Observed and expected interest rate pass-through under remarkably high market rates*

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Abstract

This paper investigates the interest rate pass-through from the observed and expected policy rates to the remarkably high lending rates in the Brazilian economy, accounting for financial-institution specific characteristics, borrower type, asymmetric adjustment and persistence in loan rates. We use a unique and non-public dataset with expected variables identified by professional forecasters and apply a fixed-effects approach to alternative specifications as robustness checks. Financial institutions correctly forecast the next target level of the policy rate and adjust their loan interest rates accordingly. There is evidence of overshooting and positively asymmetric pass-through for modalities with higher interest rate margins. The degrees of pass-through and interest rate margins are positively correlated across persistent loan rates. These findings contribute to explain why loan interest rates are so high in the Brazilian economy, despite the downward bias in the policy rate.

Keywords: Interest rate pass-through, Asymmetry, Lending rates, Monetary policy.
JEL: E43, E44, E52.

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1. Introduction

The degrees of pass-through from the policy interest rate to lending and deposit rates unveil the transmission channel of the monetary policy to the financial sector of the economy. In an ideal scenario, changes in the policy (or base) interest rate should be completely transmitted to the market rates in a full and symmetric pass-through environment, characterizing the efficiency of the monetary policy to affect the market rates, and so the real sector of the economy through the credit channel. However, in practice, this might not be the case, as the degree of interest rate pass-through might be either smaller or bigger than one, featuring an incomplete or overshooting pass-through, respectively. In addition, the pass-through might be asymmetric, meaning that increases or decreases in the policy rate are conveyed in different proportions to the market rates. As a result, the monetary policy might not affect the market interest rates, domestic credit and economic activity as desirable.

The issue is of special concern in the Brazilian economy, which historically has one of the highest interest rates in the world, in both nominal and real terms. Despite the lowest level of 2% per year achieved in 2020 as a monetary policy response to stimulate the economy during the COVID-19 pandemic, market rates remained at very high levels and have not followed the downward bias in the policy interest rate. Some authors have explained this abnormal behavior by specific features of the financial market, such as high probability of default by borrowers, market power by banks and concentration in the financial sector. These assertions, however, sound misleading as long as they only focus on the interest rate margins (or spread) and overlook features from the interest rate pass-through. We argue that consistent estimates of the degree of pass-through from the observed and expected policy interest rates to the different modalities of lending rates by financial institutions and borrower types might contribute to fulfill this gap. Specifically, departing from high interest rates margins, an overshooting pass-through coupled with asymmetric behavior by financial institutions that overreact to increases and under-react to decreases in the base interest rate, both observed and expected, might sustain the long lasting Brazilian world interest rate record.

The objective of this paper is to investigate the interest rate pass-through from the observed and expected policy rates to the remarkably high lending rates in the Brazilian

economy. We estimate observed and expected degrees of pass-through by accounting for financial institution specific characteristics, asymmetric behavior and partial adjustment due to persistence in the lending rate modalities. We use a unique and non-public dataset of lending interest rates, observed Over-Selic rate and expected Over-Selic rate identified by professional forecasters (financial institutions) covering the period from January 2012 to April 2019 on a weekly basis, available from the Central Bank of Brazil. The sample is disaggregated by interest rate modalities, financial institutions and loan operations for either households or non-financial corporations. In addition to the static panel data estimation, we also allow for partial adjustment in the lending rates to changes in the observed and expected policy interest rates.

We apply a fixed effects approach to panels of financial institutions and non-earmarked lending interest rates disaggregated by households and non-financial corporations. The policy interest rate is the Over-Selic rate, representing the monetary policy instrument in the inflation targeting regime adopted by the Central Bank of Brazil since June 1999. We also use the expected Over-Selic rate identified by professional forecasters to assess whether financial institutions correctly anticipate changes in the policy rate when setting their loan interest rates.[1] This unique and non-public dataset with identified expectations reduces loss of information caused by aggregation of expectations by the mean or median, for instance, making our results more reliable than other counterparts.

Empirical studies have found asymmetric responses of lending rates (Castro and Mello, 2012) and deposit rates (Chong, 2010; Hannan and Berger, 1991) to downward versus upward movements in policy interest rates. Liu et al. (2008) provided evidences of asymmetric responses in both rates, while Neumark and Sharpe (1992) only for deposit rates of banks in concentrated markets. These findings suggest that rigidity in the pass-through is bigger when there is stimulus for downward movements in lending rates or for upward changes in deposit rates.

Market power might affect the banks' responses to changes in the policy rate, although the

[1]Banerjee et al. (2013) used aggregate data for the four major Euro area economies and argued that banks anticipate short-term market rates when setting interest rates on loans and deposits, and even more so when they will have to refinance the loans that they make in the future. We found a similar result but by using a loan-specific dataset with the expected policy interest rate identified by financial institutions.

effects are unclear in the interest rate pass-through empirical literature (Kopecky and Hoose, 2012). Hannan and Berger (1991) argued that banks in concentrated markets exhibit higher rigidity in deposit rates, and Holton and d'Acri (2018) found similar results for lending rates. However, while bank concentration is one of the most common indicators of market power, measures of competition are considered more relevant to assess banks' behavior (e.g. Ornelas et al., 2020; Berger et al., 2004; Cottarelli and Kourelis, 1994). Cottarelli and Kourelis (1994) claimed that lack of competition increases stickiness of lending rates and simulations of a DSGE model by Hristov et al. (2014) yielded similar results under weaker competition. The results by Holton and d'Acri (2018) are also in accordance, since large banks (proxy for banks with bigger market power) showed a lower long-run pass-through, especially for small loans (proxy for small and medium sized enterprises). On the other hand, Coelho et al. (2010) suggested that larger Brazilian banks had stronger reactions to the monetary policy than the smaller ones.

Conflicting evidences also prevail when assessing the ownership control and capital origin of the banks. Cottarelli and Kourelis (1994) found that lending rates appear to be stickier in publicly owned banking systems, and privatizing would substantially increase flexibility of lending rates. Using data from May 2006 to March 2010, Pereira and Maia-Filho (2013) also suggested lower pass-through for public-owned government banks (GCBs) before the financial crisis, but found no evidence that private banks and GCBs adjusted their lending rates differently afterwards. This behavior before the financial crisis contrasts with Coelho et al. (2010), who uncovered similar responses for both types of Brazilian banks in the period of June 2000 to December 2006. Arena et al. (2007) argued that deposit and lending rates of foreign banks are less sensitive to changes in monetary conditions during periods of financial crisis, but Coelho et al. (2010) found that both foreign and domestic banks displayed similar responses for lending rates.

The combined effects of high-risk balance sheets and distress in the banking sector to a sluggish pass-through were highlighted by the financial crisis (Altavilla et al., 2020; Holton and d'Acri, 2018; Von Borstel et al., 2016; Hristov et al., 2014). Such environment changed the interest rate setting strategy, making loan spreads higher in banks that incurred larger losses or shortfall in capital and liquidity buffers (Gambacorta and Mistrulli, 2014; Santos,

2011). Slowing down in the speed of pass-through is also associated with longer term of loans or deposits (Liu et al., 2008), repeated discount rate as a signalling device (Cottarelli and Kourelis, 1994), and absence of lending relationship (Gambacorta and Mistrulli, 2014). These latter elements, however, were not included in our specifications because would require some arbitrary adjustments to synchronize the data frequency, since a larger dataset is not readily available.[2]

We found convincing evidence of full pass-through from both the observed and the expected policy interest rates to the majority of lending rate modalities. For the overall sample, sub-samples by households and non-financial corporations and some specific lending modalities, the estimates indicated an overshooting pass-through, meaning that banks increase loan interest rates more than proportional to any raise in the Over-Selic interest rate, either observed or expected. The banks' behavior is asymmetric, as downward adjustments in the lending rates are always smaller than the upward ones. The degrees of pass-through are strongly correlated with the interest rate margins, meaning that higher spreads are coupled with larger and positively asymmetric pass-through coefficients. These findings are robust to the inclusion of other control variables and partial adjustment in a dynamic panel data environment, which additionally revealed high persistence in some loan interest rates. Taken together, these results might explain why loan interest rates are so high in the Brazilian economy regardless of downward bias in the observed and expected policy rates during the period. Any increase in the policy interest rate, either observed or expected, leads to increases at least as proportional as in highly persistent lending rates, while any stimulus to decrease these rates is refrained by the financial institutions.

Other complementary findings also contribute to disentangle the role of the interest rate pass-through to sustain the sky-high lending rates in the Brazilian economy. First, it is important to control for the heterogeneity in the lending rates by both modality and borrower types as the interest rate margins, credit risk and other specific features are quite different among them. Second, financial institutions anticipate adjustments in their lending rates by correctly forecasting the next level of the policy rate. The estimated degrees of pass-

[2]See Gregor et al. (2021) for a comprehensive review of the pass-through literature.

through from either the observed or the expected Over-Selic rates are basically the same. Finally, loan modalities with higher interest rate margins also show larger degrees of pass-through and lower stickiness than those with smaller margins. There is a strong and positive correlation between the pass-through estimates and the interest rate margins across the lending modalities, borrower types and policy rates.

The paper is organized as follows. The next section discusses the dataset and provides a summary of descriptive statistics and illustrates the several interest rate modalities. Section 3 outlines the hypotheses and presents the empirical strategy. Section 4 reports the major findings. Section 5 describes and applies robustness tests. Resorting to the theoretical literature, Section 6 discusses and explains the major empirical findings. Finally, Section 7 is dedicated to the concluding remarks.

2. Data

The dataset comprises interest rates from new credit operations (lending rates), Over-Selic interest rate[3] and expectations identified by professional forecasters (financial institutions) of the next Over-Selic target level. The sample covers the period from January 5^{th}, 2012 to April 4^{th}, 2019 on a weekly basis. The original dataset of loan operations contains the five-business-days weighted moving average of interest rates by financial institutions and loan modalities.[4] To synchronize with the dates of the Monetary Policy Committee (Copom) meetings and capture Selic changes, we considered only observations beginning on Thursdays or the next business day in case the Thursday was a holiday. This procedure resulted in up to 378 weekly observations per financial institution and loan modality, as illustrated in Figures 1 and 2.[5]

Within that period, there were 58 Copom meetings, with an average interval of 46 days between two consecutive meetings (ranging from 35 to 63 days). Meetings always begin on

[3]The Over-Selic rate is the daily average of the overnight rates of interbank loans backed by federal securities, carried out in the Special System for Settlement and Custody (the Selic System).

[4]It is available from the Open Data Portal https://opendata.bcb.gov.br/, from where we also extracted the observed and expected Over-Selic rates. Data on the Monetary Policy Committee meetings and financial institutions were obtained from Central Bank of Brazil website https://www.bcb.gov.br/en.

[5]See Appendix A for a detailed description of the loan modalities.

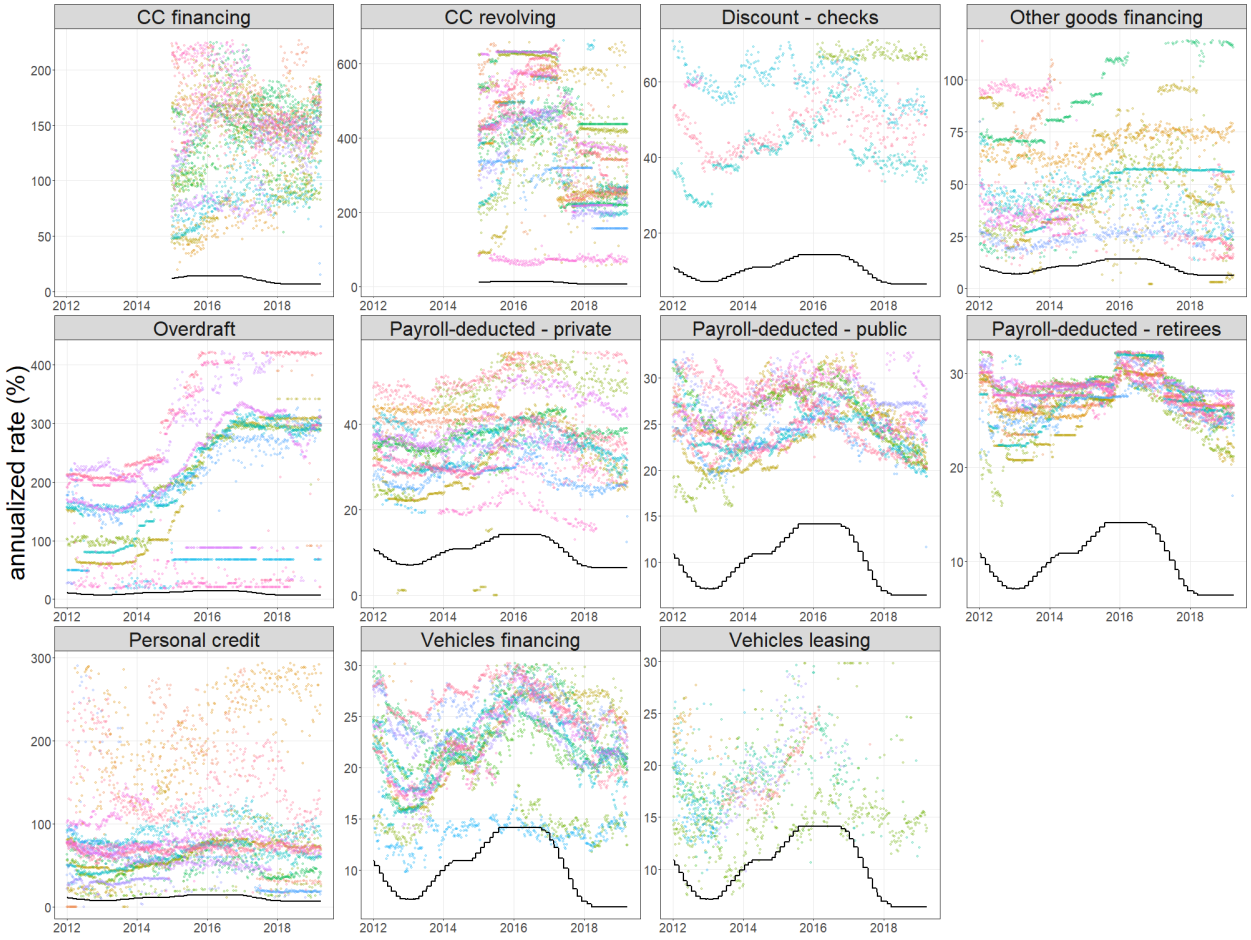

Figure 1: Observed Over-Selic rate and household lending rates.
Notes: The figure reports the observed Over-Selic rate (black line) and households lending rates by financial institutions and loan modalities (colored dots). Each color corresponds to a financial institution. CC stands for credit card. All modalities are fixed interest rates.

