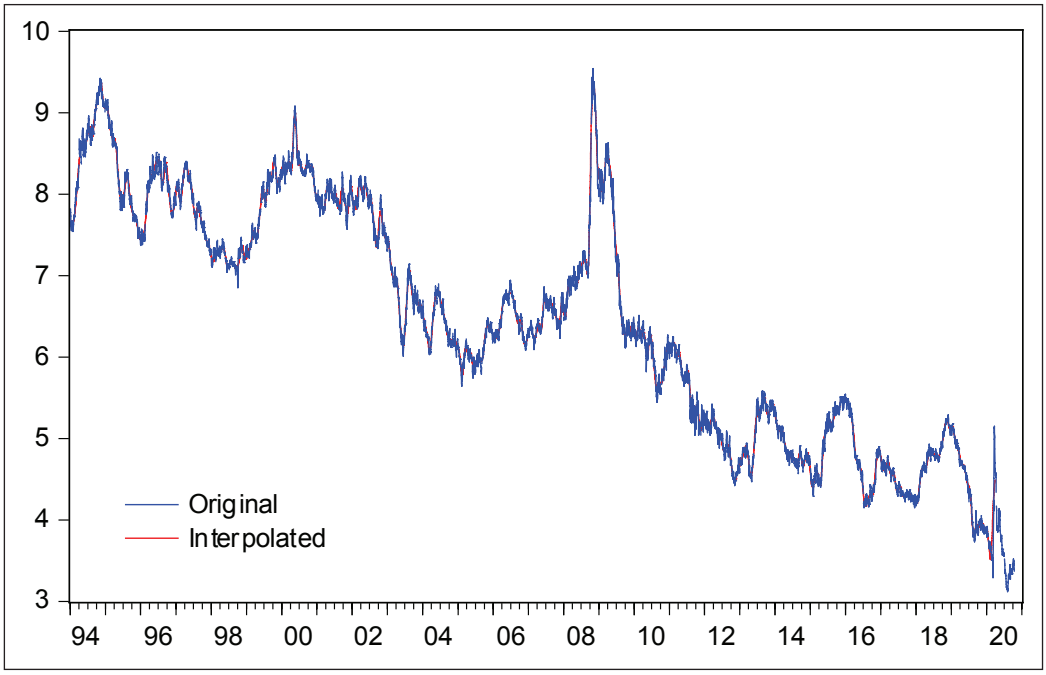

Figure 8 Moody's Seasoned Baa Corporate Bond (percent p.y.).

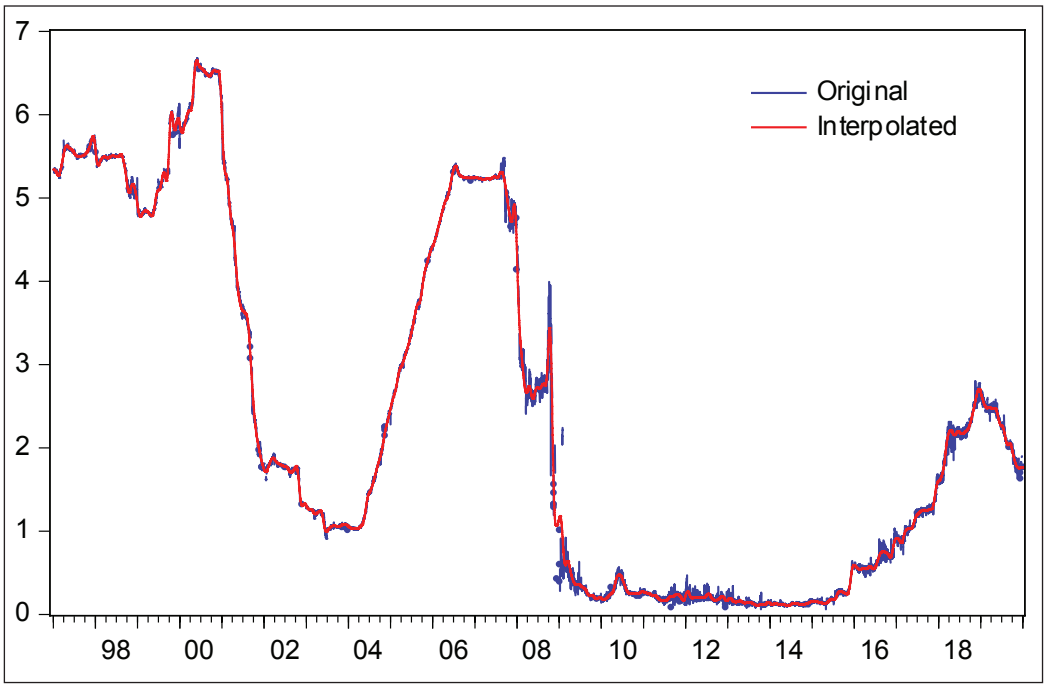

Figure 9 3-Month AA Financial Commercial Paper (percent p.y.).

3.4 EMPIRICAL SPECIFICATION

We estimate the effect of monetary policy surprises on lending rates with a simple ordinary least squares regression.

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The dependent variable is the difference between the lending rate averages computed in the intervals before and after the meeting. Using our calculated daily series on lending rates (explained in Section 3.3), we take averages at each 45 days between monetary policy decisions. The main explanatory variable is the surprise associated with the meeting under consideration. Lagged dependent variables in one and two periods are also included to control for some tendency in the low-frequency series.

We estimate the following regression:

$$\Delta r_t = \beta s_t + \gamma \Delta r_{t-1} + \xi \Delta r_{t-2} + \epsilon_t$$

where Δr_t is the change in lending rates around the monetary shock that occurs in t (the difference between the average calculated from the previous meeting ($t-1$) until the present one (t), and the average from the present meeting until the next one ($t+1$); s_t is the surprise associated with the meeting in t, and ϵ_t is an error term. The regression is estimated for a wide range of loan types.

The pass-through is measured by coefficient β. If $\beta = 0$, then there is no transmission to the lending rates. If $0 < \beta < 1$, we say the pass-through is incomplete; if $\beta = 1$, it is 1:1; and if $\beta > 1$, the monetary shock is amplified.

4 RESULTS

4.1 THE CREDIT CHANNEL IN THE UNITED STATES

Table 1 presents the estimates of coefficient β for a wide range of dependent variables in the United States. Our baseline estimation in the United States considers only scheduled FOMC meetings (See Appendix C for results with all meetings). There is robust evidence that the pass-through is effective in the United States, with loans of different maturities and types responding significantly to monetary shocks. Consistently with Gertler and Karadi (2015), lending rates respond more than proportionally to changes in Fed fund rates.

DEPENDENT VARIABLE	β
Commercial paper: non-financial firms	1.71***
	(0.52)
Commercial paper: financial firms	2.32***
	(0.69)
Mortgage: 5/1-year adjustable rate	1.68***
	(0.49)
Mortgage: 30 years	0.92*
	(0.55)
Bank prime loan rate	1.76***
	(0.51)
Baa: 20 years	1.62**
	(0.75)
Credit spread	2.13***
	(1.21)
Excess bond premium	1.41*
	(0.81)
Personal loans: 24 months	0.52***
	(0.20)
Consumer loans: new autos, 48 months	0.38**
	(0.16)

(Contd.)

Table 1 Pass-through estimates in the United States.

Only scheduled FOMC meetings: 185 observations between 1994 and 2016. The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1 percent level, ** 5 percent level, * 10 percent level. Coefficient β is an estimate of the monetary policy pass-through to lending rates.

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DEPENDENT VARIABLE	β
Consumer loans: new autos, 60 months	0.22**
	(0.11)
Credit card: accounts assessed interest	0.36
	(0.37)
Credit card: all accounts	0.33
	(0.32)

In response to a 100 bps increase in Fed fund rates, the non-financial commercial paper rate increases by 171 bps, and the financial commercial paper rate goes up by 232 bps.[14] Similarly, the effect on the prime rate is estimated at 1.76. As one should expect, long-term rates have a pass-through smaller than one. Nevertheless, we found significant estimates even for 30-year mortgages.[15]

We also investigated how monetary policy affects credit spread using a measure developed by Gilchrist and Zakrajsek (2012). Their measure reflects the yield difference between corporate security and a government bond of similar maturity. We find that a one percentage point increase in fed funds is associated with a rise in credit spreads by more than two percentage points. The coefficient on the excess bond premium (EBP), credit spread measure free of default risk, is 1.41. Finally, Moody's seasoned Baa corporate bond, based on bonds with maturities 20 years and above, is also significantly affected by monetary policy. Only the estimates on credit card rates are not statistically significant.

These results thus confirm that monetary shocks are amplified by the credit channel in the US.

4.1.1 Are the adjusted data series good enough?

For most credit types, there is no available daily data and we rely on the methodology described in Section 3.3 to create our adjusted data series for market interest rates before and after each monetary policy decision. However, we have daily interest rate data for several credit categories in the US. This allows us to compare results using daily data with estimates using monthly data and the interpolation methodology from Section 3.3. Table 2 shows this comparison for all available daily series.

Estimates in column II (interpolated data) are often smaller, which might reflect attenuation bias caused by measurement error. In particular, for assets with very large coefficients (higher than 2), the estimates with interpolated data are always below the estimates based on daily data. Although the conclusions from both sets of results are basically the same, there is a sizable difference.

However, the attenuation bias seems to be much smaller for assets that do not respond so strongly to monetary policy. Indeed, out of 11 coefficients below 2, estimates based on daily data are higher than those using interpolated data in 6 cases (and lower in 4). It seems that our interpolation procedure does not get all the sharp movements induced by large responses to monetary shocks, but is a good approximation when changes aren't so large and the series is relatively smooth.

Although we cannot perform a similar exercise using Brazilian data, we find the results in Table 2 reassuring. Since the estimated response of credit rates to monetary policy in Brazil is small, this exercise suggests that the point estimates we would obtain using daily data would be very similar.

14 Table 12 in Appendix D provides results on different types of commercial papers. Estimates are typically larger than 1.

