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Interest rate and credit channel for households and firms: Evidence from a large emerging economy

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Abstract

This study analyzes the effect of the monetary policy interest rate on the credit channel taking into account disaggregated information for households and firms under inflation targeting. Based on aggregate data of the Brazilian economy for the period 2001-2015, this article addresses empirical evidence regarding the impact of the interest rate on credit granted and the credit spread. The results indicate that there is a negative effect of the interest rate on credit granted to firms and that, in the case of credit spread, there is a positive impact on both households and firms. The magnitude of the effect of the interest rate on credit granted to firms is greater than that observed for households. In contrast, the magnitude of the effect of the interest rate on the credit spread is lower for firms when compared to households.

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1. Introduction

The credit channel is an important transmission mechanism of monetary policy. Nowadays, due to the diffusion of inflation targeting, the interest rate has become the main instrument available to the monetary authority. In this context, an important issue is to analyze the impact of monetary policy on the different borrowers (households and firms) through the credit channel. This study examines how the interest rate, under inflation targeting, affects the credit channel through bank loans to households and to firms (legal entities). To this end, this analysis uses two indicators to measure the drivers of the credit channel: the volume of loans granted, and the spread of loans. The effect of the monetary policy interest rate on the credit channel is analyzed by means of regressions, which also include other variables that are able to explain the credit supply and the spread. Data from Brazil available in Time Series Management System/Central Bank of Brazil are utilized in this study.

The results in this paper suggest that the interest rate under inflation targeting in Brazil does not affect the credit granted to households. However, the interest rate is important to the determination of the credit granted to firms. The results from an analysis that considers the risk of bias in the credit channel indicate that the interest rate is relevant to explain the banking spread for both households and firms. It is noteworthy that these results remain when the period in which there were changes in the methodology for the measurement of loans granted and spread of loans (after 2012) is also considered.

Part of monetary policy shocks are transmitted to the real economy by changes in credit supply of banks. The more sensitive the credit supply of banks is to a shock in the interest rate, the greater is the power of monetary policy. However, if the supply of loans is very sensitive to interest rates, the bank lending channel may result in a sudden overheating process or a halt in economic activity, which in turn leads to a greater volatility of output (Ramos-Tallada, 2015).

Under inflation targeting, the interest rate set by the central bank is a tool to lead expectations (see Clarida, Galí, and Gertler, 2000; Blinder, et al., 2008; and Dincer and Eichengreen, 2014). In general, several central banks make use of a Taylor rule for setting the interest rate (Martin and Milas, 2004; Melo and Moccero, 2011, and Neuenkirch and Tillmann, 2014). In other words, when the current inflation exceeds the target, a rise in the interest rate is expected. As a result of this process, a higher interest rate leads to a decrease in the credit supply and to an increase in the spread.

The theory of the credit channel takes into account transmission mechanisms that amplify the effects of interest rates on the economy (Bernanke and Gertler, 1995). There are several studied for developed economies in order to examine the behavior of the bank lending channel. For example, Ludvigson (1998) finds that contractionary monetary policy produces a reduction in the relative supply of bank consumer loans. Garretsen and Swank (2003) find that corporate loans are reduced only after a lag of over a year, whereas household loans reduce almost instantly due to an interest rate rise. However, since the decrease in household loans is not accompanied by a fall in consumer expenditure, the bank lending channel is not very important for the transmission of monetary policy. Den Haan, Sumner, and Yamashiro (2007) find evidence that a monetary tightening produces a decrease in the real estate and consumer loans, while commercial and industrial loans increase.[1]

Unlike the research mentioned above, there are fewer studies that are concerned with the analysis of the monetary policy on the credit channel for developing countries. Based on the bank lending channel respectively for Russia and Thailand, Juurikkala, Karas, and Solanko (2011) and Charoenseang and Manakit (2007) conclude that the effect of the monetary policy

[1] Other investigations are made by: Altunbas, Fazylov, and Molyneux (2002), Kakes and Sturm (2002), Hülsewig, Mayer, and Wollmershäuser (2006), Atta-Mensah and Dib (2008), Apergis and Alevizopoulou (2012).

on the credit supply is significant. Agung (1998), through an analysis via balance sheet channel swings for Indonesia observes that the effect of the monetary policy on the credit supply depends on the size of banks.