Tuesday and end on Wednesday, when the Selic target is decided and publicly released. The target rate is effective from the next business day after the meeting until a new decision is made in the next meeting.

Selic expectations always refer to the next Over-Selic target level. These expectations are collected daily through the "Focus Survey" carried out by Central Bank of Brazil across financial institutions and a median expectation is weekly released to the public.[6] Selic expectations are also available by financial institutions, but with one-year delay in the release and each institution anonymously identified by a non-public code, as illustrated in Figure 3.

[6]Focus Survey monitors the market expectations for several economic indicators, including Selic target level and inflation rate.

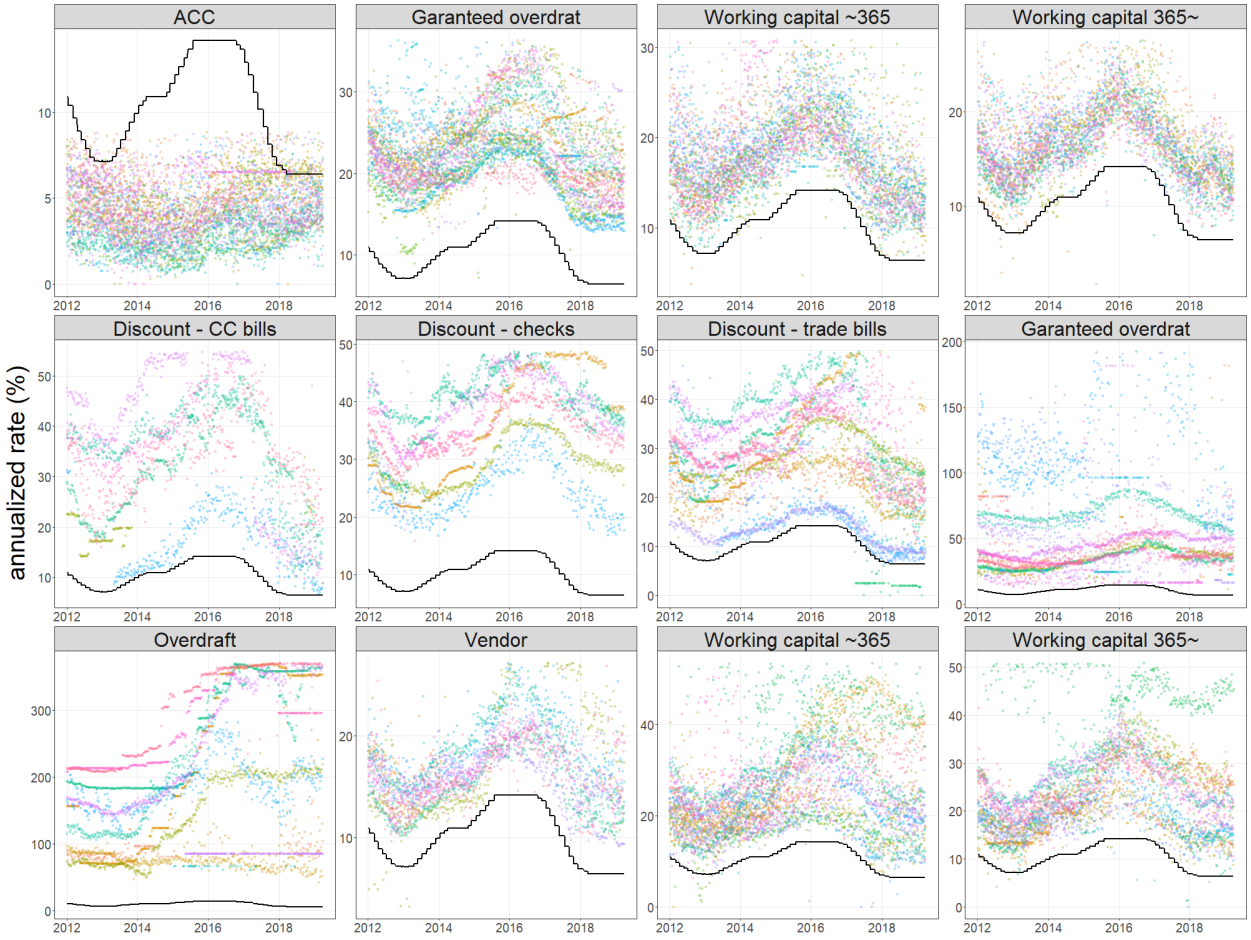

Figure 2: Observed Over-Selic rate and non-financial corporations lending rates.
Notes: The figure reports the observed Over-Selic rate (black line) and non-financial corporations lending rates by financial institutions and loan modalities (colored dots). Each color corresponds to a financial institution. ACC and CC stands for advances on exchange contracts and credit card, respectively. The modalities in the first row are floating interest rates, except ACC which is a foreign-currency indexed interest rate. The remaining modalities are fixed interest rates.

For this research, the Central Bank of Brazil has kindly provided a list of the confidential codes that matches lending rates and Selic expectations by financial institutions.[7] As a result, we were able to build an accurate dataset of lending interest rates and Selic expectations both identified by financial institutions. This unique dataset reduces loss of information that would be caused by using aggregate median expectations as usually done by other studies.[8]

[7]The confidential financial institutions codes list was kindly provided by Department of Statistics (DSTAT) of the Central Bank of Brazil only for the purposes of this work.

[8]Estimates using median Selic expectations were significantly different from those with Selic expectations identified by financial institutions, especially in models with disaggregated loan operations. The higher the disaggregation in the sub-samples, the bigger the difference in the estimated pass-through coefficients between the median Selic expectations and the identified expectations by financial institutions. These results

It also allows us to estimate the pass-through from the identified Selic expectations to the loan interest rates and infer whether future changes in the Selic rate are correctly anticipated by the financial institutions and transmitted to their lending interest rates.

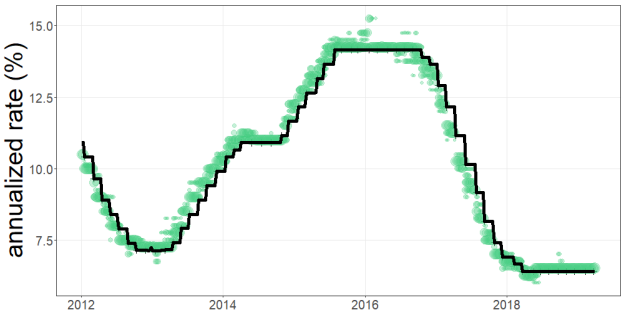

Figure 3: Observed and expected Over-Selic rates.
Notes: The figure presents the observed Over-Selic rate (black line) and expected Over-Selic rate (green bubbles). The size of the bubble represents the number of financial institutions that reported the same expected value in a given week.

The financial institutions are identified by the National Register of Legal Entity (CNPJ), a public enterprise tax identification number of the financial institution that granted the loan. On the other hand, the Selic expectations are associated to a code other than the CNPJ that identifies the financial institution responsible for entering the forecasts in the Focus Survey. There is a unique and confidential list from the Central Bank of Brazil matching CNPJ and Selic expectation codes by financial institution. However, CNPJ from lending rates and codes from Selic expectations hardly match one another without further information. In some cases, several financial institutions are part of the same conglomerate, where each one has its own area of experts responsible for forecasting the next target level of the Over-Selic. In many cases, the area in charge of making the forecasts has a different CNPJ than the area that grants loans to individuals and firms. The information binding these distinct CNPJ is the conglomerate. Therefore, we replaced all financial institutions' specific CNPJ by their respective conglomerate's CNPJ. In case there is no corresponding conglomerate, we considered the financial institution as a conglomerate with only one subsidiary. By doing this manipulation in the original dataset, we were able to faithfully match CNPJ and Selic expectation codes by financial institutions.

are available from the authors upon request.

The original dataset of Selic expectations contains observations for all dates on which financial institutions entered their initial forecast or revision of forecast. In addition, because Selic expectations might refer to any specific future Copom meeting, they are not restricted to the next meeting. In order to standardize the dataset and match the lending rates frequency, we selected the last expectations in effect on Thursdays to transform the data frequency in weekly figures. We also filtered observations to keep only expectations for the target level to be decided in the next Copom meeting. Expectations older than 45 days since the last Copom meeting are not considered because forecasts are more reliable as the Copom meeting approaches.

Loan operations are classified by size and capital origin of the financial institution, type of borrowers and interest rate modality. Segment S1, as defined by the Central Bank of Brazil, is composed of systemically important banks whose characteristics are a size equals to or bigger than 10% of the Brazil GDP or a relevant international activity, regardless its size. Regarding the proprietorship, a financial institution might be either private- or public-owned and the capital origin might be either domestic or foreign. There are two types of borrowers, represented by households (HH) and non-financial corporations (NFC). Loans for NFC are categorized in 12 modalities, while for HH in 11 modalities. All HH modalities and the majority of NFC modalities have fixed interest rates (Fixed). For NFC, three loan modalities have floating interest rates (Float) and one has foreign-currency-indexed (FCI) interest rate. This later modality is used as a placebo in the empirical evidence, given that there should be no pass-through from the domestic rates to the FCI rate. In order to avoid estimation biases, we trimmed outliers above the 97^{th} percentile of each modality. Descriptive statistics for the whole sample are reported in Table 1. Table 2 describes the distribution of loan modalities and financial institutions by borrower and lender types.

This dataset contains more accurate information and covers an updated period when compared to other studies (Pereira and Maia-Filho, 2013; Castro and Mello, 2012; Coelho et al., 2010). According to the Central Bank of Brazil, in the new database of credit operations, the data coverage was extended and the operations were reclassified to meet needs

Table 1: Descriptive statistics

Modality	Observations	Mean	Std. dev.	Minimum	25%	Median	75%	Maximum
Households								
CC financing	3,611	137.3	42.7	15.1	103.2	145.9	166.3	226.6
CC revolving	4,035	384.2	154.8	53.9	253.8	399.5	495.5	662.3
Discount - checks	1,259	51.5	11.0	26.9	42.3	51.4	60.6	70.8
Other goods financing	3,468	49.5	24.5	2.1	29.6	44.3	66.4	118.6
Overdraft	3,732	201.9	106.0	12.7	101.4	207.6	292.5	422.3
Payroll-deducted - private	4,914	36.2	8.8	0.0	29.9	35.7	41.2	56.8
Payroll-deducted - public	4,630	25.4	3.2	11.6	23.0	25.4	27.8	32.8
Payroll-deducted - retirees	5,184	27.4	2.5	15.9	26.1	27.6	28.9	32.3
Personal credit	4,992	84.7	57.4	0.0	51.6	70.9	93.2	293.4
Vehicle financing	5,190	22.0	4.4	9.8	19.3	22.4	25.3	30.2
Vehicle leasing	1,408	17.7	4.1	7.5	14.7	17.2	20.3	29.8
Non-financial corporations								
ACC (FCI)	5,995	4.2	1.7	0.0	2.9	4.0	5.4	8.8
Discount - CC bills	2,095	31.1	12.0	6.6	20.6	32.6	40.3	54.8
Discount - checks	2,834	34.6	7.8	15.8	28.6	34.9	40.6	48.6
Discount - trade bills	4,542	26.3	10.1	0.0	18.9	26.4	33.8	49.6
Guaranteed overdrat	3,689	51.7	32.3	9.6	31.2	39.5	62.9	192.2
Guaranteed overdrat (Float)	5,542	22.4	4.8	7.2	19.2	22.0	25.1	36.3
Overdraft	3,581	196.6	101.6	42.7	92.1	185.7	281.4	370.9
Vendor	2,905	16.6	3.6	3.2	14.0	16.2	18.9	27.2
Working capital ∼365	4,859	24.8	9.5	0.0	18.0	22.4	29.9	53.4
Working capital ∼365 (Float)	5,151	17.8	4.5	3.7	14.5	17.5	20.7	30.7
Working capital 365∼	4,386	23.6	8.6	0.0	17.2	21.9	28.4	50.9
Working capital 365∼ (Float)	4,550	16.5	3.8	1.7	13.8	16.2	19.0	27.6
Selic								
Selic rate	378	10.1	2.8	6.4	7.2	10.2	12.9	14.2
Selic expectation	14,390	10.0	2.8	6.0	7.2	10.0	12.8	15.2

Notes: Interest rates are non-weighted and in percent values. CC and ACC stand for credit card and advances on exchange contracts; FCI designates foreign-currency-indexed interest rate.