15 DeFusco and Paciorek (2017) estimate the interest rate elasticity of mortgage demand in the United States and show that a one percentage point increase in the rate on a 30-year fixed-rate mortgage reduces mortgage demand by between two and three percent. Our results confirm that monetary policy affects mortgage lending.

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	β	β
	I (ORIGINAL DAILY DATA)	**II (INTERPOLATED)**
Baa	1.62**	1.20***
	(0.75)	(0.35)
Bank prime loan rate	1.76***	1.42***
	(0.51)	(0.57)
Non-Financial Commercial Paper		
Overnight AA	0.35	0.40
	(0.81)	(0.50)
7-Day AA	0.62	0.62
	(0.75)	(0.48)
15-Day AA	0.87	0.98**
	(0.70)	(0.48)
30-Day AA	1.04*	1.12**
	(0.66)	(0.43)
60-Day AA	1.62***	1.40***
	(0.48)	(0.40)
90-Day AA	1.68***	1.32***
	(0.55)	(0.45)
Overnight A2/P2	4.94***	3.22***
	(1.60)	(1.24)
7-Day A2/P2	5.48***	3.74***
	(1.52)	(1.14)
15-Day A2/P2	5.32***	3.78***
	(1.51)	(1.12)
30-Day A2/P2	5.49***	3.92***
	(1.43)	(1.07)
60-Day A2/P2	5.55***	3.99***
	(1.46)	(1.17)
Financial Commercial Paper		
Overnight AA	0.47	0.48
	(0.77)	(0.49)
7-Day AA	1.26**	0.98**
	(0.65)	(0.44)
15-Day AA	1.63**	1.30***
	(0.70)	(0.44)
30-Day AA	2.64***	2.22***
	(0.82)	(0.68)
60-Day AA	2.69***	2.09***
	(0.70)	(0.68)
90-Day AA	2.34***	1.72**
	(0.73)	(0.76)
Asset-backed Commercial Paper		
Overnight AA	3.49***	2.21***
	(1.33)	(0.88)
7-Day AA	4.97***	3.52***
	(1.36)	(1.22)
15-Day AA	5.11***	3.32***
	(1.43)	(1.22)
30-Day AA	5.37***	3.80***
	(1.44)	(1.41)
60-Day AA	4.43***	3.31***
	(1.10)	(1.15)
90-Day AA	4.56***	3.27***
	(1.07)	(1.08)

Table 2 Estimates using (I) daily data and (II) monthly data.

DOI: 10.31389/eco.391

4.2 THE CREDIT CHANNEL IN BRAZIL

Table 3 presents the pass-through estimates for lending rates in Brazil for aggregate categories. The dependent variables are average rates considering all credit operations and the distinction between earmarked and non-earmarked operations. These categories are further disaggregated in credit for non-financial firms and households. The regressors are surprises reflected in 30-day interest rate futures (DI-30, our preferred specification) and 90-day interest rate futures (DI-90).

Table 3 Pass-through estimates in Brazil.

Copom meetings between 2003 to 2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1 percent level, ** 5 percent level, * 10 percent level.

DEPENDENT VARIABLE	β	
	DI-30	DI-90
Non-earmarked	0.70	0.82
	(0.72)	(0.56)
Non-earmarked: non-financial firms	1.08***	1.02***
	(0.43)	(0.34)
Non-earmarked: households	–0.15	0.43
	(1.07)	(0.86)
Total	0.08	0.18
	(0.80)	(0.56)
Total: non-financial firms	0.37	0.26
	(0.67)	(0.45)
Total: households	–0.29	0.04
	(1.02)	(0.74)
Earmarked	0.45	0.40
	(0.40)	(0.28)
Earmarked: non-financial firms	–0.02	0.03
	(0.61)	(0.49)
Earmarked: households	0.79	0.64*
	(0.52)	(0.35)

The results for the Brazilian economy are very different from those for the US. The estimated coefficient for non-earmarked credit for non-financial firms is statistically significant at 1 percent and equal to 1.08 in our preferred specification.[16] However, all other estimated coefficients in that column are statistically insignificant, and four out of eight have negative signs.

This result is important because non-earmarked credit to non-financial firms represents only 25–30 percent of total credit in Brazil. As shown in Figure 10, a large share of credit is earmarked.

Earmarked credit for non-financial firms does not respond to monetary policy. This reflects the role played by BNDES, the Brazilian development bank that provides huge amounts of subsidized credit to firms. Appendix D shows details for different BNDES loan types for firms and households. More than half of them actually have a negative sign. Our results thus confirm that monetary policy does not affect their lending rates.

16 Our finding is similar to the estimate of Bonomo and Martins (2015) using firm-level data. They estimate that a one percentage point change in the Selic rate is related to an increase of 1.15 percentage points in the interest rate of private loans to a firm without access to earmarked credit.

DOI: 10.31389/eco.391

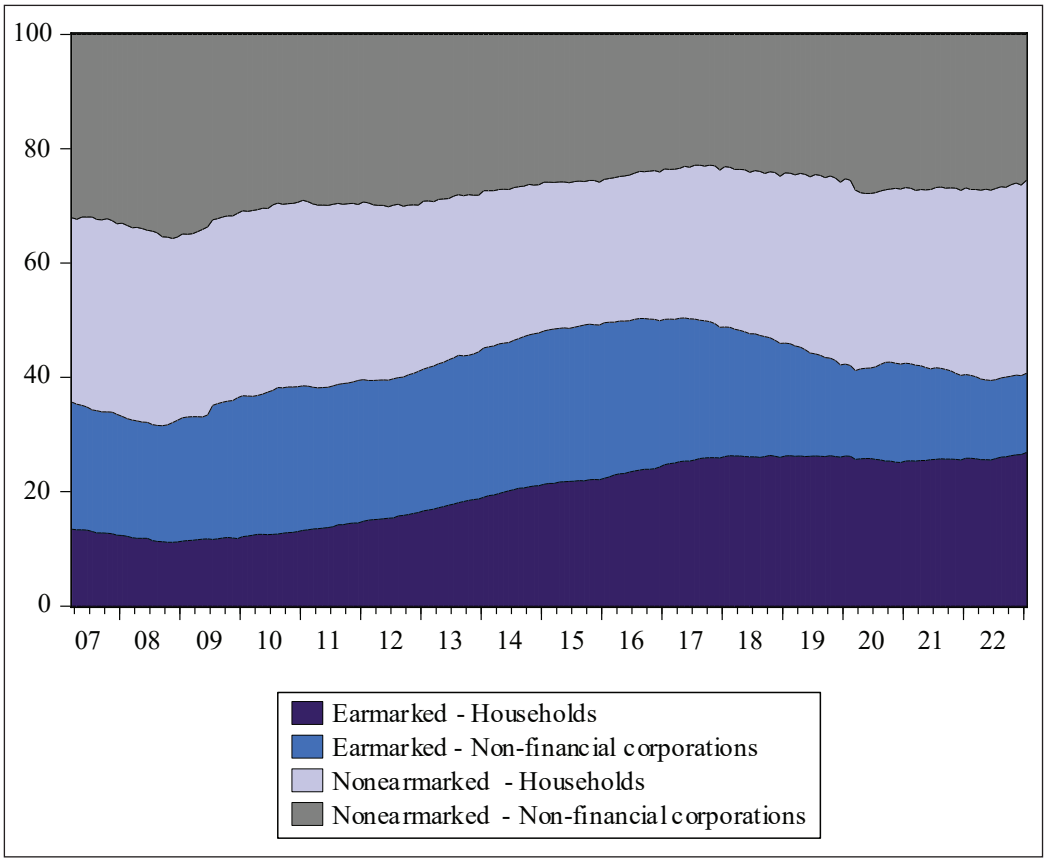

Figure 10 Composition of Credit Outstanding in Brazil (Shares).
Source: BCB.

BNDES loans are typically indexed by a rate called TJLP (acronym for *Long Term Interest Rate* in Portuguese). Figure 11 shows this rate does not follow closely the Selic rate. It is then not surprising that monetary policy has little of no effect on earmarked lending rates to non-financial firms in Brazil.

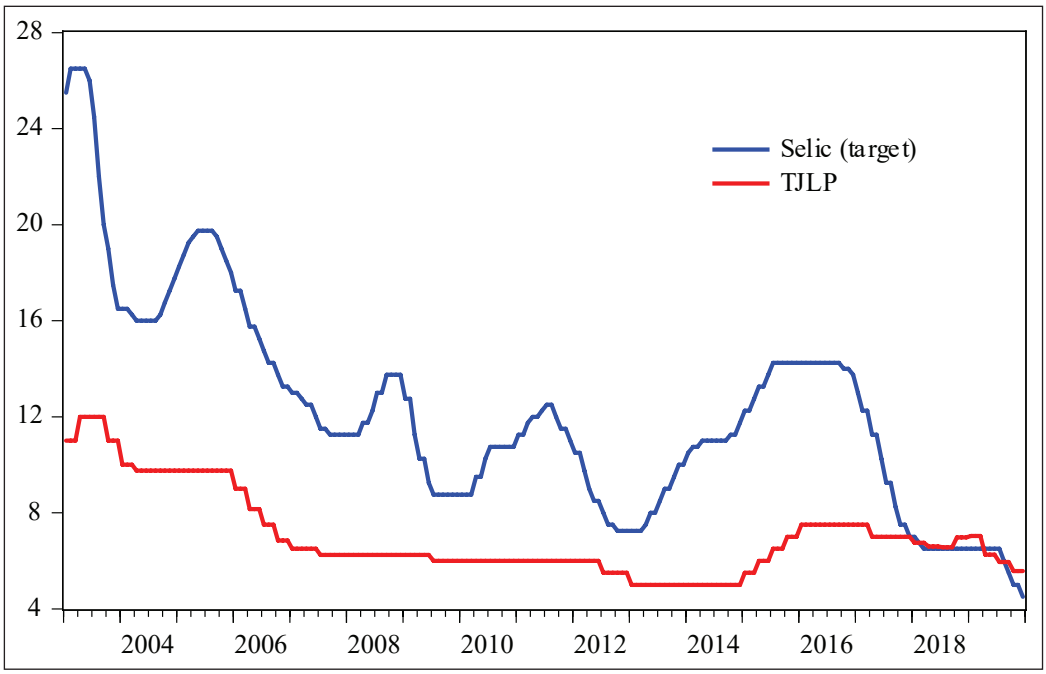

Figure 11 TJLP and Selic rate.
Source: BCB.