There is a significant number of developing countries that adopts inflation targeting and the interest rate is the main instrument available to the monetary authority for the search of the target.[2] In particular, Brazil is one of the developing economies which has used inflation targeting the longest. Moreover, Brazil had a significant expansion of the credit market from the 2000s and increased the information available for the public provided by the Central Bank of Brazil (CBB). In brief, Brazil fits well for the analysis regarding the impact of the monetary policy rate on volume of loans granted and the spread of loans for both households and firms.

There are fewer studies that analyzed the credit channel under inflation targeting in Brazil. For example, Auel and de Mendonça (2011), Montes and Machado (2013), and Montes and Peixoto (2014) find that the effect of the interest rate on the bank lending channel is relevant. Melo and Pisu (2010) observe that the credit supply is negatively related to the Interbank Deposit Certificate rate (CDI), which suggests the existence of a lending channel for the transmission of the monetary policy. Analyzing the bank lending channel for the period post subprime crisis, Ramos-Tallada (2015) observe that the money market rate does not affect the lending supply of the average banks, while small banks and those who do not have access to long term funds appear to be more sensitive to monetary shocks. However, none of the studies mentioned above performs an analysis that decomposes the impact of the monetary policy rate on loans granted and on the spread of loans for both households and firms. In particular, the analysis of the credit channel for households and firms permits policymakers to identify specific characteristics that can help to devise a more efficient credit policy.

Households and firms present significant differences between them when we consider issues on credit. For obvious reasons, while credit to households links to consumption, credit to firms links to investment. This observation is important because if the policymaker wants to promote a rapid effect on the economy, the choice is a stimulus to the consumption, that is, credit to households. However, this effect is not enduring. In a different way, credit to investment does not imply an immediate impact on the economy due to the lag between the decision for the investment and its return. Nevertheless, the impact on the economy tends to be durable. In brief, it is not an easy decision to make by the policymaker. Therefore, the observation of how the monetary policy interest rate affects both households and firms is an information that helps the policymaker to adopt the best strategy regarding the credit policy.

The remainder of this study is organized as follows: Section 2 presents the data and methodology used in this study. Section 3 provides empirical evidence through an econometric analysis of the effect of the interest rate set by CBB on loans granted and on the spread of loans for both households and firms. Section 4 concludes the paper.

2. Data and methodology

In order to analyze the impact of the monetary policy interest rate on credit granted and on credit spread disaggregated for households and firms, this study makes use of monthly data (growth rate in the last 12 months) available from Time Series Management System of CBB (TSMS/CBB) and IPEAdata.