Table 2: Number of observations and financial institutions by borrower and lender types

	All financial institutions				S1 financial institutions			
	Total	Public	Private	Foreign	Total	Public	Private	Foreign
Number of observations								
Total	92,552	21,279	48,528	22,745	52,002	13,893	28,335	9,774
Households	42,423	9,865	23,981	8,577	27,978	6,595	15,950	5,433
Non-financial corporations	50,129	11,414	24,547	14,168	24,024	7,298	12,385	4,341
Number of financial institutions								
Total	57	4	34	19	30	3	20	7
Households	49	4	33	12	30	3	20	7
Non-financial corporations	32	3	17	12	11	2	7	2

Note: S1 is for systemically important banks.

for households and corporate financing.[9] Another distinguish feature is that Selic expectations are uniquely identified by financial institutions, unlike earlier information on aggregate expectations by the mean or median across financial institutions. A potential limitation, however, is that data with weekly figures of interest rates by financial institutions are only available after the year of 2012. Nonetheless, all modalities of loan interest rates are freely negotiated between financial institutions and borrowers, meaning that they are market rates.

[9]See BCB's methodological notes in https://www.bcb.gov.br/content/statistics/methodologicalnotes_docs/financialsystemloans/notaempri.pdf and https://www.bcb.gov.br/content/statistics/methodologicalnotes_docs/financialsystemloans/notaempr201502i.pdf.

3. Empirical strategy

We are interested in testing the following hypotheses:

Hypothesis 1. *There is overshooting pass-through from the observed and expected policy rates to the lending interest rates.*

Hypothesis 2. *The observed and expected interest rate pass-through are positively asymmetric, meaning that the financial institutions avoid downward lending interest rates adjustments.*

To test these hypotheses, we propose a panel-based approach to investigate how changes in the observed Over-Selic rate and expected Over-Selic rate might affect lending interest rates in the Brazilian economy. The fixed effects estimation controls for unobserved individual heterogeneity, which is a relevant feature among financial institutions and loan modalities. Panels are unbalanced because financial institutions are not obligated to report Selic expectations to the Focus survey of the Central Bank of Brazil and we trimmed outliers above the 97^{th} percentile of each loan modality.[10] The next sections report the empirical models and discuss the major results.

3.1. Baseline specification

In order to have a comprehensive view of the interest rate pass-through, we use not only aggregate data, but also sub-samples by lending rate modalities and type of borrowers. This is rather relevant due to the heterogeneity in interest rate modalities, as illustrated in Table 1 and Figures 1 and 2. The overall sample comprises all modalities except credit card revolving and advances on exchange contracts (ACC). There is a structural break in the former[11] and the funding of the latter comes from the foreign market, whose interest rate is

[10] As a robustness check, we also used winsorized data by setting the top 3% to the 97^{th} percentile. The results were similar and are available from the authors upon request.

[11] National Monetary Council Resolution 4,549 of 2017 (http://www.bcb.gov.br/pre/normativos/busca/downloadNormativo.asp?arquivo=/Lists/Normativos/Attachments/50330/Res_4549_v1_O.pdf) states that the outstanding balance in the credit card invoice, once not completely paid at the due date, may be financed by revolving credit only until the next invoice. This measure led consumers to settle down the debt in full, to pay it in instalments, or to seek more advantageous credit sources for financing the debt. The new rule has become effective in April 3^{rd}, 2017.

not affected by the domestic monetary policy.[12] Sub-samples by household (HH) and non-financial corporation (NFC) loans also do not include these modalities. In addition to the overall sample and two sub-samples, we also estimate panels for each one of the 23 lending rate modalities across all financial institutions. Considering the fact that we estimate the pass-through for both observed and expected Over-Selic rates, there are 52 panels in total in the empirical analysis. The baseline model is:

$$LendingRate_{m,i,t} = \alpha + \beta BaseRate_{i,t} + C_t\delta + \varepsilon_{m,i,t} \tag{1}$$

where $LendingRate_{m,i,t}$ is the lending rate of modality m and financial institution i during time t, $BaseRate_{i,t}$ is the explanatory variable (either observed or expected Over-Selic rate), C_t is a row vector of control variables, and $\varepsilon_{m,i,t}$ is the compound error term. Let's define $A \equiv [Inflation_t^e \quad EMBI_t]$, where $Inflation_t^e$ is the 12-months-ahead expected inflation rate and $EMBI_t$ is the EMBI+ Brazil index, used as a proxy for risk perception.[13] We have $C_t = A$, except for two sub-samples. First, $C_t = [A \quad D(CC)_t \quad BaseRate_{i,t} \times D(CC)_t]$ for Credit card revolving, where $D(CC)_t$ is a dummy variable for the structural change in the rules of this loan modality. $D(CC)_t$ accounts for the change in level while $BaseRate_{i,t} \times D(CC)_t$ for the change in slope or in the pass-through coefficient. Second, $C_t = [A \quad Libor_t]$ for ACC, where $Libor_t$ is the US dollar Libor rate. Since ACC funding comes from the foreign market, we consider the US dollar Libor rate as a proxy for the foreign funding cost. We assume the one-way error component model for the compound disturbance:

$$\varepsilon_{m,i,t} = \mu_{m,i} + \nu_{m,i,t} \tag{2}$$

[12] Advances on exchange contracts is a credit type directed at foreign trade, mainly to advance funds to exporters before payment by importers. Financial institutions that offer this type of credit line obtain funds from abroad and charge interest rates indexed to credit costs in the international markets. As stated earlier, it is included as a placebo in the analysis by loan rate modality because no pass-through should be observed from the domestic interest rates.

[13] We do not control for credit risk because this information is not available by loan modalities and financial institutions. We only had access to monthly default rates for some loan modalities that do not perfectly match any other in our weekly-basis sample. While controlling for credit risk of loan operations is relevant to explain interest rate margins (or spread), this might not be the case in the estimation of the degree of pass-through. The correlation between the credit risk by loan operations and the observed or expected Over Selic rates should not be higher enough to bias the estimates of the interest rate pass through.

where $\mu_{m,i}$ is the unobservable modality–financial institution specific effect and $\nu_{m,i,t}$ is the aggregate time varying disturbance.

Coefficients α and β are scalars while δ is a column vector. The explanatory variable $BaseRate_{i,t}$ is either the Over-Selic rate ($Selic_t$) or the identified expectations of the Over-Selic rate ($Expec_{i,t}$). Sub-index i is ineffective for the observed Over-Selic rate because it varies over time but not across financial institutions. The expected Over-Selic rate, however, is identified by financial institutions (professional forecasters) and so varies in both dimensions, i and t. The coefficient of primary interest is β. We should have $\beta > 1$ for overshooting interest rate pass-through (Hypothesis 1). In case $\beta = 0$, there is no pass-through, while $0 < \beta < 1$ and $\beta = 1$ means incomplete and full pass-through, respectively.[14]

We assume that $\mu_{m,i}$ is the modality-financial institution fixed effects. Hausman's and other specification tests might be used to check the alternative specifications of fixed-effects, random effects and pooled sample. We found evidence in favor of the consistent generalized least squares (GLS) estimator for the aggregate samples and 17 lending rate modalities. Nevertheless, instead of using different specifications, we choose to apply the fixed-effects estimator for the overall sample and all sub-samples. We prefer to lose efficiency, but get consistent estimators under eventual correlation between explanatory variables and the unobserved time-invariant component of the error term, $\mu_{m,i}$.[15]

The constraint $\sum_{m,i} \mu_{m,i} = 0$ is applied to compute the overall intercept, α, meaning that it makes the weighted average of fixed effects null. This condition equalizes the averages of the observed and fitted values, leaving the remaining fixed effects as deviations from the estimated lending rates. Additionally, under this constraint, the fixed-effects estimator, although less efficient, becomes adequate for estimating the random-effects model as well. The intercept, α, represents a constant average bank margin—or mark up, or interest rate

[14]Kopecky and Hoose (2012) developed a dynamic adjustment cost model with imperfect competition where bank retail deposit and loan rates depend on own lagged values and on lagged, current, and expected future values of the security rate, but without providing further empirical evidence. The problem with applying this framework is that the observed Over-Selic rate varies only over time and is highly correlated with the expected rate, which changes over time and by financial institutions. This prevented us from including both observed and expected Over-Selic rates in a unique panel-data pass-through regression. The results were meaningless and are available from the authors upon request.

[15]In a robustness check, we applied the random effects specifications to all regressions and there was no significant change in the results, which are available from the authors upon request.

spread—over the reference rate (e.g. Gregor et al., 2021; Banerjee et al., 2013). It is an average margin independent from the monetary policy upon the risk-free interest rate, the Over-Selic rate. It will also be computed as an expected average margin upon the expected Over-Selic rate identified by financial institutions.

We apply a robust variance-covariance matrix given by the Huber/White/sandwich estimator for within-groups, which is heteroskedasticity and serial correlation consistent according to Arellano (1987). Standard errors are clustered by loan modalities and financial institutions in the aggregate samples, and by financial institutions in the sub-samples.

3.2. Assymetric pass-through

In order to test for asymmetric responses of the loan interest rates to changes in the Over-Selic rate or expected Over-Selic rate (Hypothesis 2), we estimate the following model:

$$\begin{aligned} LendingRate_{m,i,t} = \; & \alpha + \beta BaseRate_{i,t} \\ & + \theta^{-} \left(BaseRate_{i,t} \times D(\Delta BaseRate < 0)_{i,t} \right) \\ & + \theta^{+} \left(BaseRate_{i,t} \times D(\Delta BaseRate > 0)_{i,t} \right) \\ & + \gamma^{-} D(\Delta BaseRate < 0)_{i,t} \\ & + \gamma^{+} D(\Delta BaseRate > 0)_{i,t} \\ & + C_t \delta + \varepsilon_{m,i,t} \end{aligned} \quad (3)$$

where $D(\Delta BaseRate < 0)_{i,t}$ and $D(\Delta BaseRate > 0)_{i,t}$ are dummy variables that assume values equal to 1 in the following cases (and zero otherwise): $D(\Delta Selic < 0)_t = 1$ for negative variation in the Selic rate, $D(\Delta Expec < 0)_{i,t} = 1$ for negative variation in the expected Selic rate, $D(\Delta Selic > 0)_t = 1$ for positive variation in the Selic rate, $D(\Delta Expec > 0)_{i,t} = 1$ for positive variation in the expected Selic rate. The compound error term, $\varepsilon_{m,i,t}$, follows the same specification described in Equation (2). We are interested in θ^{-} and θ^{+}, which capture the differentials in the pass-through coefficient due to decreases and increases in the Selic rate or the expected Selic rate, respectively. Differentials in the level of the loan interest rates are measured by γ^{-} and γ^{+}, and are included in the model to avoid bias in the estimated asymmetry coefficients. We cannot reject the hypothesis of positively asymmetric pass-

through (Hypothesis 2) when either $\theta^+ > 0$, $\theta^- < 0$, or $\theta^+ > 0$ and $\theta^- < 0$ simultaneously. In case $\theta^+ < 0$ and $\theta^- > 0$, either simultaneously or independently, then there is evidence of negatively asymmetric pass-through.

4. Results

4.1. Baseline interest rate pass-through

We first estimate the baseline model for the overall sample and the HH and NFC sub-samples, whose results are reported in Table 3. Confidence intervals for the coefficients of $Selic_t$ and $Expec_{i,t}$ indicate the existence of overshooting pass-through in all panels, with similar responses in the HH and NFC loan interest rates. The confidence intervals also suggest that the pass-through from the observed and expected policy interest rates to the loan rates are analogous in all samples. A remarkable difference, however, is the interest rate margins, α, which are clearly higher for HH loans.

Table 3: Interest rate pass-through.

Modality	Pass-through (β)	Interest rate margin (α)	Selic
Overall (1)	1.77^{***}	55.1^{***}	OBS
	(1.36, 2.18)	(47.9, 62.3)	
Overall (2)	1.80^{***}	57.0^{***}	EXP
	(1.37, 2.23)	(49.7, 64.3)	
Households (3)	1.78^{***}	74.3^{***}	OBS
	(1.07, 2.50)	(63.1, 85.5)	
Households (4)	1.79^{***}	76.2^{***}	EXP
	(1.04, 2.54)	(64.9, 87.5)	
Non-financial corporations (5)	1.76^{***}	38.1^{***}	OBS
	(1.33, 2.20)	(29.1, 47.1)	
Non-financial corporations (6)	1.82^{***}	40.0^{***}	EXP
	(1.37, 2.27)	(30.8, 49.3)	

Notes: *p<0.1; **p<0.05; ***p<0.01. 95% confidence interval in parentheses. Estimated with fixed effects. All regressions are controlled by expected inflation and EMBI. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

However, these apparently strong results should be interpreted with caution because of the wide heterogeneity in interest rate loan modalities in the overall sample as well in the HH and NFC sub-samples, as illustrated earlier. The disaggregation of the overall sample by HH and NFC sub-samples did not affect the degree of pass-through as the heterogeneity in the loan modalities is still high within each borrower category.

Table 4 increases the disaggregation and reports estimates by interest rate modalities. For HH interest rate modalities, there is no pass-through from both observed and expected Over-Selic only for the Credit card financing rate (panels 1 and 2). Two modalities—Credit

card revolving rate (3 and 4) and Personal credit rate (17 and 18)—revealed significant β for the Selic rate, but not for the expected Selic rate. For all remaining interest rate modalities, however, there is evidence of pass-through at the 95% confidence level from both observed and expected Selic rates.