We have also not found significant results for non-earmarked credit to households. This may be related to the high spreads and levels of the rates on loans for individuals. Figure 12 shows the average spreads of lending rates of non-earmarked credit for households and non-financial firms.

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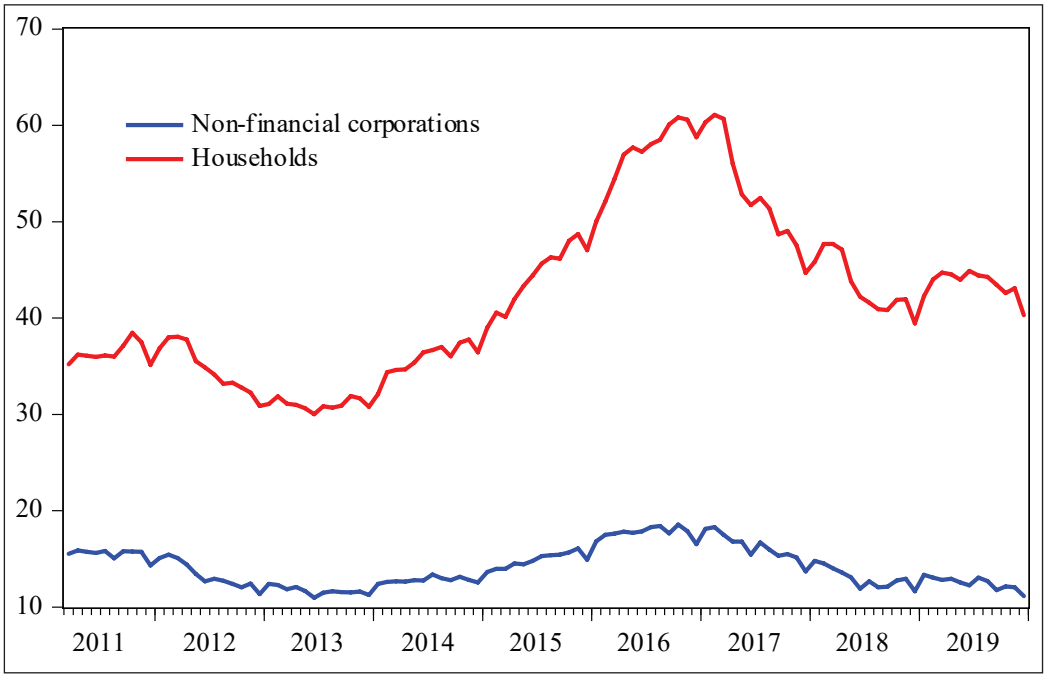

Figure 12 Spread of new non-earmarked credit operations (percent/year).
Source: BCB.

Figure 16 in the appendix shows the path of interest rates for different credit types. Lending rates are specifically high in some loan types, such as overdraft, personal credit, credit card, discount of checks, etc. Such high rates are often accompanied by massive changes, typically unrelated to monetary policy. For example, between 2013 and 2015, the overdraft rate increased by whopping 129 percentage points.

Given such high spreads, changes of a percentage point in lending rates are likely to have negligible effects on the amount of credit. Thus, we conclude that lending rates on non-earmarked household credit do not seem to respond much to monetary shocks and that monetary policy would only affect household credit in the case of very large amplification.

Interestingly, earmarked credit for households seems positively affected by monetary policy. When considering the surprise associated with the three-month future rate, the coefficient is equal to 0.64 and significant at a 10 percent level. In the next section, we look at different types of credit to understand what drives this result.

In a nutshell, we found very different results for Brazil and the United States. In the latter, the estimates are significant for most loans, the pass-through tends to be larger than 1 (especially for short-term credit), and the Federal Reserve is able to affect long-term lending rates. In Brazil, the effects are smaller and restricted to a subset of total credit. Less than one-third of credit outstanding has a pass-through of roughly 1:1, and most of it does not seem to be affected at all.

Adding insult to injury, the credit demand in Brazil is more inelastic given the high spreads and lending rates, especially in loans for households. Furthermore, even if the pass-through were similar in both countries and affected the credit quantities in the same manner, the effects on aggregate demand would continue to be smaller in Brazil due to the development of credit markets. Figure 13 shows credit to the private non-financial sector as a percentage of GDP. Whereas credit is around 150 percent of GDP in the United States, it is 70 percent in Brazil.

4.2.1 Monetary Policy Transmission to Firm Credit

We now show detailed results for a comprehensive set of types of credit operations.

Table 4 provides the estimates on different types of non-earmarked loans for non-financial firms. We found significant coefficients for several loans, especially for those of shorter maturities. The lending rates on working capital reacted more than proportionally to the changes in the Selic rate, with an estimated pass-through of 1.75 and 1.66 associated with the surprises measured with DI-

DOI: 10.31389/eco.391

30 and DI-90, respectively. This 1 percent significance stems from the short-term working capital (up to 365 days), which has a coefficient of 3.12 when using the 1-month surprise and 1.83 with the three-month surprise.

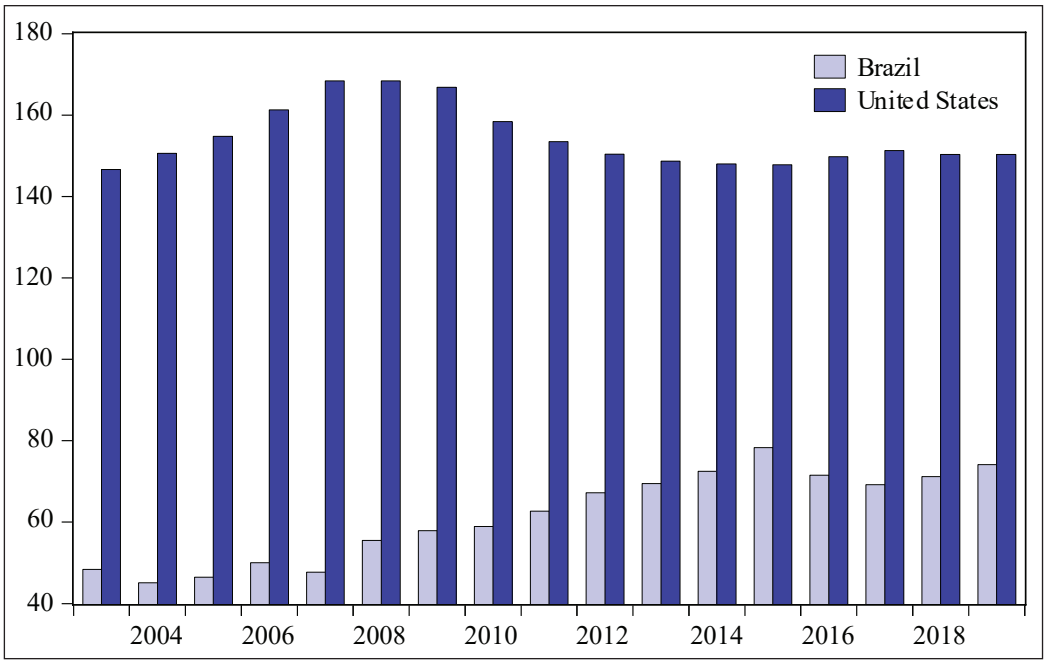

Figure 13 Credit to Private Non-financial Sector (percent of GDP).

Source: BIS.

DEPENDENT VARIABLE	β	
	DI 30	DI 90
Prime rate	1.12**	1.07***
	(0.56)	(0.37)
Discount of trade bills	1.50	1.44*
	(1.06)	(0.83)
Discount of checks	2.21**	1.33**
	(0.99)	(0.64)
Discount of credit card bills	0.90	1.96
	(2.50)	(1.83)
Working capital up to 365 days	3.12***	1.83***
	(0.93)	(0.74)
Working capital over 365 days	0.39	0.32
	(1.35)	(0.91)
Working capital revolving credit	−0.20	−0.58
	(3.22)	(2.02)
Working capital (total)	1.75***	1.66***
	(0.60)	(0.48)
Guaranteed overdraft accounts	1.47	0.55
	(2.06)	(1.39)
Overdraft	0.01	−2.11
	(7.7)	(4.54)
Vehicles financing	0.85	0.61
	(0.69)	(0.45)
Other goods financing	−1.28	−1.45
	(1.52)	(1.07)
Vehicles and other goods financing	0.61	0.74
	(0.74)	(0.56)

Table 4 Brazil: Non-earmarked credit for non-financial corporations.

Copom meetings between 2003 to 2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1 percent level, ** 5 percent level, * 10 percent level.

(Contd.)

DOI: 10.31389/eco.391

DEPENDENT VARIABLE	β	
	DI 30	DI 90
Vehicles leasing	1.74***	1.13***
	(0.66)	(0.42)
Other goods leasing	1.38	0.54
	(0.93)	(0.68)
Vehicles and other goods leasing	1.39*	0.61
	(0.73)	(0.55)
Vendor	1.40**	1.88***
	(0.72)	(0.63)
Compror	−0.24	−0.08
	(0.79)	(0.53)
Advances on exchange contracts	0.22	0.07
	(0.34)	(0.24)
Imports financing	2.01	1.77
	(2.22)	(1.77)
Exports financing	−1.18	−0.25
	(0.82)	(0.64)
Foreign on lendings	0.03	0.29
	(1.27)	(0.88)
Credit card revolving credit	−23.7	−14.9
	(18.10)	(13.92)
Credit card financing	45.8***	24.92***
	(12.55)	(8.50)
Credit card total	−1.68	−3.20
	(9.04)	(5.97)
Hot money	−0.27	−0.76
	(2.93)	(2.23)
Discounting promissory notes	0.44	0.07
	(2.23)	(1.68)

The prime rate refers to the rate charged on loans for firms with low credit risk (AA or A ratings), and the associated pass-through is estimated to be around one. Several other credit lines respond significantly to monetary shocks with a pass-through larger than one; for instance, discount of checks, vendor, vehicles leasing, total leasing, discount of trade bills, and credit card financing. Note, however, that the amount of loan types that do not respond to monetary shocks is not negligible. Credit card financing has a large and negative coefficient. There was a spike in the series in the second quarter of 2017, when a change in the legislation took place.[17] Regardless of this structural change, the series is very volatile and many monetary shocks are associated with substantial credit card rate changes, even when there is no change in legislation.