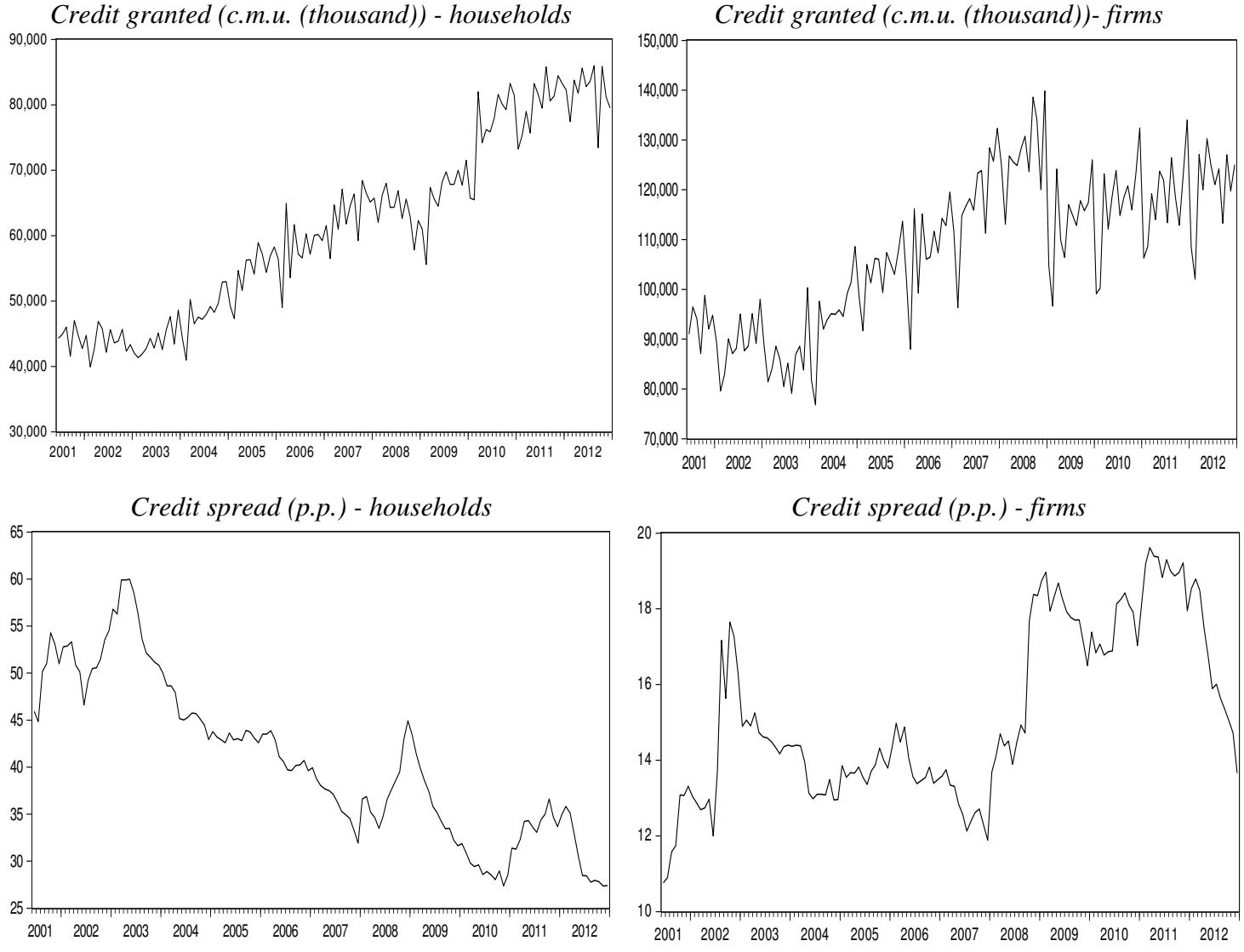
As a measure of credit granted to households and firms (*CREDG*), this study makes use

[2] Brazil adopted inflation targeting in 1999. Regarding the dates of the adoption of inflation targeting, see de Mendonça and de Guimarães e Souza (2012). Regarding the use of the interest rate under inflation targeting, see: Taylor (1993, 1995), Clarida, Galí, and Gertler (2000), Martin and Milas (2004), Melo and Moccero (2011), and Neuenkirch and Tillmann (2014).

of the series "Credit operations with nonearmarked funds - Consolidate grantings (accumulated in the month)" in TSMS/CBB. Figure 1 shows the path of loan granted for both households and firms for the period from June 2001 to December 2012. In general, it is possible to see that there is an up trend of credit granted for households throughout the period, while for the case of firms there is a slowdown and stability from 2008.

Regarding the credit spread (*SPREAD*), the indicator used in this analysis for both households and firms is the "Credit operations with nonearmarked funds - Average spread" provided in TSMS/CBB. Figure 1 permits us to observe that the credit spread for households presents a downward trend over the period while the credit spread for firms reacts to crisis over the period.