Table 4: Interest rate pass-through by loan modalities.

Households				*Non-financial corporations*			
Modality	Pass-through (β)	Interest rate $margin(\alpha)$	Selic	Modality	Pass-through (β)	Interest rate $margin(\alpha)$	Selic
CC financing (1)	2.44	151.8***	OBS	ACC (1)	0.00	3.4***	OBS
	(-0.53, 5.40)	(115.5, 188.2)			(-0.05, 0.06)	(2.3, 4.4)	
CC financing (2)	2.41	154.0***	EXP	ACC (2)	-0.02	3.6***	EXP
	(-0.69, 5.50)	(119.9, 188.2)			(-0.07, 0.03)	(2.5, 4.7)	
CC revolving (3)	17.07***	361.6***	OBS	Discount - CC bills (3)	2.96***	8.3	OBS
	(8.03, 26.11)	(236.1, 487.0)			(2.23, 3.69)	(-8.4, 25.0)	
CC revolving (4)	7.14*	499.1***	EXP	Discount - CC bills (4)	3.07***	11.6*	EXP
	(-0.15, 14.42)	(369.9, 628.3)			(2.21, 3.92)	(-4.2, 27.3)	
Discount - checks (5)	1.31***	42.9***	OBS	Discount - checks (5)	1.38***	31.4***	OBS
	(0.63, 1.98)	(35.4, 50.4)			(1.22, 1.54)	(25.0, 37.8)	
Discount - checks (6)	1.44***	44.5***	EXP	Discount - checks (6)	1.40***	32.8***	EXP
	(0.65, 2.24)	(37.9, 51.1)			(1.22, 1.58)	(26.5, 39.1)	
Other goods financing (7)	1.82***	51.4***	OBS	Discount - trade bills (7)	1.66***	11.2***	OBS
	(0.72, 2.91)	(36.0, 66.8)			(1.17, 2.15)	(4.5, 18.0)	
Other goods financing (8)	1.59***	52.4***	EXP	Discount - trade bills (8)	1.69***	13.0***	EXP
	(0.68, 2.50)	(38.0, 66.8)			(1.16, 2.21)	(6.5, 19.5)	
Overdraft (9)	6.34***	312.9***	OBS	Garanteed overdraft (9)	2.34**	45.4***	OBS
	(3.18, 9.49)	(276.3, 349.4)			(0.49, 4.19)	(33.6, 57.3)	
Overdraft (10)	6.81***	321.3***	EXP	Garanteed overdraft (10)	2.28**	47.6***	EXP
	(3.55, 10.08)	(283.2, 359.4)			(0.41, 4.14)	(36.4, 58.8)	
Payroll-deducted (11) - private	0.85***	34.8***	OBS	Garanteed overdraft (11) (Float)	1.00***	12.8***	OBS
	(0.54, 1.16)	(32.0, 37.5)			(0.81, 1.19)	(9.8, 15.8)	
Payroll-deducted (12) - private	0.86***	35.7***	EXP	Garanteed overdraft (12) (Float)	1.03***	14.0***	EXP
	(0.52, 1.19)	(32.9, 38.6)			(0.84, 1.22)	(11.1, 16.9)	
Payroll-deducted (13) - public	0.65***	22.1***	OBS	Overdraft (13)	7.13***	295.1***	OBS
	(0.47, 0.82)	(19.9, 24.4)			(4.24, 10.02)	(223.0, 367.1)	
Payroll-deducted (14) - public	0.64***	22.8***	EXP	Overdraft (14)	7.34***	303.0***	EXP
	(0.45, 0.83)	(20.6, 24.9)			(4.30, 10.38)	(229.2, 376.9)	
Payroll-deducted (15) - retirees	0.59***	23.4***	OBS	Vendor (15)	0.82***	10.7***	OBS
	(0.48, 0.70)	(22.0, 24.8)			(0.62, 1.02)	(7.4, 13.9)	
Payroll-deducted (16) - retirees	0.59***	24.1***	EXP	Vendor (16)	0.83***	11.5***	EXP
	(0.48, 0.71)	(22.7, 25.4)			(0.61, 1.05)	(8.5, 14.5)	
Personal credit (17)	2.53**	75.4***	OBS	Working capital (17) ∼365	1.21***	17.0***	OBS
	(0.09, 4.98)	(36.8, 113.9)			(0.84, 1.58)	(9.3, 24.7)	
Personal credit (18)	2.43*	77.8***	EXP	Working capital (18) ∼365	1.26***	18.4***	EXP
	(-0.25, 5.11)	(41.7, 113.9)			(0.87, 1.64)	(10.9, 25.8)	
Vehicle financing (19)	0.66***	17.7***	OBS	Working capital (19) ∼365 (Float)	0.90***	6.2***	OBS
	(0.49, 0.83)	(15.7, 19.7)			(0.77, 1.03)	(4.5, 8.0)	
Vehicle financing (20)	0.69***	18.4***	EXP	Working capital (20) ∼365 (Float)	0.96***	7.4***	EXP
	(0.51, 0.87)	(16.4, 20.4)			(0.82, 1.11)	(5.7, 9.1)	
Vehicle leasing (21)	0.61***	13.8***	OBS	Working capital (21) 365∼	1.12***	10.6***	OBS
	(0.29, 0.93)	(7.6, 19.9)			(0.77, 1.47)	(4.6, 16.6)	
Vehicle leasing (22)	0.65***	14.5***	EXP	Working capital (22) 365∼	1.20***	12.0***	EXP
	(0.28, 1.02)	(8.7, 20.3)			(0.81, 1.59)	(6.3, 17.7)	
				Working capital (23) 365∼ (Float)	0.74***	5.1***	OBS
					(0.52, 0.95)	(3.8, 6.4)	
				Working capital (24) 365∼ (Float)	0.78***	6.0***	EXP
					(0.56, 1.01)	(4.6, 7.5)	

Notes: *p<0.1; **p<0.05; ***p<0.01. 95% confidence interval in parentheses. Estimated with fixed effects. CC is for credit cards and ACC is for advances on exchange contracts. All regressions are controlled by expected inflation and EMBI. CC revolving is also controlled by the structural change in the rules of this loan modality, and ACC is also controlled by the Libor rate. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

The estimated confidence intervals indicate incomplete pass-through for three modalities—Payroll-deducted loans to public sector employees (13 and 14), Payroll-deducted loans to retirees (15 and 16), and Vehicle financing (19 and 20)—and full pass-through for four other modalities—Discount of checks (5 and 6), Other goods financing (7 and 8), Payroll-deducted

loans to private sector employees (11 and 12), and Personal credit (17). One modality—Vehicle leasing (21 and 22)—shows incomplete pass-through from the Selic rate, but full pass-through from the expected Selic rate. An interesting result is that, for Credit card revolving (3) and Overdraft (9 and 10), there is evidence of overshooting pass-through, similarly to the estimates for the overall, HH and NFC samples reported in Table 3. Credit card revolving and Overdraft are the most expensive credit lines and have the highest margins in the sample, suggesting that the overshooting pass-through was not found merely by chance.

Estimated pass-through from the expected Selic rate (even-numbered panels), in general, confirm the findings from the observed Selic rate (odd-numbered panels) and the degrees of pass-through are very similar when changing between them for a given loan modality. The only exception is Credit card revolving rate (3 and 4), where the pass-through for the expected Selic rate was not statistically significant at the 5% level. One possible explanation is a potential structural break resulting from the legal change in the Credit card revolving rules. This legal change was announced some months before the effective implementation, allowing for the financial institutions and borrowers to adjust behaviors in advance.

Results for NFC are even more homogeneous. Estimated pass-through coefficients are statistically significant for all modalities, except for Advances on exchange contracts (panels 1 and 2) as expected because it was used as a placebo.[16] There is overshooting pass-through for the following modalities: Discount of credit card bills (3 and 4), Discount of checks (5 and 6), Discount of trade bills (7 and 8), and Overdraft (13 and 14). Not a coincidence, the highest interest rate margin is coupled with the highest degree of overshooting pass-through for the Overdraft modality under both observed and expected Selic rate. For the other NFC modalities, the pass-through is complete for both observed and expected Selic rates. The only exceptions are Working capital over 365 days and floating rate (23 and 24), which showed incomplete pass-through under the observed Selic rate.

Similarly to the HH results, the NFC modalities with higher loan interest rates also revealed less rigidity and overshooting pass-through. The top five most expensive modalities, considering the average interest rates, also presented the highest pass-through coefficients.

[16] As explained earlier, funding for this modality comes from abroad and is not related to the domestic interest rates.

Among them, only for Guaranteed overdraft fixed rates (9 and 10) there is evidence of full, but not overshooting, pass-through. Similarly to the HH modalities, the estimated degrees of pass-through are very similar for both observed and expected selic rates, indicating that financial institutions successfully forecasts the next target level of the Over-Selic rate and adjust in advance their lending interest rates.

The interest rate margins, α, are positive and well dispersed across the loan modalities. It is not statistically significant only for Discount of credit card bills of NFC. There is a striking pattern of positive correlation between the margins and the degrees of pass-through, as reported in Figure 4. The correlations are very strong, irrespective of the borrower category (HH or NFC) or Selic rate (observed or expected). The positive slopes of the fitted regressions illustrate that modalities with the highest margins also present overshooting degrees of pass-through. While the margins in Figure 4 might be correlated with the risk levels by modalities and borrower types, the degree of pass-through is also bigger for riskier loans. There are other factors that might affect margins, such as operating, administrative and taxing costs, but banks claim that the risk of default is a key component of the interest rate spread.[17]

It is worth highlight that the heterogeneity in lending rates shall be taken into account when assessing the pass-through from the observed or expected policy rates. Loan modalities with higher rates and margins appear to show lower stickiness and overshooting degrees of pass-through. The prevalence of full and overshooting pass-through differs from previous findings by Holton and d'Acri (2018) and Hristov et al. (2014), but is in line with Coelho et al. (2010), who accounted for the concentration in the Brazilian banking system.

4.2. Asymmetric interest rate pass-through

We estimate Equation (3) to evaluate asymmetry in the interest rate pass-through and the results are reported in Table 5. The estimates of θ^- and θ^+ measure the asymmetric effects of changes in the observed or expected Selic rates on the degree of pass-through for

[17]The Central Bank of Brazil Banking Report 2018 brings a decomposition of the average cost of outstanding loans in which delinquency — losses arising from non-payment of debts or interest and discounts granted — represented 23% of the total cost and 37% of the spread in the last three years. The report is available at https://www.bcb.gov.br/content/publications/bankingreport/BAR_2018.pdf.

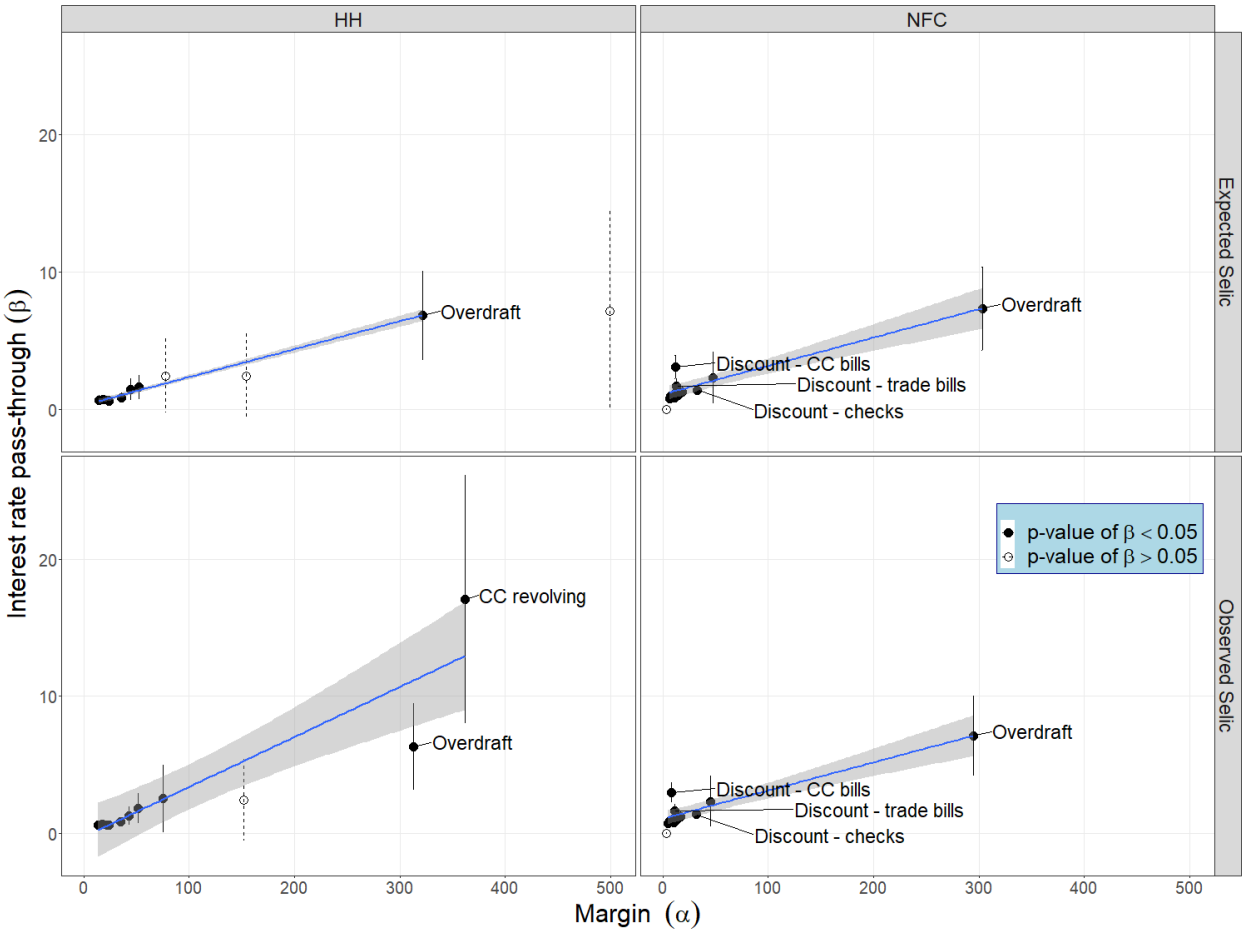

Figure 4: Interest rate margins and degrees of pass-through for both observed and expected Selic rates
Notes: The figure reports the margins (α) and the degrees of pass-through (β) by type of borrower (HH and NFC) and policy rate (observed and expected Selic). Filled dots are for statistically significant β, while open dots are for non-statistically significant β. Vertical bars represent the 95% confidence interval for β. Shaded areas are the 95% confidence interval for predictions by a linear model with significant β's. Modalities with overshooting pass-through are highlighted with their type of loans.

distinct lending rates. They are not statistically significant for the HH sub-sample, but θ^- is negative and statistically significant for the overall sample and NFC sub-sample, meaning lower pass-through under decreases in the policy rates. On the contrary, none of the estimates for θ^+ is statistically significant. HH and NFC sub-samples have different findings, as there are significant asymmetric effects only for the latter. To account for the heterogeneity, we disaggregate the sub-samples by loan modalities.