Table 5 contains the estimates for earmarked credit to non-financial firms. We found a significant transmission to interest rates charged on rural and real estate loans. In case of the 30-day surprise, the pass-through is larger than zero at the 1 percent significance level. However, rural and real estate financing represent a very small share of earmarked credit for firms. Whereas BNDES credit outstanding is around R$ 380 billion, rural and real estate with earmarked rates have an outstanding of R$ 17 billion and R$ 13 billion, respectively.[18] Only BNDES funds to the agroindustry are associated with a significant pass-through, but with a negative coefficient. All other estimates related to BNDES loans are not significant and the point estimates tend to be negative.

17 National Monetary Council Resolution 4,549 of 2017, available at https://www.bcb.gov.br/pre/normativos/busca/downloadNormativo.asp?arquivo=/Lists/Normativos/Attachments/50330/Res_4549_v1_O.pdf. Accessed on 06 December 2020.

18 Values of December 2019. Source: Central Bank of Brazil.

DOI: 10.31389/eco.391

DEPENDENT VARIABLE	β	
	DI 30	DI 90
Rural credit: market rates	–1.71	–1.92
	(2.07)	(1.28)
Rural credit: earmarked rates	1.64***	0.97***
	(0.39)	(0.22)
Rural credit: total	0.65	0.25
	(0.83)	(0.48)
Real estate financing: market rates	2.31	1.73
	(1.83)	(1.23)
Real estate financing: earmarked rates	1.79***	1.11**
	(0.63)	(0.47)
Real estate financing: total	1.65*	1.05
	(0.96)	(0.67)
BNDES funds: working capital	–0.03	–0.12
	(1.88)	(1.19)
BNDES funds: fixed capital investment	–0.22	–0.09
	(0.81)	(0.63)
BNDES funds: agroindustry	–1.36*	–1.09*
	(0.72)	(0.52)
BNDES funds: total	–0.30	–0.14
	(0.77)	(0.61)

Table 5 Brazil: Earmarked credit for non-financial corporations.

Copom meetings between 2003 to 2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1 percent level, ** 5 percent level, * 10 percent level.

4.2.2 Monetary Policy Transmission to Household Credit

The pass-through estimates of the non-earmarked credit for households are available at Table 6. Contrary to the estimates of non-financial firms, there is a lack of significance across the loans. The point estimates tend to be high and positive, but the associated standard deviations are usually very large – which is unsurprising given the high levels of household loan rates. With such high rates, changes can be very large as well.[19] We found significant coefficients for the discount of checks, with a pass-through of almost 5 when using the 30-day shock. Credit cards—financing and total—have significant negative coefficients.

DEPENDENT VARIABLE	β	
	DI 30	DI 90
Overdraft	3.58	3.62
	(3.31)	(2.82)
Personal credit (no payroll-deducted)	6.54	2.69
	(6.12)	(3.90)

(Contd.)

Table 6 Brazil: Non-earmarked credit for households.

Copom meetings between 2003 to 2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1 percent level, ** 5 percent level, * 10 percent level.

19 Lending rates are particularly high in some loan types, such as overdraft, personal credit, credit card, discount of checks, and so on. The transmission in these loans is more likely to be non-linear and a little unpredictable. For instance, between 2013 and 2015, the Selic rate increased by 7 percentage points (p.p.), whereas the overdraft rate increased by almost 129. However, when the Selic decreased by about 10 p.p. between 2016 and 2019, the overdraft rate decreased only by 8 p.p. Figure 16 in the appendix shows how several series have some spikes and other changes that are not directly related to the Central Bank's actions.

DOI: 10.31389/eco.391

DEPENDENT VARIABLE	β	
	DI 30	DI 90
Personal credit: renegotiation	3.42	1.80
	(4.84)	(3.15)
Payroll-deducted personal loans: private sector employees	−0.31	−0.50
	(1.26)	(0.79)
Payroll-deducted personal loans: public sector employees	0.34	0.45
	(0.67)	(0.43)
Payroll-deducted personal loans: retirees and pensioners	−0.10	−0.05
	(0.53)	(0.42)
Payroll-deducted personal loans total	0.49	0.65
	(0.65)	(0.45)
Personal credit total	0.37	0.61
	(1.38)	(0.57)
Vehicles financing	0.31	0.98
	(0.89)	(0.72)
Other goods financing	−1.33	−0.20
	(2.28)	(1.67)
Vehicles and other goods financing	0.00	(0.78)
	(1.00)	(0.79)
Vehicles leasing	1.48	1.29
	(3.49)	(1.98)
Other goods leasing	−1.65	0.19
	(4.57)	(3.71)
Vehicles and other goods leasing	1.45	1.37
	(3.42)	(1.95)
Discount of checks	4.79**	2.72**
	(2.11)	(1.52)
Credit card revolving credit	−32.19	−20.89
	(24.41)	(16.61)
Credit card financing	−9.98*	−7.97**
	(5.05)	(3.22)
Credit card total	−12.12*	−7.18
	(7.10)	(4.99)

As shown in the last section, earmarked rates to households seem to respond to monetary policy. Table 7 reveals significant transmissions to rates charged on rural and real estate loans. The estimated pass-through to earmarked rates is usually incomplete, though real estate financing with market rates has a significant coefficient larger than 1 (1.18 in response to the 90-day surprise). Interestingly, Table 5 also shows a positive and significant effect of earmarked real estate financing and rural credit to firms.

DOI: 10.31389/eco.391

DEPENDENT VARIABLE	β	
	DI 30	DI 90
Rural credit: market rates	0.00	−0.90
	(1.73)	(1.18)
Rural credit: earmarked rates	0.91***	0.43***
	(0.28)	(0.15)
Rural credit: total	0.85***	0.37**
	(0.27)	(0.15)
Real estate financing: market rates	0.97	1.18**
	(0.64)	(0.52)
Real estate financing: earmarked rates	0.86	0.73*
	(0.64)	(0.43)
Real estate financing: total	0.80	0.79*
	(0.60)	(0.40)
BNDES funds: investment	−0.85	−0.58
	(0.61)	(0.39)
BNDES funds: agroindustry	0.03	−0.30
	(0.60)	(0.42)
BNDES funds: total	−0.08	−0.33
	(0.55)	(0.39)
Microcredit: consumers	7.32	2.82
	(6.89)	(3.37)
Microcredit: entrepreneurs	4.08	0.41
	(4.33)	(2.54)
Microcredit: total	4.21	0.75
	(3.12)	(2.05)

Table 7 Brazil: Earmarked credit for households.

Copom meetings between 2003 to 2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1 percent level, ** 5 percent level, * 10 percent level.

The positive effects on earmarked rural and real estate credit might be the exception that confirms the rule, as they probably respond to monetary policy through a convoluted indirect effect. The legislation states that 34 percent of demand deposits in banks must be lent as rural credit and 65 percent of *caderneta de poupança* (a popular type of savings account in Brazil) must finance real estate. Moreover, 80 percent of the total amount that must finance real estate have earmarked rates.

The remuneration of *caderneta de poupança* is linked to another indicator – the *Taxa Referencial* (TR).[20] During our sample period, the response of TR to changes in the policy interest rate is weak, as shown in Figure 14. The slope coefficient of a linear regression of TR on the Selic rate is 0.24.

When the policy rate is high, government bonds become more attractive, while demand deposits and *caderneta de poupança* become relatively less attractive. By channeling savings away from demand deposits and *caderneta de poupança*, tighter monetary policy reduces earmarked credit that depends on this funding (namely rural and real estate credit).

Therefore, monetary policy is likely to affect real estate and rural earmarked loans not because it affects consumption-savings or investment decisions, but because it channels funds to different types of saving accounts.

20 If the Selic rate is higher than 8.5 percent per year, then the *caderneta de poupança* yields 0.5 percent per month plus the TR. If the Selic rate is lower than 8.5 percent per year, the *caderneta de poupança* pays 70 percent of the Selic rate plus the TR. The TR loosely follows the Selic rate and was at 0 percent per year from 2017 until the end of our sample period.

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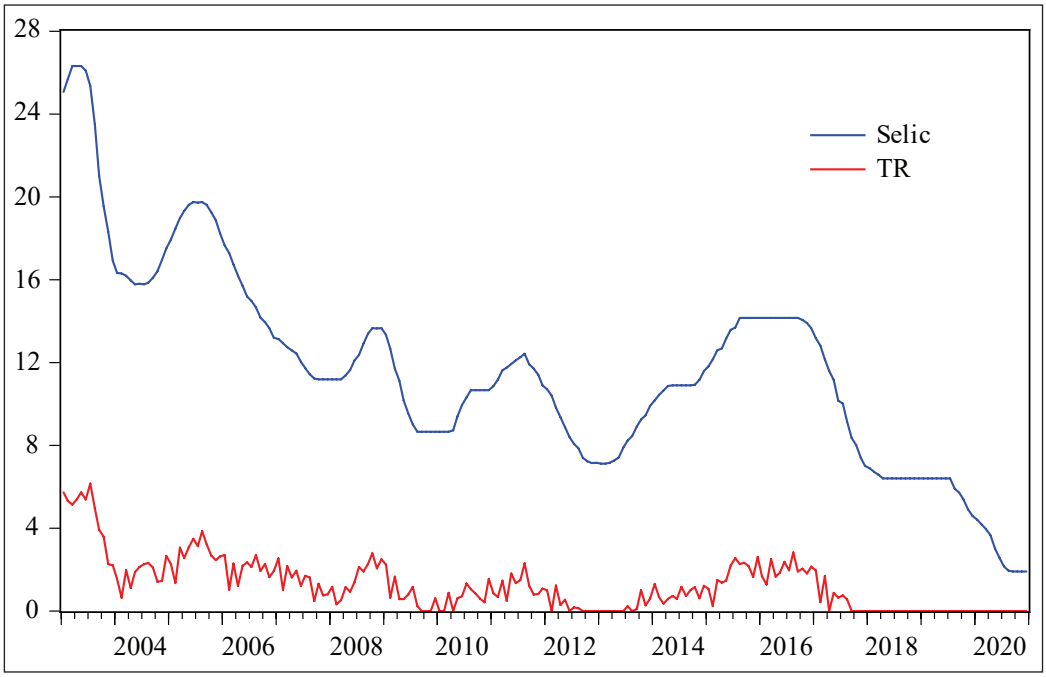

Figure 14 Selic Rate and TR (percent p.y.).
Source: BCB.