Figure 1 - *Credit granted and credit spread (households and firms)*

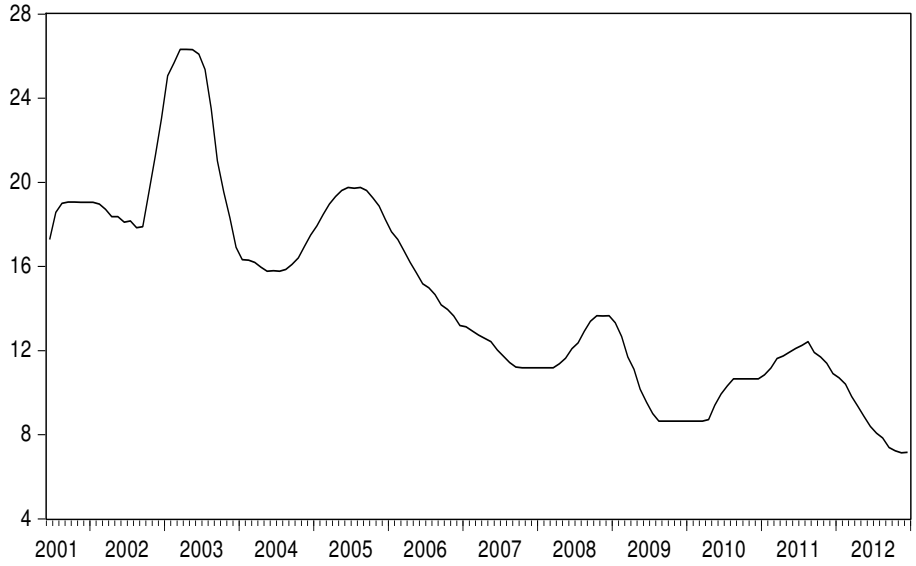


In the Brazilian case, the monetary policy interest rate (*IR*) and thus the benchmark for other interest rates charged by banks is the Selic rate. Therefore, this study takes into account the "Selic accumulated in the month in annual terms" available in TSMS/CBB. An increase in the Selic rate tends to worsen the conditions of the credit market because loan rates tend to be higher, which causes a reduction in the loan granted and an increase in the spread for both households and firms. In other words, higher interests rate on consumer credit mean a greater

sacrifice of future income for an increase in the current consumption financed by future income. Therefore, in general, higher interest rates on consumer credit will discourage current consumption (Park, 1993). In the case of firms, a higher interest rate increases the interest expenses, decreasing net cash flows and weakening the borrower's financial position (Bernanke and Gertler, 1995). In general, figure 2 shows that, with the exception of the crisis of confidence due to the election of President Luiz Inácio Lula da Silva (last quarter 2002 to third quarter 2003), there is a downward trend over the period.

For mitigating omitted variable biases, in addition to those aforementioned, this study makes use of well-accepted variables present in the literature on the determination of credit loans and credit spreads. In this sense, the following variables are considered in the empirical model:

Figure 2 - *Interest rate (Selic) - % p.y.*



- *Economic growth* (*GROWTH*) - bank lending is procyclical, that is, during recessions it tends to reduce and during to economic expansions tends to increase.[3] In general, economic growth increases loans, improves cash flows of firms, and also the wealth of both firms and households. As a result, there is an increase in the demand for credit. Moreover, an increase in wealth due to economic growth represents an improvement in the ability of households and firms to honor their financial commitments which, in turn, reduces bank spread. In this context, a measurement of economic growth from the Gross Domestic Product deflated by official price index (IPCA) available from TSMS/CBB is included in the models for the determination of credit granted and credit spread.
- *DEFAULT* - percentage of portfolio in arrears of more than 90 days − general total (available in TSMS/CBB). The default rate represents the level of losses incurred by banks in their credit operations. As highlighted by Auel and de Mendonça (2011) and Montes and Peixoto (2014), an increase in the default level worsens the credit market conditions (fall in credit supply and increase in the credit spread).
- *BOVESPA* – Bovespa - monthly index (deflated by IPCA). Bovespa represents the behavior of asset prices. As pointed out by Mishkin (2003) and de Mendonça and Auel (2011), valuation of assets increases the power of firms offering a guarantee for banking loans and thus creates

[3] Regarding the relation between bank credit and business cycles, see Drummond (2009), Berger and Udell (2004), Ruckes (2004), and Gorton and He (2008).

an improvement in the credit market (increase in the credit granted and decrease in the credit spread).