For the HH sub-sample, Table 6 reveals that four modalities—Overdraft (panels 9 and 10), Payroll-deducted loans to public sector employees (14), Payroll-deducted loans to retirees (15 and 16), and Vehicle financing (20)—show statistically significant asymmetry for either

Table 5: Asymmetric interest rate pass-through.

Modality	Pass-through (β)	Asymmetry (θ^-)	Asymmetry (θ^+)	Selic
Overall (1)	1.80***	-0.24**	-0.19	OBS
	(1.39, 2.22)	(-0.44, -0.03)	(-0.50, 0.12)	
Overall (2)	1.84***	-0.30**	-0.13	EXP
	(1.41, 2.28)	(-0.54, -0.06)	(-0.33, 0.07)	
Households (3)	1.82***	-0.22	-0.22	OBS
	(1.09, 2.54)	(-0.56, 0.13)	(-0.87, 0.43)	
Households (4)	1.83***	-0.21	-0.12	EXP
	(1.08, 2.59)	(-0.65, 0.23)	(-0.51, 0.27)	
Non-financial corporations (5)	1.80***	-0.28**	-0.13	OBS
	(1.35, 2.24)	(-0.51, -0.04)	(-0.37, 0.11)	
Non-financial corporations (6)	1.86***	-0.38***	-0.11	EXP
	(1.39, 2.33)	(-0.62, -0.15)	(-0.29, 0.08)	

Notes: *p<0.1; **p<0.05; ***p<0.01. 95% confidence interval in parentheses. Estimated with fixed effects. All regressions are controlled by expected inflation and EMBI. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

observed or expected Selic rates. For the majority of these modalities, decreases in policy rate are coupled with smaller degree of pass-through when compared to increases in this rate. Only Payroll-deducted loans to retirees revealed an opposite behavior. The coefficient θ^+ is negative for credit card financing, but β is not statistically significant for this modality.

There is statistically significant asymmetry for five NFC modalities, represented by Discount of checks (panel 6), Overdraft (13 and 14), Working capital up to 365 days and floating rate (19), Discount of credit card bills (3 and 4), and Vendor (16), as reported in Table 6. For the first three, the asymmetry is positive while for the last two it is negative. The results are inconclusive for Discount of trade bills (7 and 8), since both θ^- and θ^+ are negative and statistically significant in the observed Selic rate regression.

In summary, out of the 23 loan modalities, 9 revealed asymmetric interest rate pass-through for the observed, expected or both Selic rates. Among them, there is evidence of positive asymmetry for six modalities. The negative estimates for θ^- or positive for θ^+ imply smaller degrees of pass-through for decreases and higher for increases in the observed or expected Selic rates, respectively. These findings are in line with the argument that higher rigidity occurs for movements in interest rates that might decrease the banks' profitability (e.g. Castro and Mello, 2012; Chong, 2010; Liu et al., 2008; Neumark and Sharpe, 1992; Hannan and Berger, 1991). Despite the asymmetry in some loan modalities, in general, the pass-through coefficients and their confidence intervals have not significantly changed relatively to the baseline estimates, confirming the previous findings.

Table 6: Asymmetric interest rate pass-through by loan modalities.

Households					*Non-financial corporations*				
Modality	Pass-through (β)	Asymmetry (θ^-)	Asymmetry (θ^+)	Selic	Modality	Pass-through (β)	Asymmetry (θ^-)	Asymmetry (θ^+)	Selic
CC financing (1)	2.43 (-0.54, 5.40)	0.24 (-0.88, 1.37)	-9.12*** (-13.51, -4.73)	OBS	ACC (1)	0.01 (-0.04, 0.07)	-0.06** (-0.11, -0.00)	-0.09** (-0.17, -0.02)	OBS
CC financing (2)	2.40 (-0.72, 5.53)	0.03 (-1.55, 1.61)	-1.32*** (-2.22, -0.43)	EXP	ACC (2)	-0.02 (-0.07, 0.03)	-0.03 (-0.08, 0.02)	-0.04* (-0.08, 0.00)	EXP
CC revolving (3)	18.20*** (8.82, 27.58)	0.20 (-3.80, 4.19)	-11.39* (-24.89, 2.11)	OBS	Discount - CC bills (3)	2.98*** (2.25, 3.71)	0.00 (-0.50, 0.50)	-0.58** (-1.02, -0.13)	OBS
CC revolving (4)	8.08** (0.38, 15.77)	0.16 (-3.50, 3.83)	-2.32 (-5.94, 1.30)	EXP	Discount - CC bills (4)	3.06*** (2.23, 3.90)	-0.05 (-0.72, 0.63)	-0.44*** (-0.70, -0.17)	EXP
Discount - checks (5)	1.28*** (0.59, 1.97)	0.09* (-0.01, 0.19)	0.44* (-0.07, 0.96)	OBS	Discount - checks (5)	1.38*** (1.23, 1.54)	-0.07 (-0.19, 0.05)	-0.01 (-0.33, 0.31)	OBS
Discount - checks (6)	1.39*** (0.57, 2.21)	0.14* (-0.02, 0.31)	0.16 (-0.42, 0.75)	EXP	Discount - checks (6)	1.41*** (1.23, 1.59)	-0.19** (-0.38, -0.01)	0.04 (-0.10, 0.18)	EXP
Other goods financing (7)	1.87*** (0.74, 3.00)	-0.66 (-1.54, 0.23)	-0.58 (-1.63, 0.48)	OBS	Discount - trade bills (7)	1.69*** (1.21, 2.18)	-0.31** (-0.57, -0.05)	-0.44** (-0.86, -0.02)	OBS
Other goods financing (8)	1.67*** (0.73, 2.61)	-1.46 (-3.33, 0.42)	-0.36 (-1.05, 0.34)	EXP	Discount - trade bills (8)	1.70*** (1.17, 2.22)	-0.19** (-0.38, -0.00)	-0.10 (-0.29, 0.08)	EXP
Overdraft (9)	6.22*** (2.91, 9.53)	-0.96 (-3.14, 1.22)	5.28*** (2.69, 7.86)	OBS	Garanteed overdraft (9)	2.52** (0.59, 4.46)	-1.64* (-3.60, 0.31)	-1.11 (-2.72, 0.50)	OBS
Overdraft (10)	7.03*** (3.74, 10.31)	-2.18* (-4.51, 0.16)	2.61** (0.42, 4.80)	EXP	Garanteed overdraft (10)	2.33** (0.41, 4.25)	-0.43 (-1.58, 0.72)	-0.55 (-1.87, 0.76)	EXP
Payroll-deducted (11) - private	0.86*** (0.56, 1.17)	-0.06 (-0.27, 0.15)	-0.14 (-0.50, 0.22)	OBS	Garanteed overdraft (11) (Float)	1.00*** (0.81, 1.20)	-0.05 (-0.19, 0.10)	-0.08 (-0.33, 0.16)	OBS
Payroll-deducted (12) - private	0.87*** (0.52, 1.21)	-0.07 (-0.26, 0.12)	-0.08 (-0.25, 0.08)	EXP	Garanteed overdraft (12) (Float)	1.03*** (0.84, 1.23)	-0.08 (-0.23, 0.07)	-0.07 (-0.22, 0.08)	EXP
Payroll-deducted (13) - public	0.65*** (0.47, 0.83)	-0.08* (-0.16, 0.00)	-0.01 (-0.19, 0.16)	OBS	Overdraft (13)	7.32*** (4.35, 10.29)	-2.13** (-3.80, -0.47)	1.01 (-1.63, 3.65)	OBS
Payroll-deducted (14) - public	0.64*** (0.44, 0.84)	-0.13*** (-0.23, -0.04)	0.03 (-0.05, 0.12)	EXP	Overdraft (14)	7.68*** (4.63, 10.74)	-3.52*** (-5.09, -1.95)	0.31 (-1.74, 2.35)	EXP
Payroll-deducted (15) - retirees	0.60*** (0.49, 0.70)	0.00 (-0.03, 0.04)	-0.19*** (-0.30, -0.08)	OBS	Vendor (15)	0.83*** (0.64, 1.02)	-0.06 (-0.25, 0.13)	-0.07* (-0.13, 0.00)	OBS
Payroll-deducted (16) - retirees	0.59*** (0.47, 0.71)	-0.01 (-0.07, 0.05)	-0.09** (-0.17, -0.01)	EXP	Vendor (16)	0.83*** (0.61, 1.05)	-0.03 (-0.14, 0.08)	-0.14*** (-0.23, -0.05)	EXP
Personal credit (17)	2.69** (0.30, 5.08)	-0.53 (-1.74, 0.69)	-1.90* (-3.96, 0.16)	OBS	Working capital (17) ∼365	1.20*** (0.82, 1.57)	0.10 (-0.20, 0.40)	0.14 (-0.25, 0.53)	OBS
Personal credit (18)	2.41* (-0.28, 5.09)	0.84 (-0.22, 1.90)	-0.46 (-1.19, 0.28)	EXP	Working capital (18) ∼365	1.26*** (0.85, 1.66)	-0.14 (-0.42, 0.14)	0.05 (-0.15, 0.25)	EXP
Vehicle financing (19)	0.65*** (0.48, 0.83)	-0.00 (-0.09, 0.08)	0.15* (-0.02, 0.33)	OBS	Working capital (19) ∼365 (Float)	0.91*** (0.77, 1.04)	-0.13*** (-0.21, -0.05)	0.06 (-0.02, 0.14)	OBS
Vehicle financing (20)	0.70*** (0.51, 0.88)	-0.11*** (-0.19, -0.03)	0.01 (-0.08, 0.10)	EXP	Working capital (20) ∼365 (Float)	0.97*** (0.82, 1.11)	-0.05 (-0.17, 0.08)	0.01 (-0.09, 0.11)	EXP
Vehicle leasing (21)	0.61*** (0.28, 0.93)	-0.17 (-0.40, 0.07)	0.18* (-0.02, 0.38)	OBS	Working capital (21) 365∼	1.11*** (0.77, 1.46)	-0.03 (-0.21, 0.16)	0.16 (-0.05, 0.37)	OBS
Vehicle leasing (22)	0.64*** (0.27, 1.00)	0.04 (-0.22, 0.30)	0.16 (-0.08, 0.39)	EXP	Working capital (22) 365∼	1.21*** (0.82, 1.60)	-0.16* (-0.33, 0.00)	0.09 (-0.02, 0.19)	EXP
					Working capital (23) 365∼ (Float)	0.73*** (0.51, 0.95)	0.06 (-0.08, 0.19)	-0.06 (-0.20, 0.08)	OBS
					Working capital (24) 365∼ (Float)	0.78*** (0.55, 1.01)	-0.03 (-0.11, 0.06)	-0.04 (-0.13, 0.06)	EXP

Notes: *p<0.1; **p<0.05; ***p<0.01. 95% confidence interval in parentheses. Estimated with fixed effects. CC is for credit cards and ACC is for advances on exchange contracts. All regressions are controlled by expected inflation and EMBI. CC revolving is also controlled by the structural change in the rules of this loan modality, and ACC is also controlled by the Libor rate. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

5. Alternative specifications and robustness checks

We examine whether the degrees of pass-through for the loan interest rates reported in Section 4.1 are robust to alternative model specifications. First, we control for size, ownership type and capital origin of the financial institutions. Then, we allow for persistence in the loan interest rates and consider the effects of partial adjustment in a dynamic panel data environment.