Appendix E shows results when we calculate the surprise measure using survey data. Our conclusions remain the same. If anything, the transmission of monetary policy to lending rates seems to be even weaker, which could reflect larger measurement error in this case. Again, only non-earmarked credit for non-financial firms seems to react to monetary policy, but the point estimate is smaller than before (0.8 instead of 1). Results for specific types of credit are also very similar. In the case of earmarked credit, only rural and real estate credit significantly respond to monetary policy. We still find significant coefficients for several lending rates of loans to non-financial corporations, but they tend to be smaller and less accurate. For households, we only find significant—but negative—coefficients for rates on credit cards.

5 CONCLUSION

In the United States, most lending rates respond to changes in Fed funds. Moreover, the pass-through tends to be larger than 1, especially for short-term credit. In Brazil, monetary policy seems to affect only a subset of total outstanding credit. We only found evidence of an effective and proportional transmission to rates on non-earmarked loans for corporations.

In the United States, credit represents around 150 percent of GDP, whereas it is around 70 percent in Brazil. Credit for non-financial corporations—the one that seems to respond proportionally to monetary policy—is around 15 percent of GDP. Thus, the transmission via the credit channel in Brazil seems to be an order of magnitude smaller than in the US.

The results raise questions about the conduction of monetary policy in Brazil. Monetary policy typically affects credit to firms and households. However, according to our results, the bank lending channel in Brazil works mainly through non-earmarked loans for firms. As long as earmarked credit and spreads continue as they are, we must be aware that monetary policy might have little influence over the credit channel.

Our results raise further questions about the transmission of monetary policy. It is well known that credit frictions vary according to firm size. Cavalcanti et al. (2021) show that in Brazil, interest rates faced by a firm with 300 employees are 3 percentage points lower than rates for firms with 30 employees and 5.5 percentage points lower than those for firms with 3 employees. Since bank credit is too expensive, large suppliers often provide trade credit to small firms. Cazzaniga (2023) argues that trade credit in the input-output network is an additional source of shock propagation of monetary policy (and other) shocks. A better understanding of the quantitative importance of this channel would complement our results.

DOI: 10.31389/eco.391

Moreover, Lazzarini et al. (2015) and Bonomo et al. (2015) argue that cheap earmarked credit from BNDES usually flows to firms that could fund their projects with other sources of capital. Combined with those findings, our results imply that monetary policy affects small and large firms in different ways.

APPENDIX

A DESCRIPTIVE STATISTICS

Table 8 Descriptive statistics – lending rates in Brazil (1).

The statistics refer to the baseline sample 2003–2019. The observations refer to the original monthly periodicity. Rates are in percent per year.

	OBS. (MONTHS)	MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.
All operations	106	25.89	25.13	32.99	20.39	3.41
All non-earmarked operations	196	39.97	38.32	53.06	28.89	5.80
All earmarked operations	106	8.94	8.67	11.54	6.92	1.23
Prime rate	180	15.44	15.36	21.78	8.80	3.13
Non-Financial Corporations						
All operations	106	17.60	16.79	22.74	13.47	2.44
Non-earmarked operations	196	26.06	26.38	34.02	16.31	4.21
Earmarked operations	106	9.53	9.60	12.88	6.87	1.67
Non-earmarked loans						
Discount of trade bills	196	33.18	33.68	48.48	14.82	8.12
Discount of checks	106	38.44	37.96	48.32	29.60	5.07
Discount of credit card bills	106	26.83	28.14	37.25	9.47	6.83
Working capital up to 365 days	106	20.72	20.63	27.57	11.99	3.20
Working capital over 365 days	106	19.66	19.75	27.93	13.93	3.49
Working capital revolving credit	106	33.03	32.57	50.22	20.81	7.98
Working capital – total	196	23.56	22.89	33.82	14.21	4.82
Guaranteed overdraft accounts	196	56.18	51.07	101.37	36.06	16.93
Overdraft	106	246.27	227.42	349.38	143.66	82.20
Vehicles financing	106	18.36	18.75	23.01	11.94	2.82
Other goods financing	106	16.84	16.27	22.42	9.61	2.72
Vehicles and other goods financing	196	20.19	18.77	33.53	12.09	4.87
Vehicles leasing	106	15.62	15.75	20.76	10.57	2.34
Other goods leasing	106	14.79	14.85	19.94	10.13	2.18
Vehicles and other goods leasing	106	15.14	15.34	20.05	10.29	2.15
Vendor	196	17.47	17.21	25.98	9.65	3.55
Compror	106	17.44	17.10	23.71	12.12	3.55
Advances on exchange contracts	196	4.74	4.18	10.55	2.08	1.64
Imports financing	106	12.05	12.48	18.90	1.30	3.63
Exports financing	106	12.57	12.63	18.21	7.43	2.73
Foreign on lendings	196	14.89	15.05	22.93	7.91	3.45
Credit card revolving credit	106	248.84	226.15	370.70	155.14	53.53
Credit card financing	106	82.40	72.55	158.27	16.08	49.10

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	OBS. (MONTHS)	MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.
Credit card total	106	65.50	56.03	117.19	35.85	23.14
Hot money	112	47.53	49.45	62.81	29.43	7.43
Discounting promissory notes	112	52.30	52.41	68.99	38.83	5.57
Earmarked loans						
Rural credit – Market rates	106	12.83	12.19	21.64	7.12	3.41
Rural credit – Earmarked rates	106	7.28	6.78	10.40	5.36	1.48
Rural credit – Total	106	8.60	8.36	11.66	6.27	1.34
Real estate financing – Market rates	106	11.44	11.46	14.01	7.04	1.22
Real estate financing – Earmarked rates	106	10.85	10.63	12.57	9.29	0.84
Real estate financing – total	106	11.18	11.05	13.41	9.38	0.92
BNDES funds – Working capital	106	11.51	11.21	19.66	7.75	3.01
BNDES funds – Fixed capital investment	106	9.50	9.41	13.60	6.40	1.94
BNDES funds – Agroindustry	106	7.29	7.31	9.42	4.94	1.12
BNDES funds – Total	106	9.50	9.44	13.55	6.49	1.88

Table 9 Descriptive statistics – lending rates in Brazil (2).

The statistics refer to the baseline sample 2003–2019. The observations refer to the original monthly periodicity. Rates are in percent per year.

	OBS. (MONTHS)	MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.
All operations	106	25.89	25.13	32.99	20.39	3.41
All non-earmarked operations	196	39.97	38.32	53.06	28.89	5.80
All earmarked operations	106	8.94	8.67	11.54	6.92	1.23
Prime rate	180	15.44	15.36	21.78	8.80	3.13
Households						
All operations	106	33.16	31.60	42.27	26.93	4.31
Non-earmarked operations	196	52.86	50.82	72.93	38.90	9.02
Earmarked operations	106	8.49	8.23	10.71	6.85	1.04
Non-earmarked loans						
Overdraft	196	181.89	155.18	285.17	121.13	54.31
Personal credit (no payroll-deducted)	106	104.32	110.04	141.86	66.30	23.26
Personal credit – renegotiation	106	50.41	52.29	65.16	35.50	9.09
Payroll-deducted personal loans – private sector employees	106	36.84	36.40	44.55	29.58	4.44
Payroll-deducted personal loans – public sector employees	106	24.43	24.23	27.81	18.21	2.29
Payroll-deducted personal loans – retirees and pensioners	106	27.97	27.79	32.07	22.32	2.35
Payroll-deducted personal loans total	192	29.04	27.96	41.40	20.54	4.61
Personal credit total	196	51.31	48.14	83.92	36.75	10.91
Vehicles financing	196	27.13	25.73	38.78	19.15	5.41

(Contd.)

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	OBS. (MONTHS)	MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.
Other goods financing	196	69.70	68.79	96.66	44.38	13.27
Vehicles and other goods financing	196	29.94	28.37	43.05	21.19	5.89
Vehicles leasing	106	16.62	16.28	28.12	10.09	3.20
Other goods leasing	106	17.00	16.72	33.93	0.00	5.87
Vehicles and other goods leasing	106	16.55	16.11	26.91	10.11	3.07
Discount of checks	106	52.01	51.71	60.95	41.24	5.12
Credit card revolving credit	106	332.41	304.91	497.73	250.18	71.67
Credit card financing	106	135.11	126.65	178.47	100.13	27.45
Credit card total	106	78.42	72.22	123.07	56.14	18.65
Earmarked loans						
Rural credit – market rates	106	13.75	13.25	20.37	8.70	3.31
Rural credit – earmarked rates	106	6.37	6.06	8.64	4.44	1.30
Rural credit – total	106	6.65	6.38	9.05	4.68	1.33
Real estate financing – market rates	106	13.43	13.33	19.51	7.99	2.81
Real estate financing – earmarked rates	106	8.41	8.18	10.67	6.84	1.01
Real estate financing – total	106	9.11	9.02	11.39	7.23	1.16
BNDES funds – investment	106	7.90	7.77	11.39	5.30	1.46
BNDES funds – agroindustry	106	5.94	6.26	8.00	3.50	1.37
BNDES funds – total	106	6.14	6.64	8.03	3.84	1.29
Microcredit – consumers	106	12.31	10.74	46.47	6.39	6.76
Microcredit – entrepreneurs	106	23.77	29.27	37.82	8.74	9.45
Microcredit – total	106	23.54	28.41	36.44	8.75	9.00

Table 10 Descriptive statistics – lending rates in the United States.