- *EMBI+* - Emerging Markets Bond Index Plus Brazil (country risk) calculated by JP Morgan (the difference between the stated rate of return on Brazilian dollar-denominated and U.S. dollar-denominated government bonds of the same maturity) is a measure of the probability of default on the public debt available in IPEAdata. As observed by Albertazzi et al. (2014), Gennaioli, Martin, and Rossi (2014), Cantero-Saiz et al. (2014), an adverse shock to sovereign risk means that external resource flows become more expensive, consequently, increases the bank financing costs and reduces credit supply.

Because the Brazilian economy was hit by significant shocks over the period, the models also include a dummy variable (*SHOCKS*) which captures the two main shocks in the period. Specifically, (i) the confidence crisis due to the presidential election in the last quarter of 2002; and (ii) the effects caused by the subprime crisis that hit the economy in the last quarter of 2008. In this context, a dummy variable is introduced in the models, which assumes value "1" for the periods October 2002 to September 2003 and October 2008 to September 2009, and "0" otherwise.

Based on the variables described above, this study considers several models for observing a possible effect caused by the monetary policy interest rate on the credit granted and on the credit spread for both households and firms. The baseline models for credit granted and spread credit, respectively, are a result of:[4]

$$CREDG_t = \beta_0 + \beta_1 IR_{t-1} + \beta_2 GROWTH_t + \beta_3 DEFAULT_{t-1} + \beta_3 X_{t-1} + \beta_4 SHOCKS + \varepsilon_t, \text{ and} \quad (1)$$

$$SPREAD_t = \alpha_0 + \alpha_1 IR_{t-1} + \alpha_2 GROWTH_t + \alpha_3 Z_{t-1} + \alpha_4 SHOCKS + \varepsilon_t, \quad (2)$$

where: *CRED* is credit granted (*CREDG*) or credit spread (*SPREAD*), the subscript i = households or firms; X – set of control variables ($DEFAULT_i$, *BOVESPA*, and *EMBI+*); and Z - control variables: *BOVESPA* and *EMBI+*; and ε_t is the disturbance.

Because CBB changed the methodology to measure credit granted and credit spread, the analysis is divided in two steps. Firstly, it takes into account information provided directly from TSMS/CBB for the period June 2001 to December 2012. Secondly, in order to extend the database for the recent period and following the procedure adopted by CBB to make compatible the old and new methodologies, the analysis is made for the period from June 2001 to August 2015.[5]

The use of regressions allows one to see the magnitude of the impact of each independent variable in the model on the dependent variable. Therefore, this framework allows one to measure how much is the difference of a shock in the monetary policy interest rate on credit granted and spread credit regarding households and firms. This information is particularly useful for policymakers that plan to implement credit policy. In this context, in order to estimate the models for credit granted and credit spread, this study uses two methods: Ordinary Least Squares (OLS) and Generalized Method of Moments (GMM). These methods are a straightforward framework to see the impact caused by the monetary policy interest rate on the credit granted and credit spread for both households and firms through the observation of the estimated parameters.

In general, the use of macroeconomic time series is subject to the problem of heteroscedasticity. Furthermore, loans granted and spread can influence the determination of variables such as economic growth and default rate. Therefore, the use of these variables as regressors can create a possible risk of endogeneity that is not treated in the OLS regressions. Hence, GMM is used because the results are robust even with these problems. An efficient

[4] See table A.1 (appendix) for sources of data and description of the variables.