5.1. Financial-institutions specific characteristics

In the previously estimated models, we accounted for macroeconomic conditions (expected inflation, sovereign risk, foreign interest rate) and a modality-specific dummy variable to control for a structural change in credit card revolving rules. However, as discussed in Section 1, specific characteristics of the financial institutions might potentially affect the interest rate pass-through. Size, ownership type (private or public) and capital origin (domestic or foreign) of the financial institution are some of the specific characteristics explicitly accounted for in the estimation of the following model:

$$\begin{aligned} LendingRate_{m,i,t} = \; & \alpha + \beta BaseRate_{i,t} \\ & + \sigma \left(BaseRate_{i,t} \times D(\text{non-S1})_i \right) \\ & + \psi \left(BaseRate_{i,t} \times D(\text{Public})_i \right) \\ & + \phi \left(BaseRate_{i,t} \times D(\text{Foreign})_i \right) \\ & + C_t \delta + \varepsilon_{m,i,t}, \quad (4) \end{aligned}$$

where the dummies $D(\text{non-S1})_i$, $D(\text{Public})_i$, and $D(\text{Foreign})_i$ are equal to one for non-systemically important institutions, public-owned government institutions and foreign-controlled private institutions, respectively, and equal to zero otherwise. The term $\varepsilon_{m,i,t}$ follows the one-way error component model described by Equation (2).

Since financial-institution-specific effects, such as those captured by $D(\text{non-S1})_i$, $D(\text{Public})_i$, and $D(\text{Foreign})_i$, are already accounted for in the fixed-effects component, $\mu_{m,i}$, the inclusion of level dummies has no role in the estimation. However, their interactions with the observed and expected Selic rates measure disproportional effects from different types of financial institutions in the degree of pass-through. The estimates of β are now for systemically important (S1), private and domestic financial institutions, while the coefficients σ, ψ, and ϕ captures the differentials in the degree of pass-through for non-systemically important, public-owned, and foreign-controlled financial institutions, respectively.

The results for the complete sample and sub-samples by HH and NFC lending rates are reported in Table 7. None of the interaction coefficients between the dummy variables and either the observed or expected Selic rates was statistically significant at the 5% significance

level. Therefore, the previous findings were not driven by the financial-institutions specific characteristics in the overall sample and two sub-samples.

Table 7: Pass-through controlling for size and ownership of the financial institutions.

Modality	Pass-through (β)	Size (σ)	Ownership (ψ)	Origin (ϕ)	Selic
Overall (1)	1.79***	-0.06	0.03	-0.02	OBS
	(1.12, 2.46)	(-0.68, 0.56)	(-0.79, 0.86)	(-0.74, 0.69)	
Overall (2)	1.83***	0.04	-0.20	0.01	EXP
	(1.16, 2.50)	(-0.55, 0.63)	(-0.98, 0.59)	(-0.66, 0.67)	
Households (3)	1.49***	0.43	0.14	0.55	OBS
	(0.40, 2.58)	(-0.81, 1.68)	(-1.34, 1.62)	(-0.93, 2.03)	
Households (4)	1.55***	0.47	-0.13	0.57	EXP
	(0.45, 2.66)	(-0.70, 1.65)	(-1.56, 1.30)	(-0.80, 1.94)	
Non-financial corporations (5)	2.19***	-0.54*	-0.17	-0.41	OBS
	(1.46, 2.92)	(-1.15, 0.08)	(-0.86, 0.53)	(-1.11, 0.28)	
Non-financial corporations (6)	2.22***	-0.41	-0.35	-0.39	EXP
	(1.51, 2.93)	(-0.98, 0.16)	(-0.98, 0.27)	(-1.02, 0.23)	

Notes: *p<0.1; **p<0.05; ***p<0.01. 95% confidence interval in parentheses. Estimated with fixed effects. All regressions are controlled by expected inflation and EMBI. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

Taking into account the heterogeneity in the loan operations, the results for the HH lending rates are reported in Table 8. In general, the previous findings by HH modalities are also robust to the inclusion of the new dummy variables. The non-systemically important financial institutions yield a significant differential in the degree of pass-through only for Discount of checks (panels 5 and 6), Overdraft (9) and Payroll-deducted loans to retirees (15 and 16), but with no specific pattern among these modalities and similar effects for both observed and expected Selic rates. For Other goods financing (7 and 8), β was not statistically significant, meaning that the non-S1 institutions might have driven the estimated pass-through in the baseline specification. On the other hand, the public-owned government banks, whenever statistically significant, yielded positive differentials for the estimated degrees of pass-through, except for Credit card revolving (3 and 4) where it was negative. This was the case for Discount of checks (5 and 6), Payroll-deducted loans to retirees (15 and 16) and Vehicles leasing (21 and 22). Finally, foreign-controlled financial institutions, except for Discount of checks (panels 5 and 6) and Vehicles leasing (21 and 22), yielded positive differentials for the pass-through whenever statistically significant. This also happened with Overdraft (9), Payroll-deducted loans to public sector employees (13 and 14), and Payroll-deducted loans to retirees (15 and 16). Interesting to notice that these differentials are very similar for either the observed or expected Selic rates in the regressions, confirming that financial institutions correctly anticipated the next target level of the policy interest rate

regardless of their specific characteristics.

Table 8: Pass-through for HH loans controlling for size and ownership of the financial institutions.

Modality	Pass-through (β)	Size (σ)	Ownership (ψ)	Origin (ϕ)	Selic
CC financing (1)	1.80	4.84	-5.59	3.30	OBS
	(-1.81, 5.40)	(-1.13, 10.81)	(-12.50, 1.31)	(-0.70, 7.29)	
CC financing (2)	1.85	4.80	-6.04*	3.01	EXP
	(-1.70, 5.41)	(-0.94, 10.54)	(-12.71, 0.64)	(-1.03, 7.06)	
CC revolving (3)	24.28***	-7.99	-16.47***	-11.85	OBS
	(13.59, 34.97)	(-19.15, 3.17)	(-28.90, -4.05)	(-32.68, 8.98)	
CC revolving (4)	15.06***	-7.57	-17.00***	-10.89	EXP
	(5.98, 24.14)	(-18.37, 3.24)	(-29.27, -4.73)	(-31.25, 9.46)	
Discount - checks (5)	1.37***	-2.10***	0.89***	-0.22***	OBS
	(1.23, 1.52)	(-2.26, -1.94)	(0.87, 0.91)	(-0.25, -0.18)	
Discount - checks (6)	1.54***	-2.11***	0.88***	-0.30***	EXP
	(1.40, 1.68)	(-2.22, -2.00)	(0.86, 0.90)	(-0.35, -0.26)	
Other goods financing (7)	1.20	2.18***	0.03	0.15	OBS
	(-0.25, 2.66)	(1.33, 3.03)	(-1.28, 1.33)	(-1.61, 1.92)	
Other goods financing (8)	1.12	2.33***	-0.46	0.09	EXP
	(-0.28, 2.52)	(1.49, 3.18)	(-1.92, 1.00)	(-1.71, 1.89)	
Overdraft (9)	7.38***	-4.67**	1.74	4.23**	OBS
	(3.49, 11.28)	(-8.96, -0.37)	(-2.69, 6.17)	(0.13, 8.33)	
Overdraft (10)	7.91***	-3.91*	0.81	3.30*	EXP
	(3.85, 11.98)	(-8.05, 0.23)	(-3.49, 5.11)	(-0.32, 6.92)	
Payroll-deducted (11) - private	0.80***	-0.06	0.56*	-0.46	OBS
	(0.43, 1.17)	(-0.50, 0.39)	(-0.06, 1.18)	(-1.15, 0.23)	
Payroll-deducted (12) - private	0.78***	0.02	0.53*	-0.44	EXP
	(0.43, 1.13)	(-0.41, 0.45)	(-0.05, 1.10)	(-1.12, 0.23)	
Payroll-deducted (13) - public	0.43***	0.12	0.34	0.37***	OBS
	(0.15, 0.70)	(-0.19, 0.43)	(-0.10, 0.79)	(0.16, 0.59)	
Payroll-deducted (14) - public	0.43***	0.11	0.32	0.37***	EXP
	(0.16, 0.69)	(-0.21, 0.43)	(-0.15, 0.80)	(0.16, 0.58)	
Payroll-deducted (15) - retirees	0.41***	0.12**	0.41***	0.24***	OBS
	(0.30, 0.52)	(0.01, 0.23)	(0.30, 0.53)	(0.11, 0.37)	
Payroll-deducted (16) - retirees	0.42***	0.12**	0.40***	0.25***	EXP
	(0.30, 0.53)	(0.01, 0.22)	(0.27, 0.54)	(0.13, 0.36)	
Personal credit (17)	3.40	-1.64	0.39	-1.77	OBS
	(-1.43, 8.23)	(-5.91, 2.63)	(-3.88, 4.66)	(-5.65, 2.10)	
Personal credit (18)	3.24	-1.53	0.26	-1.43	EXP
	(-1.91, 8.39)	(-6.05, 2.99)	(-4.14, 4.67)	(-5.52, 2.65)	
Vehicle financing (19)	0.68***	0.05	0.06	-0.14	OBS
	(0.40, 0.95)	(-0.21, 0.30)	(-0.28, 0.39)	(-0.58, 0.30)	
Vehicle financing (20)	0.71***	0.04	0.02	-0.11	EXP
	(0.42, 0.99)	(-0.22, 0.30)	(-0.33, 0.38)	(-0.54, 0.31)	
Vehicle leasing (21)	0.85***	0.03	0.43***	-0.66***	OBS
	(0.50, 1.19)	(-0.25, 0.32)	(0.23, 0.62)	(-0.99, -0.32)	
Vehicle leasing (22)	0.90***	0.01	0.39***	-0.69***	EXP
	(0.53, 1.27)	(-0.28, 0.31)	(0.26, 0.52)	(-1.05, -0.33)	

Notes: *p<0.1; **p<0.05; ***p<0.01. 95% confidence interval in parentheses. Estimated with fixed effects. All regressions are controlled by expected inflation and EMBI. CC revolving is also controlled by the structural change in the rules of this loan modality. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

For the NFC loan modalities, the results reported in Table 9 are even more stronger, in the sense that the baseline results were basically kept unchanged. The new estimates confirmed that all loan modalities, except Advances on exchange contracts (1 and 2), experienced a full or overshooting pass-through in all alternative specifications. Advances on exchange contracts is the placebo and should not have any pass-through, as expected. For systemically important, private and domestic financial institutions, the overshooting pass-through was confirmed for Discount of credit card bills (3 and 4), Discount of checks (5 and 6), Discount of trade bills (7 and 8), and Overdraft (13 and 14). For these institutions, full pass-through held in place for all remaining loan modalities. Overall, these findings are basically the same

for either the observed or expected Over-Selic rates.

Table 9: Pass-through for NFC loans controlling for size and ownership of the financial institutions.

Modality	Pass-through (β)	Size (σ)	Ownership (ψ)	Origin (ϕ)	Selic
ACC (1)	0.01	-0.02	-0.05	0.05	OBS
	(-0.07, 0.09)	(-0.12, 0.07)	(-0.18, 0.08)	(-0.06, 0.17)	
ACC (2)	-0.01	-0.03	-0.06	0.06	EXP
	(-0.10, 0.07)	(-0.12, 0.06)	(-0.18, 0.07)	(-0.05, 0.16)	
Discount - CC bills (3)	3.76***	-2.08***	-0.44	-1.70***	OBS
	(2.83, 4.68)	(-3.28, -0.89)	(-1.47, 0.59)	(-2.72, -0.68)	
Discount - CC bills (4)	3.92***	-2.19***	-0.59	-1.88***	EXP
	(2.81, 5.04)	(-3.52, -0.86)	(-1.75, 0.57)	(-3.04, -0.72)	
Discount - checks (5)	1.60***	-0.15	-0.27*	-0.52***	OBS
	(1.48, 1.72)	(-0.40, 0.09)	(-0.57, 0.03)	(-0.63, -0.42)	
Discount - checks (6)	1.64***	-0.15	-0.32*	-0.50***	EXP
	(1.48, 1.79)	(-0.45, 0.15)	(-0.71, 0.06)	(-0.66, -0.34)	
Discount - trade bills (7)	2.34***	-1.28***	0.28	0.09	OBS
	(1.77, 2.90)	(-1.76, -0.80)	(-0.20, 0.76)	(-0.44, 0.61)	
Discount - trade bills (8)	2.38***	-1.28***	0.14	0.12	EXP
	(1.80, 2.96)	(-1.77, -0.79)	(-0.32, 0.61)	(-0.43, 0.66)	
Garanteed overdraft (9)	2.04**	0.70	-0.74	0.75	OBS
	(0.25, 3.84)	(-1.81, 3.21)	(-3.03, 1.56)	(-1.33, 2.83)	
Garanteed overdraft (10)	2.07**	0.58	-0.71	0.59	EXP
	(0.23, 3.91)	(-1.80, 2.95)	(-2.85, 1.43)	(-1.38, 2.56)	
Garanteed overdraft (11) (Float)	1.04***	0.10	-0.09	-0.20	OBS
	(0.66, 1.42)	(-0.40, 0.61)	(-0.59, 0.42)	(-0.69, 0.29)	
Garanteed overdraft (12) (Float)	1.07***	0.13	-0.12	-0.20	EXP
	(0.70, 1.43)	(-0.35, 0.60)	(-0.62, 0.38)	(-0.66, 0.26)	
Overdraft (13)	9.25***	-0.11	-3.84*	-3.73	OBS
	(5.24, 13.27)	(-4.08, 3.87)	(-7.92, 0.23)	(-8.25, 0.80)	
Overdraft (14)	9.03***	1.04	-4.45**	-3.15	EXP
	(4.84, 13.22)	(-2.94, 5.02)	(-8.40, -0.49)	(-7.77, 1.46)	
Vendor (15)	0.95***	-0.14	-0.10	-0.18	OBS
	(0.73, 1.17)	(-0.39, 0.10)	(-0.48, 0.27)	(-0.46, 0.10)	
Vendor (16)	0.96***	-0.17	-0.12	-0.14	EXP
	(0.71, 1.21)	(-0.44, 0.11)	(-0.54, 0.29)	(-0.45, 0.17)	
Working capital (17) ∼365	0.91**	0.37	0.74	-0.21	OBS
	(0.15, 1.66)	(-0.35, 1.09)	(-0.46, 1.94)	(-0.78, 0.36)	
Working capital (18) ∼365	0.98**	0.38	0.60	-0.22	EXP
	(0.21, 1.74)	(-0.36, 1.13)	(-0.69, 1.89)	(-0.79, 0.35)	
Working capital (19) ∼365 (Float)	1.00***	-0.13	0.04	-0.07	OBS
	(0.79, 1.20)	(-0.33, 0.08)	(-0.20, 0.28)	(-0.28, 0.14)	
Working capital (20) ∼365 (Float)	1.08***	-0.14	-0.00	-0.07	EXP
	(0.86, 1.29)	(-0.34, 0.07)	(-0.25, 0.24)	(-0.28, 0.14)	
Working capital (21) 365∼	1.16***	-0.40	0.76*	-0.22	OBS
	(0.95, 1.37)	(-0.89, 0.08)	(-0.13, 1.64)	(-0.65, 0.22)	
Working capital (22) 365∼	1.25***	-0.37	0.68	-0.24	EXP
	(0.98, 1.52)	(-0.89, 0.15)	(-0.27, 1.63)	(-0.69, 0.21)	
Working capital (23) 365∼ (Float)	0.79***	-0.12	0.13	-0.10	OBS
	(0.53, 1.06)	(-0.31, 0.07)	(-0.10, 0.36)	(-0.27, 0.06)	
Working capital (24) 365∼ (Float)	0.85***	-0.12	0.09	-0.10	EXP
	(0.58, 1.12)	(-0.29, 0.05)	(-0.10, 0.29)	(-0.26, 0.06)	