The statistics refer to the baseline sample (January 1994–December 2016) and the observations to the series original periodicity. Different series might have different sample length and interest rates are in percent per year.

	PERIODICITY	OBSERVATIONS	MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.
Commercial Paper – Non-financial Firms	Daily	3853	2.37	1.32	6.65	0.05	2.32
Commercial Paper – Financial Firms	Daily	4954	2.46	1.71	6.68	0.06	2.26
Credit Spread	Monthly	272	2.30	2.06	7.88	1.16	1.05
Excess Bond Premium	Monthly	272	–0.004	–0.223	3.002	–1.144	0.650
Baa – 20 years	Monthly	276	6.75	6.72	9.32	4.22	1.29
Mortgage – 5/1 year adjustable rate	Weekly	626	4.13	3.56	6.39	2.56	1.32
Mortgage – 30 years	Weekly	1200	5.98	6.13	9.25	3.31	1.54
Bank Prime Loan Rate	Daily	5784	5.73	5.00	9.50	3.25	2.28
Personal loans (24 months)	Quartlerly	92	12.04	12.11	14.50	9.45	1.40
Consumer Loans – New Autos (48 months)	Quartlerly	92	7.05	7.19	9.78	4.00	1.72

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	PERIODICITY	OBSERVATIONS	MEAN	MEDIAN	MAXIMUM	MINIMUM	STD. DEV.
Consumer loans – New autos (60 months)	Quartlerly	42	5.65	5.44	7.82	4.05	1.34
Credit Card – all accounts	Quarterly	89	13.60	13.30	16.14	11.82	1.49
Credit Card – accounts assessed interest	Quartlerly	89	14.17	14.22	16.26	11.96	1.02
Non-Financial Commercial Paper							
Overnight AA	Daily	4756	2.16	1.23	6.99	0.01	2.23
7-Day AA	Daily	4672	2.18	1.24	6.85	0.01	2.23
15-Day AA	Daily	4676	2.19	1.24	6.75	0.01	2.23
30-Day AA	Daily	4661	2.18	1.24	6.59	0.02	2.22
60-Day AA	Daily	4258	2.16	1.24	6.61	0.03	2.21
90-Day AA	Daily	3606	2.16	1.14	6.65	0.05	2.25
Overnight A2/P2	Daily	4757	2.41	1.41	7.27	0.16	2.22
7-Day A2/P2	Daily	4748	2.47	1.44	8.01	0.16	2.23
15-Day A2/P2	Daily	4749	2.49	1.48	8.06	0.15	2.24
30-Day A2/P2	Daily	4741	2.54	1.60	7.90	0.20	2.25
60-Day A2/P2	Daily	4371	2.74	2.05	8.42	0.14	2.24
90-Day A2/P2	Daily	3522	3.15	2.92	7.43	0.14	2.22
Financial Commercial Paper							
Overnight AA	Daily	4719	2.17	1.25	6.98	0.01	2.23
7-Day AA	Daily	4458	2.30	1.69	6.78	0.02	2.22
15-Day AA	Daily	4309	2.39	1.74	6.67	0.02	2.23
30-Day AA	Daily	4564	2.30	1.50	6.58	0.01	2.22
60-Day AA	Daily	4608	2.31	1.39	6.62	0.02	2.21
90-Day AA	Daily	4703	2.30	1.32	6.68	0.06	2.20
Asset-backed Commercial Paper							
Overnight AA	Daily	4008	1.65	0.71	6.67	0.07	1.81
7-Day AA	Daily	4003	1.70	1.00	6.55	0.07	1.80
15-Day AA	Daily	3986	1.70	1.02	6.52	0.09	1.81
30-Day AA	Daily	4006	1.69	0.84	6.49	0.12	1.82
60-Day AA	Daily	3995	1.71	0.95	6.31	0.14	1.79
90-Day AA	Daily	3994	1.74	1.04	6.18	0.14	1.78

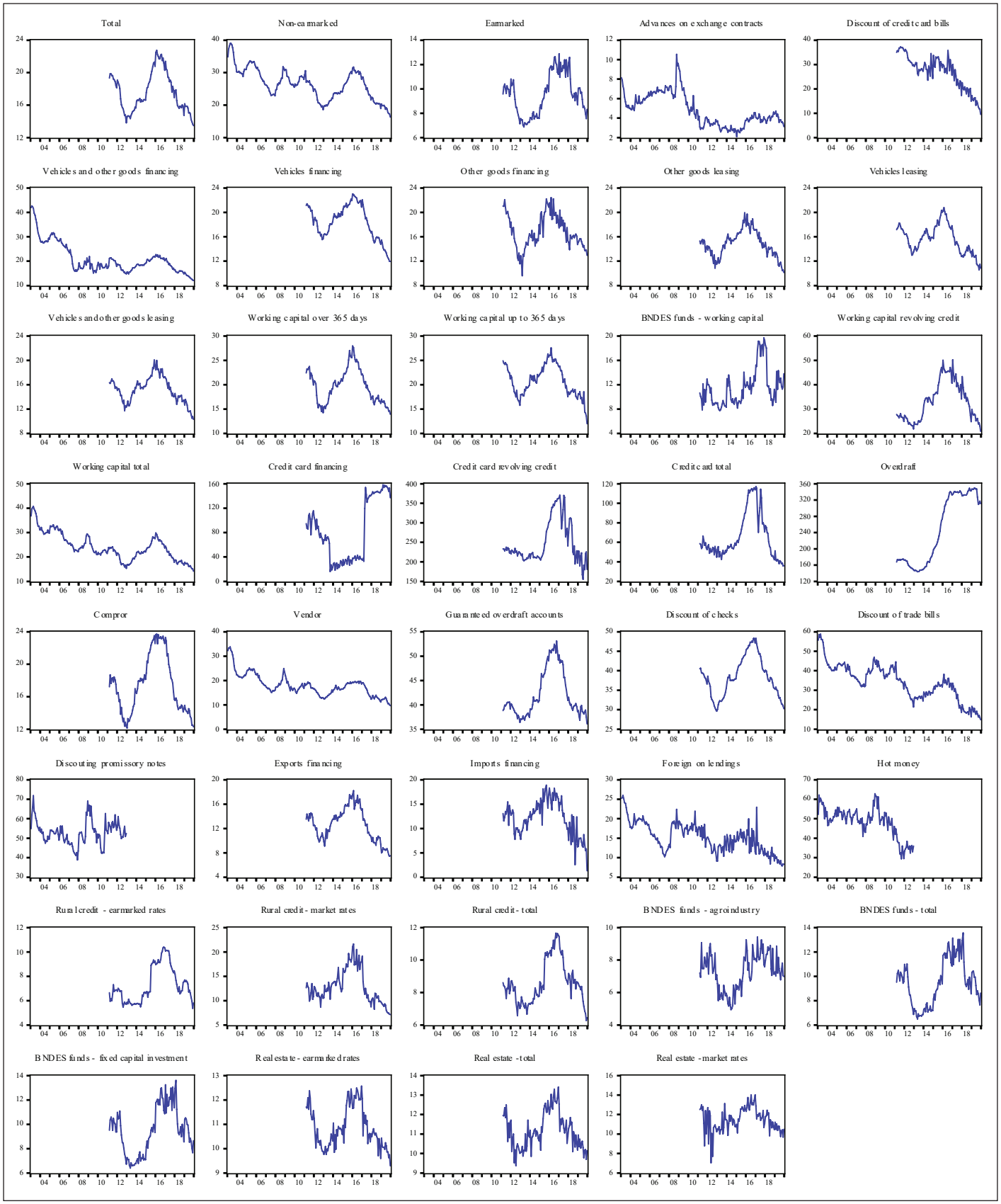

Figure 15 Interest rates of loans for non-financial firms in Brazil (% p.y.).

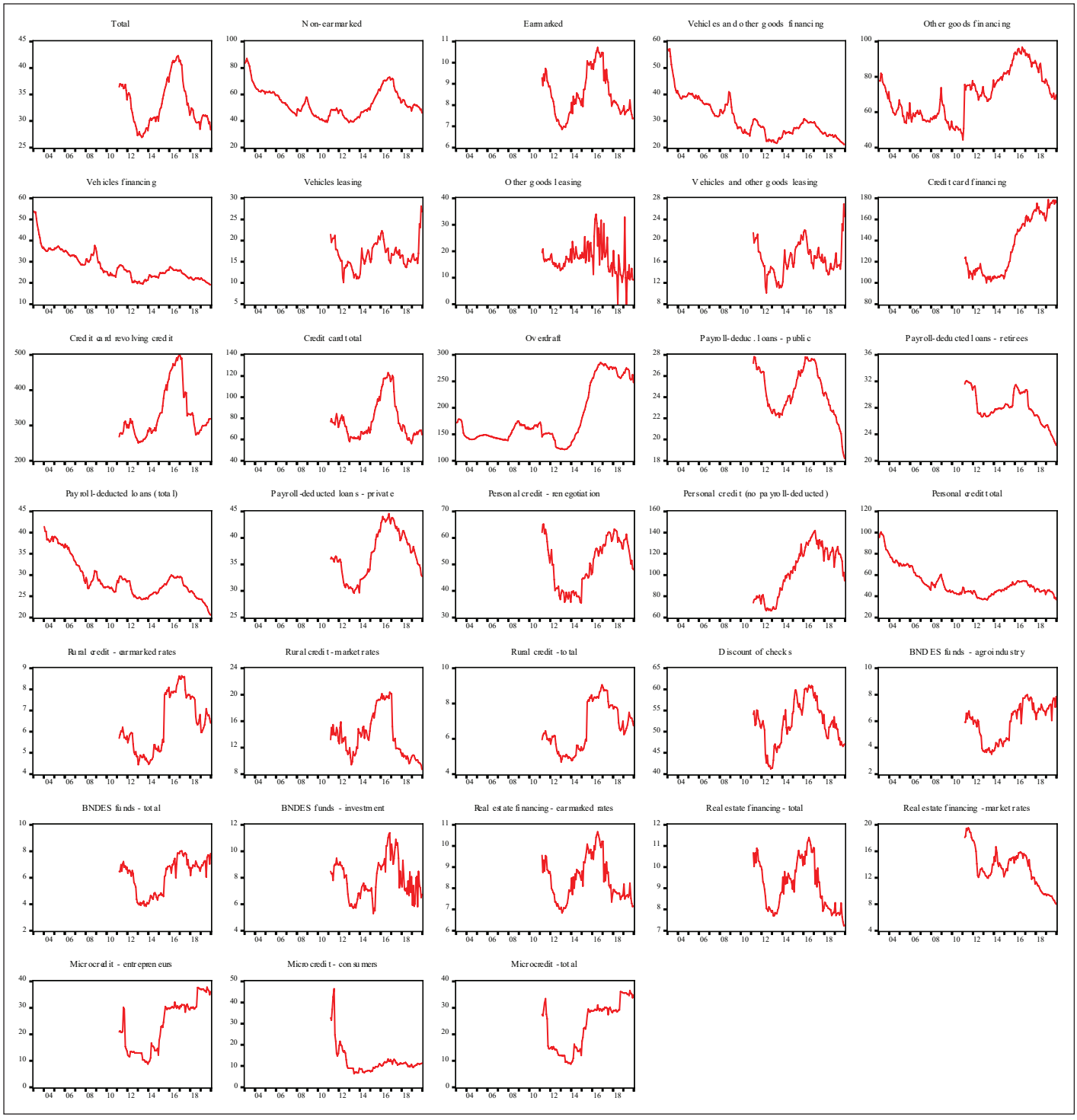

Figure 16 Interest rates of loans for households in Brazil (% p.y.).

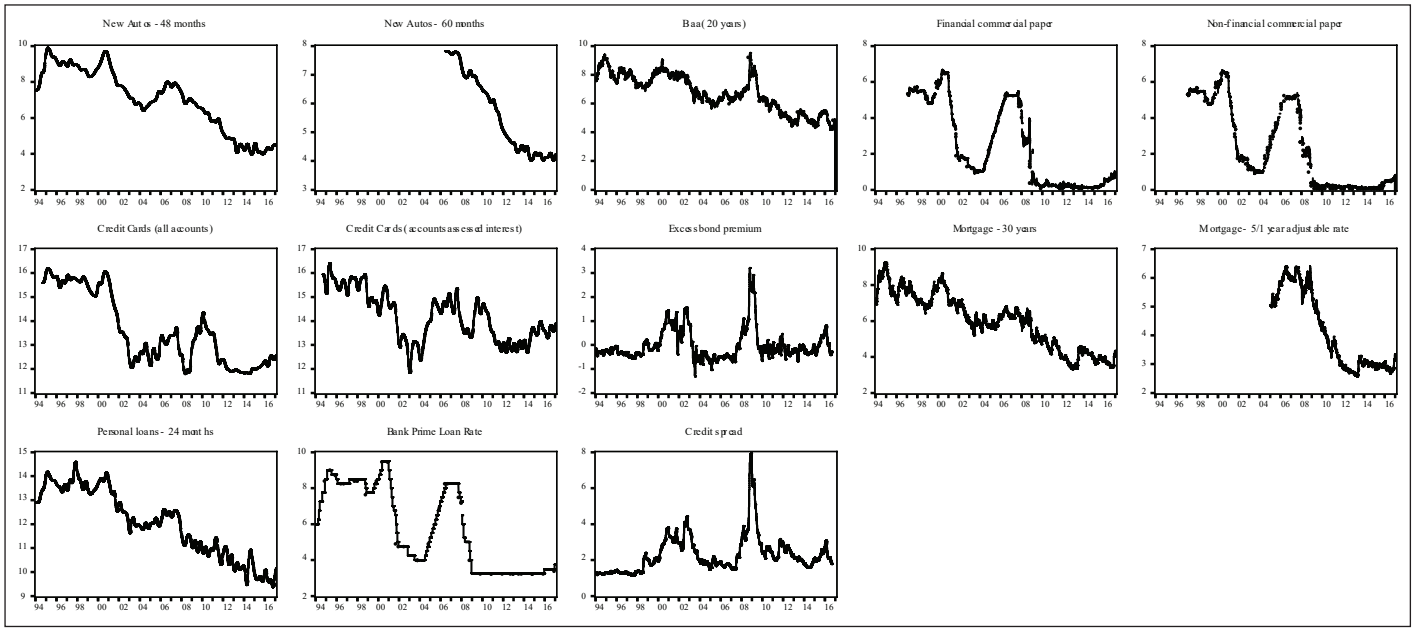

Figure 17 Interest rates in the United States.

Excess bond premium and credit spread are measured in percentage points. All other variables are in percent per year.

B THE SAX-STEINER METHOD USED IN THIS PAPER

Let y denote the high-frequency series that we are interested in and y_L the low-frequency variable that we observe. The procedure can be summarized in two steps. First, a preliminary daily series p is determined. Then, the differences between the monthly values of p and the monthly values of the observed series have to be distributed among the preliminary daily series. The final estimated daily series $\hat{y}$ is given by the sum of preliminary series p and the distributed monthly residuals:

$$\hat{y} = p + Du_L$$

where D is a $n \times n_L$ distribution matrix, n and n_L the numbers of daily and monthly observations. The $n_L \times 1$ vector of residuals u_L is defined as the difference between the monthly values of p and the released monthly values y_L:

$$u_L = y_L - Cp$$

where C is a $n_L \times n$ time-frequency conversion matrix. The procedure described above is pretty much the same for different disaggregation methods, but they differ in calculating series p and matrix D. Although the package can consider indicator series, we do not have any and then we use the option "fast", which is a variant of Chow-Lin (1971) method and numerically close to Denton-Cholette (Dagum & Cholette, 2006). Chow-Lin is a regression-based method and it runs a generalized least squares regression (GLS) of y_L on CX, where X is a $n \times m$ matrix containing m indicator series. Since we do not use any indicator series, the regression is performed on the intercept only. The estimated coefficient is:

$$\hat{\beta}(\Sigma) = \left[X'C'\left(C\Sigma C'\right)^{-1}CX\right]^{-1} X'C'\left(C\Sigma C'\right)^{-1} y_L$$

where Σ is the variance-covariance matrix. Moreover, the distribution matrix is defined as:

$$D = \Sigma C'\left(C\Sigma C'\right)^{-1}$$

The preliminary daily series is calculated as the fitted values: $p = \hat{\beta}X$. The method assumes that the high-frequency residuals follow an autoregressive process of order 1: $u_t = \rho u_{t-1} + \epsilon_t$, where $|\rho| < 1$ and $\epsilon_t \sim \mathcal{N}(0, \sigma_\epsilon)$. The variance-covariance matrix is then given by:

$$\Sigma(\rho) = \frac{\sigma_\epsilon^2}{1-\rho^2} \cdot \begin{bmatrix} 1 & \rho & \cdots & \rho^{n-1} \\ \rho & 1 & \cdots & \rho^{n-2} \\ \vdots & \vdots & \ddots & \vdots \\ \rho^{n-1} & \rho^{n-2} & \cdots & 1 \end{bmatrix}$$

It is possible to estimate the autoregressive parameter, but the method "fast" assumes ρ very close to one.

DOI: 10.31389/eco.391

C ESTIMATIONS WITH ALL FOMC MEETINGS

DEPENDENT VARIABLE	β
Commercial Paper – Non-Financial Firms	1.39***
	(0.47)
Commercial Paper – Financial Firms	1.45***
	(0.43)
Mortgage – 5 × 1-year adjustable rate	1.26**
	(0.63)
Mortgage – 30 years	0.34
	(0.37)
Bank Prime Loan Rate	1.36***
	(0.34)
Baa – 20 years	0.53
	(0.38)
Credit Spread	1.11**
	(0.51)
Excess Bond Premium	0.69*
	(0.38)
Personal Loans – 24 months	0.37***
	(0.14)
Consumer Loans – New Autos – 48 months	0.28***
	(0.09)
Consumer loans – New autos – 60 months	0.20*
	(0.11)
Credit card – accounts assessed interest	0.30
	(0.20)
Credit card – all accounts	0.22
	(0.17)

Table 11 Pass-through estimates in the United States.

D DETAILED RESULTS FOR THE UNITED STATES

DEPENDENT VARIABLE	β		
	NON-FINANCIAL	FINANCIAL	ASSET-BACKED
Overnight AA	0.35	0.47	3.49***
	(0.81)	(0.77)	(1.33)
7-Day AA	0.62	1.26**	4.97***
	(0.75)	(0.65)	(1.36)
15-Day AA	0.87	1.63**	5.11***
	(0.70)	(0.70)	(1.43)
30-Day AA	1.04*	2.64***	5.37***
	(0.66)	(0.82)	(1.44
60-Day AA	1.62***	2.69***	4.43***
	(0.48)	(0.70)	(1.1)
90-Day AA	1.68***	2.34***	4.56***
	(0.55)	(0.73)	(1.07)

(Contd.)

Table 12 Pass-through estimates in the United States – Commercial Papers.

Only scheduled FOMC meetings: 185 observations between 1994 and 2016. The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1% level, ** 5% level, * 10% level. Coefficient β is an estimate of the monetary policy pass-through to lending rates.