Notes: *p<0.1; **p<0.05; ***p<0.01. 95% confidence interval in parentheses. Estimated with fixed effects. All regressions are controlled by expected inflation and EMBI. ACC is also controlled by the Libor rate. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

The differential for non-systemically important financial institutions is statistically significant only for Discount of credit card bills (3 and 4) and Discount of trade bills (7 and 8). The public-owned government banks differential is not significant for any of the NFC modalities, except Overdraft (14) in the expected Selic regression. The foreign-controlled financial institutions yielded significant differentials only for Discount of credit card bills (3 and 4) and Discount of checks (5 and 6). In all these cases, the pass-though differentials are basically the same for both the observed and expected Selic rates. Notice that, in addition of being negative, all statistically significant differentials are for modalities with overshooting

pass-through.

Despite some statistically significant pass-through differentials, the major findings remained unchanged. However, the negative differentials for NFC loan modalities indicate that overshooting pass-through from the baseline estimates might have been driven by S1, private and domestic financial institutions. The first two characteristics are related to market power, market concentration and political interference, which might help to explain the high degrees pass-through according to the discussion in Section 6.

5.2. Persistence in the lending rates

In order to investigate how potential inertia in the lending rates might affect the interest rate pass-through, we estimate the following dynamic panel-data specification:

$$LendingRate_{m,i,t} = \rho LendingRate_{m,i,t-1} + (1-\rho)[\alpha + \beta BaseRate_{i,t} + C_t\delta] + \varepsilon_{m,i,t} \quad (5)$$

where $0 < \rho < 1$ measures the persistence in the lending rates. The other variables and parameters follow the previous definitions. In this set up, $(1-\rho)\beta$ measures the short-run pass-through while β accounts for the long-run interest rate pass-through. Thus, in the estimation of Equation (5), we have to identify β in order to compare it with the previous static estimates.

In the case of dynamic panels, it is well known that the fixed-effects estimator is inconsistent for typical applications in microeconomic data where there are few time periods and a large number of individuals (here, financial institutions). The estimator bias is caused by correlation between the lagged dependent variable and the unobserved specific heterogeneity. However, the current dataset does not fit this profile because it has a large number of time periods and relatively fewer individuals. Then, correlation induced by the Within transformation vanishes and the fixed-effects estimator becomes consistent according to Bond (2002). Additionally, the Least Squares Dummy Variable estimator generally has the lowest residual mean square error (RMSE) when compared to alternative methods usually applied to dynamic panels, as pointed out by Judson and Owen (1999).[18]

[18]We also applied the traditional Arellano and Bond (1991) estimator, but the coefficient of the lagged

Table 10 reports the results for alternative models with persistence in lending rates. All aggregate samples revealed full pass-through with estimated coefficients slightly lower than the ones found in the static models.

Table 10: Inertia in lending rates and the interest rate pass-through.

Modality	Persistence (ρ)	Pass-through (β)	Selic
Overall (1)	0.90^{***}	1.54^{***}	OBS
	(0.85, 0.95)	(0.78, 2.30)	
Overall (2)	0.90^{***}	1.61^{***}	EXP
	(0.85, 0.95)	(0.86, 2.36)	
Households (3)	0.90^{***}	1.64^{***}	OBS
	(0.85, 0.96)	(0.73, 2.56)	
Households (4)	0.90^{***}	1.76^{***}	EXP
	(0.85, 0.96)	(0.84, 2.68)	
Non-financial corporations (5)	0.89^{***}	1.50^{**}	OBS
	(0.79, 0.98)	(0.16, 2.83)	
Non-financial corporations (6)	0.89^{***}	1.53^{**}	EXP
	(0.79, 0.98)	(0.18, 2.88)	

Notes: *p<0.1; **p<0.05; ***p<0.01. ρ measures the persistence in the lending rates and β corresponds to the identified long-run interest rate pass-through coefficient according to Equation 5. 95% confidence interval in parentheses. Estimated with fixed effects. All regressions are controlled by expected inflation and EMBI. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

Table 11 reports the estimates for the HH and NFC loan modalities. Basically, most of the baseline results were kept unchanged. The full pass-through is still present for the modalities that presented this result in the static models. Statistical significance of β for Discount of checks (panels 5 and 6), Vehicle financing (19 and 20) and Vehicle leasing (21 and 22) were a bit lower when compared to the estimates from Table 4. The evidence of overshooting pass-through for Overdraft (9 and 10) was maintained. Loan modalities of Payroll-deducted loans to public employees (13 and 14) and Payroll-deducted loans to retirees (15 and 16) revealed incomplete pass-through as in the static models.

For the NFC loan modalities, most of the previous static findings were also held in the dynamic panel data environment, as reported in Table 11. The degree of pass-through is not statistically significant for Advances on exchange contracts (1 and 2), Discount of checks (5 and 6) and Overdraft (13 and 14). For all other loan modalities, the estimated values and significance levels of β were very close to the ones from the static models. However, in the dynamic environment, there is overshooting pass-through only for Discount of credit card

dependent variable did not lay within the bounds defined by the OLS and Within estimators, indicating that these estimates are not reliable according to Bond (2002) and Roodman (2009). Another practical issue is that a large number of time periods adds too many instrumental variables to the IV matrix and generates a dimensionality problem that requires some sort of arbitrary truncation. By using a fixed-effects estimator, we also avoid this issue.

Table 11: Inertia in lending rates and the interest rate pass-through by loan modalities.

Households				*Non-financial corporations*			
Modality	Persistence (ρ)	Pass-through (β)	Selic	Modality	Persistence (ρ)	Pass-through (β)	Selic
CC financing (1)	0.85^{***} (0.78, 0.92)	2.03 (-1.01, 5.07)	OBS	ACC (1)	0.38^{***} (0.29, 0.47)	0.01 (-0.05, 0.07)	OBS
CC financing (2)	0.85^{***} (0.78, 0.92)	2.15 (-1.09, 5.39)	EXP	ACC (2)	0.38^{***} (0.29, 0.47)	-0.02 (-0.07, 0.04)	EXP
CC revolving (3)	0.69^{***} (0.38, 1.00)	20.07^{**} (4.44, 35.69)	OBS	Discount - CC bills (3)	0.89^{***} (0.80, 0.98)	3.05^{**} (0.69, 5.41)	OBS
CC revolving (4)	0.70^{***} (0.39, 1.01)	9.54^{**} (0.23, 18.86)	EXP	Discount - CC bills (4)	0.89^{***} (0.82, 0.97)	3.25^{***} (1.09, 5.41)	EXP
Discount - checks (5)	0.73^{***} (0.52, 0.94)	1.31^{**} (0.24, 2.39)	OBS	Discount - checks (5)	0.90^{***} (0.78, 1.02)	1.32 (-0.26, 2.90)	OBS
Discount - checks (6)	0.73^{***} (0.52, 0.93)	1.46^{**} (0.33, 2.58)	EXP	Discount - checks (6)	0.90^{***} (0.79, 1.02)	1.40^{*} (-0.15, 2.95)	EXP
Other goods financing (7)	0.86^{***} (0.78, 0.94)	1.88^{***} (0.55, 3.22)	OBS	Discount - trade bills (7)	0.78^{***} (0.66, 0.90)	1.62^{***} (0.83, 2.42)	OBS
Other goods financing (8)	0.86^{***} (0.78, 0.94)	1.76^{***} (0.43, 3.10)	EXP	Discount - trade bills (8)	0.78^{***} (0.66, 0.90)	1.72^{***} (0.83, 2.61)	EXP
Overdraft (9)	0.92^{***} (0.86, 0.98)	7.38^{***} (2.89, 11.87)	OBS	Garanteed overdraft (9)	0.36^{***} (0.17, 0.55)	2.20^{***} (0.73, 3.68)	OBS
Overdraft (10)	0.92^{***} (0.86, 0.98)	7.87^{***} (3.09, 12.65)	EXP	Garanteed overdraft (10)	0.36^{***} (0.17, 0.55)	2.13^{***} (0.66, 3.61)	EXP
Payroll-deducted (11) - private	0.91^{***} (0.87, 0.96)	0.93^{***} (0.43, 1.43)	OBS	Garanteed overdraft (11) (Float)	0.53^{***} (0.35, 0.71)	0.96^{***} (0.54, 1.38)	OBS
Payroll-deducted (12) - private	0.91^{***} (0.87, 0.95)	0.99^{***} (0.51, 1.46)	EXP	Garanteed overdraft (12) (Float)	0.54^{***} (0.36, 0.72)	1.00^{***} (0.57, 1.43)	EXP
Payroll-deducted (13) - public	0.91^{***} (0.86, 0.96)	0.63^{***} (0.36, 0.91)	OBS	Overdraft (13)	0.91^{***} (0.81, 1.01)	7.15^{*} (-1.36, 15.66)	OBS
Payroll-deducted (14) - public	0.91^{***} (0.87, 0.96)	0.64^{***} (0.40, 0.88)	EXP	Overdraft (14)	0.91^{***} (0.81, 1.01)	7.30^{*} (-0.97, 15.57)	EXP
Payroll-deducted (15) - retirees	0.93^{***} (0.90, 0.96)	0.47^{***} (0.18, 0.76)	OBS	Vendor (15)	0.61^{***} (0.39, 0.83)	0.80^{***} (0.27, 1.33)	OBS
Payroll-deducted (16) - retirees	0.94^{***} (0.91, 0.96)	0.50^{***} (0.21, 0.79)	EXP	Vendor (16)	0.62^{***} (0.42, 0.83)	0.81^{***} (0.30, 1.33)	EXP
Personal credit (17)	0.69^{***} (0.61, 0.76)	1.98^{**} (0.20, 3.77)	OBS	Working capital (17) ∼365	0.31^{**} (0.03, 0.59)	1.20^{***} (0.64, 1.76)	OBS
Personal credit (18)	0.69^{***} (0.61, 0.76)	1.93^{*} (-0.02, 3.88)	EXP	Working capital (18) ∼365	0.31^{**} (0.03, 0.59)	1.23^{***} (0.63, 1.83)	EXP
Vehicle financing (19)	0.89^{***} (0.79, 0.98)	0.52^{**} (0.05, 0.99)	OBS	Working capital (19) ∼365 (Float)	0.27^{***} (0.16, 0.39)	0.90^{***} (0.69, 1.10)	OBS
Vehicle financing (20)	0.89^{***} (0.79, 0.98)	0.57^{**} (0.06, 1.08)	EXP	Working capital (20) ∼365 (Float)	0.27^{***} (0.16, 0.38)	0.96^{***} (0.75, 1.17)	EXP
Vehicle leasing (21)	0.43^{***} (0.21, 0.65)	0.61^{**} (0.01, 1.21)	OBS	Working capital (21) 365∼	0.63^{***} (0.51, 0.75)	1.08^{***} (0.66, 1.50)	OBS
Vehicle leasing (22)	0.43^{***} (0.21, 0.66)	0.65^{*} (-0.03, 1.32)	EXP	Working capital (22) 365∼	0.63^{***} (0.51, 0.75)	1.16^{***} (0.67, 1.64)	EXP
				Working capital (23) 365∼ (Float)	0.34^{***} (0.23, 0.46)	0.78^{***} (0.56, 1.00)	OBS
				Working capital (24) 365∼ (Float)	0.35^{***} (0.23, 0.47)	0.83^{***} (0.60, 1.05)	EXP

Notes: *p<0.1; **p<0.05; ***p<0.01. ρ measures the persistence in the lending rates and β corresponds to the identified long-run interest rate pass-through coefficient according to Equation 5. 95% confidence interval in parentheses. Estimated with fixed effects. All regressions are controlled by expected inflation and EMBI. CC revolving is also controlled by the structural change in the rules of this loan modality, and ACC is also controlled by the Libor rate. OBS indicates that the explanatory variable in the regression is Selic_t while EXP indicates that the explanatory variable is Expec_{it}.

bill (4) when regressed against the expected Selic rate.