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DEPENDENT VARIABLE	β		
	NON-FINANCIAL	FINANCIAL	ASSET-BACKED
Overnight A2/P2	4.94***		
	(1.60)		
7-Day A2/P2	5.48***		
	(1.52)		
15-Day A2/P2	5.32***		
	(1.51)		
30-Day A2/P2	5.49***		
	(1.43)		
60-Day A2/P2	5.55***		
	(1.46)		

E ROBUSTNESS: SURPRISE MEASURE USING SURVEY DATA

We also use the Focus Survey to develop an alternative measure of monetary shocks. This survey is carried out by the Brazilian Central Bank and compiles forecasts of banks, asset managers and other institutions for several variables, including the Selic rate. Expectations are collected daily, and the Central Bank publishes a summary of statistics every week. We compute the monetary shock as the difference between the median expectation for the Selic rate the day before each meeting and the effective target rate chosen by the Central Bank. Figure 18 illustrates the surprises related to each Copom meeting from September 2003 until December 2019.

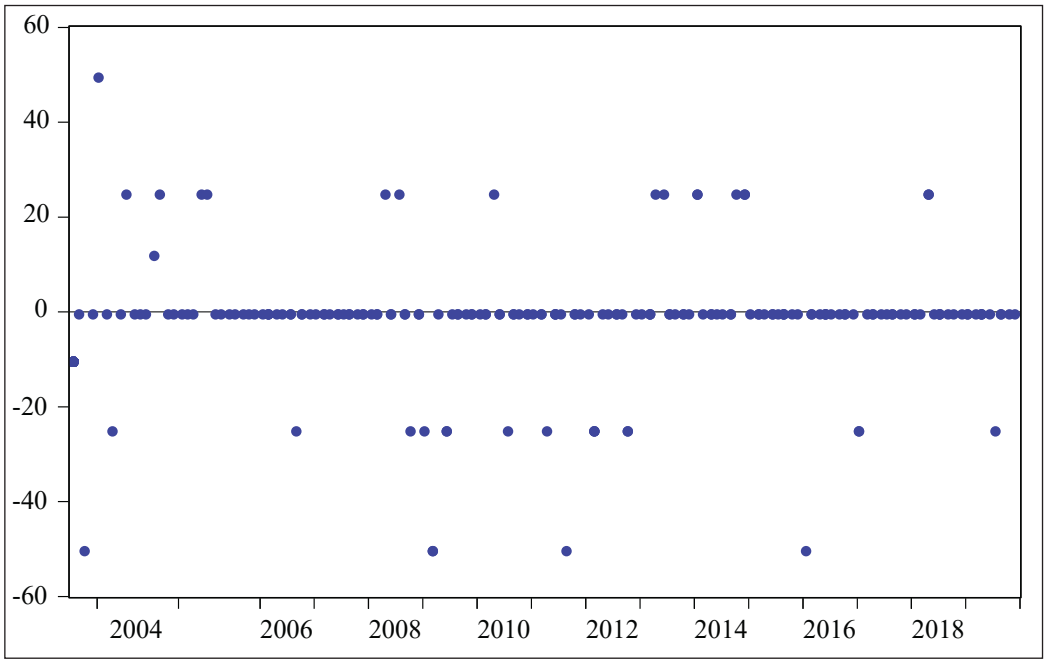

Figure 18 Monetary Shocks from Focus Survey (bps).

On the one hand, Focus data may be less accurate than the high-frequency financial data that we use in our baseline estimation. DI futures are very liquid contracts that incorporate new information within a very short period. On the other hand, surprises computed based on Focus would be less subject to endogeneity issues, since they purely reflect the expectation for the Selic rate of the next policy meeting. Events that happen overnight and political news might affect the opening prices of futures contracts, but not the survey or the decision taken early in the evening.

Table 13 shows the estimates of coefficient β with this new measure of monetary surprises.

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DEPENDENT VARIABLE	β
Non-earmarked	0.43
	(0.72)
Non-earmarked – Non-financial firms	0.83*
	(0.49)
Non-earmarked – Households	0.06
	(0.99)
Total	–0.48
	(0.67)
Total – Non-financial firms	–0.28
	(0.64)
Total – Households	–0.58
	(0.73)
Earmarked	–0.08
	(0.33)
Earmarked – Non-financial firms	–0.63
	(0.61)
Earmarked – Households	0.40
	(0.29)

Table 13 Aggregate Categories – Focus.

Copom meetings between 2003–2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1% level, ** 5% level, * 10% level.

E.1 Detailed results

We estimated the same regression as before, but with this new measure of monetary surprises. Tables 14, 15, 16 and 17 contain the estimates of coefficient β, which measures the pass-through to lending rates. We used the same interpolated credit series of our baseline estimations. Hence, we only modified our main explanatory variable.

DEPENDENT VARIABLE	β
Prime rate	1.09***
	(0.40)
Discount of trade bills	0.01
	(1.18)
Discount of checks	0.70
	(0.69)
Discount of credit card bills	–1.27
	(1.39)
Working capital up to 365 days	1.58**
	(0.74)
Working capital over 365 days	–0.05
	(0.93)
Working capital revolving credit	0.65
	(1.57)

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DEPENDENT VARIABLE	β
Working capital (total)	1.29**
	(0.59)
Guaranteed overdraft accounts	0.28
	(0.88)
Overdraft	4.58
	(6.93)
Vehicles financing	0.57
	(0.50)
Other goods financing	1.38
	(0.94)
Vehicles and other goods financing	1.14**
	(0.59)
Vehicles leasing	0.97*
	(0.51)
Other goods leasing	1.09*
	(0.67)
Vehicles and other goods leasing	0.93*
	(0.59)
Vendor	1.25**
	(0.54)
Compror	−0.29
	(0.43)
Advances on exchange contracts	0.09
	(0.28)
Imports financing	0.66
	(0.98)
Exports financing	−0.50
	(0.53)
Foreign on lendings	0.59
	(0.75)
Credit card revolving credit	−29.13***
	(10.95)
Credit card financing	11.05
	(8.38)
Credit card total	−3.41
	(5.83)
Hot money	0.59
	(1.64)
Discounting promissory notes	−0.42
	(1.33)

Table 14 Non-earmarked credit for non-financial corporations – Focus.

Copom meetings between 2003–2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1% level, ** 5% level, * 10% level.

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DEPENDENT VARIABLE	β
Overdraft	3.28
	(2.66)
Personal credit (no payroll-deducted)	1.73
	(4.34)
Personal credit – renegotiation	0.99
	(3.66)
Payroll-deducted personal loans – private sector employees	–0.31
	(0.93)
Payroll-deducted personal loans – public sector employees	0.12
	(0.40)
Payroll-deducted personal loans – retirees and pensioners	0.44
	(0.32)
Payroll-deducted personal loans total	0.44
	(0.38)
Personal credit total	0.50
	(1.06)
Vehicles financing	0.83
	(0.66)
Other goods financing	0.34
	(1.45)
Vehicles and other goods financing	0.79
	(0.71)
Vehicles leasing	–1.25
	(2.27)
Other goods leasing	2.13
	(4.27)
Vehicles and other goods leasing	–1.09
	(2.15)
Discount of checks	1.14
	(0.56)
Credit card revolving credit	–19.04
	(11.69)
Credit card financing	–6.30*
	(3.27)
Credit card total	–9.61**
	(3.91)
Rural credit – Market rates	–0.81
	(1.59)
Rural credit – Earmarked rates	0.52**
	(0.27)

Table 15 Non-earmarked credit for households – Focus.

Copom meetings between 2003–2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1% level, ** 5% level, * 10% level.

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DEPENDENT VARIABLE	β
Rural credit – Total	0.14
	(0.47)
Real estate financing – Market rates	–0.05
	(1.17)
Real estate financing – Earmarked rates	1.03***
	(0.34)
Real estate financing – total	0.44
	(0.61)
BNDES funds – Working capital	–0.79
	(1.08)
BNDES funds – Fixed capital investment	–0.92
	(0.80)
BNDES funds – Agroindustry	–0.66
	(0.41)
BNDES funds – Total	–0.90
	(0.75)

Table 16 Earmarked credit for non-financial corporations – Focus.

Copom meetings between 2003–2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1% level, ** 5% level, * 10% level.

DEPENDENT VARIABLE	β
Rural credit – Market rates	0.87
	(1.00)
Rural credit – Earmarked rates	0.30**
	(0.15)
Rural credit – Total	0.30**
	(0.14)
Real estate financing – Market rates	0.06
	(0.46)
Real estate financing – Earmarked rates	0.55*
	(0.33)
Real estate financing – total	0.44
	(0.32)
BNDES funds – Investment	–0.36
	(0.37)
BNDES funds – Agroindustry	0.14
	(0.36)
BNDES funds – Total	–0.08
	(0.36)
Microcredit – consumers	3.04
	(2.69)
Microcredit – entrepreneurs	1.18
	(2.15)
Microcredit – total	1.00
	(1.64)

Table 17 Earmarked credit for households – Focus.

Copom meetings between 2003–2019 (140 observations). The dependent variables are cumulative changes between meetings. Robust standard errors in parentheses. Significant at: *** 1% level, ** 5% level, * 10% level.

ACKNOWLEDGEMENTS

We thank David Bowie for the paper title, the editor Irene Brambilla, two anonymous referees, Carlos Carvalho, Carlos Eduardo Goncalves and seminar participants at Sao Paulo – FGV for helpful comments and suggestions.

FUNDING INFORMATION

Elias gratefully acknowledges financial support from CAPES. Guimaraes gratefully acknowledges financial support from CNPq.

COMPETING INTERESTS

The authors have no competing interests to declare.

AUTHOR AFFILIATIONS

Laura Elias
Kinea, BR

Bernardo Guimaraes orcid.org/0000-0003-0098-2174
Sao Paulo School of Economics – FGV, BR

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TO CITE THIS ARTICLE:
Elias, Laura, and Guimaraes, Bernardo. 2024. "This is not America: The Credit Channel of Monetary Policy in Brazil." *Economía LACEA Journal* 23(1): 137–174. DOI: https://doi.org/10.31389/eco.391

Submitted: 28 April 2023
Accepted: 12 October 2023
Published: 28 May 2024

Economía LACEA Journal is a peer-reviewed open access journal published by LSE Press.

LSE Press