Lending rates are highly persistent for most modalities, as indicated by the estimates of ρ. All R^2 coefficients are much higher than in the static models.[19] This was expected since

[19]This is especially evident for the aggregate samples in Table 10, Credit card financing, Other goods financing, Personal credit, and Guaranteed overdraft (fixed rate) in Table 11. For the HH modalities, the estimates of ρ ranged from 0.69 to 0.94, except for Vehicle leasing, where it was 0.43. NFC rates showed lower estimated values of ρ, ranging from 0.27 to 0.91. R^2 coefficients are available from the authors upon request.

inertia is an important component of the lending rates, increasing the explanatory power of the regressions. Overall, the major results are robust to the alternative dynamic panel data specification, despite the high persistence in most of the interest rate loan modalities. This finding, coupled with high interest rate margins, full (or overshooting) and positively asymmetric pass-through contribute to explain the historically high levels of loan interest rates in the Brazilian economy. In the next section, we lay out some explanations that might help to understand the financial institutions' behavior.

6. Discussion

The findings of full (or overshooting) and positively asymmetric pass-through coupled with high interest rate margins and highly persistent lending rates might be assessed by complementary explanations from the literature. One is the traditional structure-conduct-performance hypothesis arguing that market power creates an environment that affects the banks' behavior and performance in unfavourable ways from a social perspective (Berger et al., 2004). When borrowers are subjected to collusive price arrangements, banks may react differently to upward and downward movements in the policy rate. Notwithstanding this hypothesis is extensively used in studies of bank spreads, concentration, and other competition measures, it is also prominent in the interest rate pass-through literature. Another helpful strand is related to adjustment costs incurred by banks when changing interest rates. Finally, the efficient structure hypothesis is briefly discussed as an alternative hypothesis to the market power.

Collusive behavior can occur due to the costs that borrowers incur in switching loans from a bank to another. Switching costs are one source of market power which affects bank competition. While these costs induce bank competition to enlarge customer base by capturing new clients with lower lending rates, the spreads raise to the borrowers once they are locked in (Carletti, 2008). There are evidences of significant switching costs in Brazilian private banks, meaning that the longer is the duration of the relationship with the borrower, the higher is the spread (Ornelas et al., 2020). In case of collusive price arrangements, expected costs of breakdown should lead to a slowdown in pass-through (Cottarelli and Kourelis, 1994; Hannan and Berger, 1991), unless the interest rate change results in higher

gains. Thus, lending rates would be less likely to respond to a decrease than to an increase in the policy rate, or in the expected policy rate. This asymmetric behavior by banks was successfully identified in our previous findings.

However, we might not entirely support the hypothesis of collusive price arrangements. In Brazil, two of the largest banks are public-owned and a faster decrease in these banks' lending interest rates might have been determined by political pressure to reduce their spreads, mainly in the aftermath of the financial crisis (Pereira and Maia-Filho, 2013). Silva and Pirtouscheg (2015) argue that the Brazilian government fostered large public banks to reduce spreads as an attempt at pushing back spreads in large private banks in 2012.[20] This event coincides with the beginning of our sample, when there was a period of declines in the Over-Selic rate that might have driven an overshooting pass-through to the lending interest rates of public-owned banks. Additionally, public banks in Brazil showed relative lower market power, as measured by Lerner Index[21], which weakens the hypothesis of collusion. The difference between these indices is even higher when comparing only the largest banks. In a concentrated market where large public banks reduce lending rates, large private banks might follow them to avoid losing market share.[22]

While switching costs directly affects borrowers, adjustment costs are charged on lenders. However, borrowers' behavior against changes in lending interest rates might affect the pass-through and persistence of these rates. Adjustment costs are associated to more sluggishness of the pass-through as the market become less competitive because banks are more capable of smoothing their loan adjustments over time (Kopecky and Hoose, 2012). Hannan and Berger (1991) claim that negative customer's reaction (here, borrower's reaction) to unstable prices, coupled with a more negative reaction to unfavorable price changes (increases in the lending rate), imply a higher rigidity in pass-through. On the other hand, in the presence of fixed adjustment costs, the lending rates will be adjusted only if these costs are lower than the

[20]This inefficient behavior of "political interference" on interest rates had already been identified by Cottarelli and Kourelis (1994) for other countries in the past.

[21]See Central Bank of Brazil Banking Report 2017 at https://www.bcb.gov.br/content/publications/bankingreport/BAR_2017.pdf.

[22]This is consistent with Ornelas et al. (2020), who found median Lerner index of private banks near zero in the period analysed by Silva and Pirtouscheg (2015).

costs of keeping them unchanged (Banerjee et al., 2013; Cottarelli and Kourelis, 1994). This claim is reinforced by Hofmann and Mizen (2004), who found that non-linearities in the adjustment of retail rates to changes in base rates have arisen from menu cost models. In our sample, where changes were relatively frequent and interest rate margins were high, extra surplus by increasing lending rates could have overcome adjustment costs. The relevance of these costs depends on the demand elasticity for bank loans (Cottarelli and Kourelis, 1994), but this issue is beyond the scope this study. If the gains surpass the costs of adjusting the lending rate, then banks might have incentive to a full or even overshooting interest rate pass-through. As gains are supposed to be greater after rising lending rates, this would lead to distinct strategies of upward and downward movements in response to changes in the policy rate (or in the expected policy rate).

Two additional environments in which adjustment costs and extra surplus might play a central role are addressed in sequence. One is a perception that the changes in money market rates (or in policy rates) would be temporary (Cottarelli and Kourelis, 1994). At the beginning of our sample, throughout 2012, there was a fall in the Over-Selic rate perceived by the financial sector as inconsistent with the inflation targeting regime under place. In the following years, the policy rate climbed once again, and expectations by financial institutions indicated that the policy rate could have reached higher levels in 2016, when it peaked in our sample (Figure 3). There might have been some lack of confidence in the monetary authority during this period, and banks preferred not to fully pass-through movements in the Over-Selic rate to lending rates fearing sudden changes in the monetary policy conduction. This behavior might explain the high persistence in lending rates and asymmetric movements in cases where extra surplus were higher than the costs of changing lending rates. Another possible explanation is the timing of reactions to price changes (Hannan and Berger, 1991). There could be a delay between the interest rate changes and the borrower reactions, which could increase costs for downward movements and reduce for upward adjustments. If so, higher rigidity for lending rate decreases should be observed, as was the case for the positively asymmetric pass-through found in our estimates.

These explanations are worth to justify asymmetric pass-through and high persistence in lending rates, but not to support full or overshooting degree of pass-through. Only the

episode of "political interference" to stimulate stronger lending rates reductions by public banks would help to understand faster adjustments in lending rates after changes in the observed and expected policy rates. Collusion arrangements, switching costs, adjustment costs, or delay in borrower reactions to interest rate changes, on the contrary, would lead to asymmetric pass-through. Therefore, we need additional assessments to appropriately account for our findings.

An alternative hypothesis to the market power is the efficient structure hypothesis (e.g Berger et al., 2004; Berger and Hannan, 1989). It posits that differences in firm-specific efficiencies within markets create unequal market shares and high levels of concentration (Berger and Hannan, 1989). Thus, concentration would be endogenous and, as well as performance, stem from high market share of firms that are efficient. We argue that, under this view, banks would also be efficient in adjusting lending rates after changes in the policy rate or, at least, would incur in lower adjustment costs. It might be added that overshooting pass-through was stronger in the loan modalities with the highest interest rate margins. Presumably, these modalities should have a wider interval to adjust their interest rates.

As one can infer, the discussion is not conclusive. To adequately assess why Brazilian lending interest rates revealed full (or overshooting) and positively asymmetric pass-through coupled with high margins and persistence, specific elements of market power, market concentration, lack of competition and bank efficiency need to be modelled and appropriately tested against the data. Here, we empirically identified these striking features and offered some insightful explanations for the financial institutions' behavior when setting their lending interest rates. We leave for further research the task of building a comprehensive dataset and testing those complementary hypotheses against the data.

7. Conclusion

This paper investigated the interest rate pass-through from the observed and expected policy rates to the remarkably high lending interest rates in the Brazilian economy, accounting for financial institutions specific characteristics, asymmetric adjustment and persistence in the loan rates. We used a unique and non-public dataset with identified Over-Selic expectations by financial institutions, which reduces loss of information that would be caused

by aggregation of expectations by the mean or median. The sample covers the period from January 2012 to April 2019, on weekly basis, with variability by loan modalities, financial institutions and time. In addition to the standard static specification, we also accounted for partial adjustment of the lending rates in response to changes in both observed and expected Over-Selic rates in a dynamic panel data environment.

The results provided robust evidence of full (or overshooting) pass-through from the observed and expected Over-Selic rates to the lending interest rates. For some modalities, we found an asymmetric behavior by the financial institutions, as captured by smaller degrees of pass-through for decreases than for increases in the observed or expected policy rates. For the overall sample, sub-samples by households and non-financial corporations and some specific lending modalities, there is evidence of overshooting pass-through, meaning that increases in loan interest rates are more than proportional to any raise in the policy interest rate, either observed or expected. Loan modalities with the highest interest rate margins also revealed overshooting degrees of pass-through. In general, the higher the interest rate margin, the bigger the degree of pass-through from both observed and expected Over-Selic rates. These findings are robust to the inclusion of other control variables, such as specific characteristics by size, ownership type and capital origin, as well as to a dynamic panel data specification. In fact, the loan interest rates are highly persistent for most lending modalities and the long run pass-through closely resembles the estimates from the static models.

When addressing the interest rate pass-through, one should account for the heterogeneity in the loan modalities, as the interest rate margins, degrees of pass-through and asymmetry might vary considerably among them. A common feature, however, is that financial institutions adjust their lending rates in advance by correctly forecasting the next target level of the policy interest rate. This interest-rate setting strategy, coupled with persistently high margins, full (or overshooting) and positively asymmetric pass-through contribute to explain the remarkably high loan interest rates in the Brazilian economy.

The economic reasoning behind the financial institutions' behavior when setting loan interest rates demands complementary explanations from the specialized literature. Elements of market power, market concentration, lack of competition and other frictions should be theoretically addressed and empirically tested in an integrated environment. This task,

however, is left for further research.

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Appendix A. Description of the loan modalities

Table A.12: Description of the loans modalities.

Modality	Description
Credit card financing	Installment loans financed by the card issuer with incidence of interest. These operations are linked to financed purchases or to refinanced credit card balances. This type includes also cash withdrawals that generate scheduled installment payments.
Credit card revolving credit	Financing of the outstanding credit card balance (remaining after payment due date) or cash withdrawals that generate one payment due at next credit card bill.
Other goods financing	Financing of goods, except vehicles, for consumption of households contractors
Overdraft	Revolving credit line related to checking accounts, in which limited funds are made available for customers to use discretionarily and for short periods, through withdrawals, checks, payments or bank transfers. In such transactions, the outstanding debt balance must be promptly amortized whenever there is any deposit to the checking account. This type includes situations where the negative balance exceeds the authorized overdraft limit.
Payroll-deducted personal loans – to private sector employees	Credit for non-government employees, in which part of their salaries or wages is withheld by the employer in order to pay the loan installments to the lending institutions.
Payroll-deducted personal loans – to public sector employees	Credit to government employees (federal, state or local; active or inactive) in which part of their wage or retirement income is withheld by the public entities in order to pay the loan installments to the lending institutions.
Payroll-deducted personal loans – to retirees and pensioners	Loans to retirees or pensioners of the National Institute of Social Security (INSS), in which part of their monthly stipends is withheld by INSS in order to pay the loan installments to the lending institutions.
Personal credit	Credit to individuals not bound to any specific destination and without withholding wages for the payment of loan installments (i.e., no payroll-deducted).
Vehicle financing	To consumption of households contractors. The contract must contain a lien clause, with the financed good constituting the guarantee. Funding for vehicles intended for commercial stocks are not classified in this type of credit.
Vehicle leasing	Finance lease operations, where the lessor grants the lessee the use of the object of the lease (vehicles), with a purchase option at the end of the contract.
Advance on exchange contracts (ACC)	Partial or total advance of funds linked to export contracts, in order to finance the production of export goods. This type includes operations of advances on delivered exchange contracts (ACE).
Discount of credit card bills	Advance of funds to non-financial corporations based on future cash flows linked to receivables from credit card bills.
Discount of checks	Advance of funds to non-financial corporations based on future cash flows linked to checks.
Discount of trade bills	Advance of funds to non-financial corporations based on future cash flows linked to trade bills or other receivables, except checks and credit card bills.
Guaranteed overdraft accounts	Revolving credit related to bank accounts of non-financial corporations, in which limited funds are made available for customers to use, whether by running the checking account or by formally requesting to the financial institution, which may eventually seek binding guarantees from receivables, or other collaterals. This type includes situations where the negative balance exceeds the authorized overdraft limit.
Vendor	Sales financing transaction where the borrowing company (seller) to finance their sales and to get immediately paid by the financial institution. The buyer commits itself to the payment schedule which will settle the transaction with the financial institution. In general, the financial institution will hold the receivables of the selling company, which undertakes the risk of the operation.
Working capital up to 365 days	Short-term credit to finance operating activities of non-financial corporations, related to a specific contract that establishes deadlines, fees and guarantees. Its maturity may not exceed 365 days.
Working capital over 365 days	Medium and long term credit to finance the operating activities of non-financial corporations, related to a specific contract that establishes deadlines, fees and guarantees. Its maturity should be above 365 days.

Source: Central Bank of Brazil