[5] Regarding the procedure to make the extended series matching old and new methodologies, see metadata available in TSMS/CBB.

estimation using GMM demands that overriding restrictions need to be respected (Woodridge, 2001). As a consequence, in order to test over-identifying moment conditions, all estimations present the J-statistic. Moreover, as usual, the instrument variables used in the regressions are the lagged regressors.[6]

In addition to the analysis above, we provide more evidence through impulse-response analysis from Vector Auto Regressive (VAR) models in order to ascertain the relative importance of the monetary policy interest rate on credit granted and on credit spread disaggregated for households and firms. This procedure permits observing the impulse on credit granted and credit spread caused by shocks (or innovations) provoked by residual variables over time. Following Koop, Pesaran, and Potter (1996) and Pesaran and Shin (1998), this study uses generalized impulse response function (impulse responses are invariant to any re-ordering of the variables in the VAR) due to the fact that it provides more robust results than the orthogonalized method (Ewing, 2003). Finally, the VAR order is defined based on Schwarz (SIC), Akaike (AIC), and Hannan-Quinn (HQ) criteria (see table A.2).

In order to check whether the series contain a unit root, the standard tests Augmented Dickey–Fuller (ADF), Phillips–Perron (PP), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests were performed. The results indicate that all series are I(0) - see table A.3 (appendix).

3. Empirical evidence

After observing the main characteristics of the credit granted and credit spread as well as the monetary policy interest rate, this section presents some evidence on the credit channel for households and firms in the Brazilian economy. In the next subsection, estimations for credit granted and for credit spread were carried out, respectively, for the period from June 2001 to December 2012. In the second subsection, we re-estimate the models taking into account the extended database for the period June 2001 to August 2015. The intention is to observe if we have similarities when the sample considers the period of deterioration in the Brazilian economy's fundamentals, fall in both fiscal and monetary credibility, and change in the CBB's methodology to measure credit granted and credit spread.[7] The last subsection investigates, through impulse-response analysis, how the credit granted and credit spread (for both households and firms) respond to a shock transmitted by the monetary policy interest rate taking into account the two sample periods. One advantage of this framework is that through impulse-response functions it is possible to observe the lag of response of credit granted and credit spread to an impulse on monetary policy interest rate, as well as, the statistical significance and the duration of this event.

3.1. Effect of IR on CREDG and on SPREAD (June 2001 – December 2012)

In general, the estimations for both households and firms in tables 1 and 2 (OLS and GMM models) are in agreement with the idea that an increase in the monetary policy interest rate can decrease the credit granted. Independent of the model and method, the coefficients on *IR* are negative which suggests that the management of the monetary policy in the search for a lower inflation rate can imply a contractionary effect on the volume of loans granted.

Although the coefficient on *IR* is negative, there is no statistical significance when the credit granted to households is considered (see table 1). A possible explanation for this result is that since 2003, at the start of the government of the President Luiz Inácio Lula da Silva,

[6] In order to eliminate skewing the results, the maximum of lags used for each instrument was 6. Furthermore, the number of instruments used for all models is less than 22% in relation to the total of observations.

[7] Regarding fiscal and monetary credibility in the Brazilian economy, see de Mendonça and Silva (2016), and de Mendonça and Tostes (2015).

independent of conduct of the monetary policy by the CBB, a credit expansion policy was adopted especially for households (e.g., payroll lending, mortgages, vehicle financing, etc.). Regarding the model to firms, the coefficients on *IR* are negative and significant for all specifications (see table 2). Therefore, it is possible to conjecture that the effect of an increase in *IR* on credit granted for firms is more important than for households.

The coefficients regarding the other variables in the models are in consonance with what would be expected. The coefficients on *GROWTH* are positive and significant confirming the idea that expansions in the economy can amplify credit loans. Negative and significant coefficients on *DEFAULT* are in agreement with the view that an increase in risk reduces the credit granted. Although the coefficients on *BOVESPA* and on *EMBI+* present signs coherent with the theoretical perspective (positive and negative, respectively) no significance is observed in most of the models (except *BOVESPA* in GMM model to firms). Moreover, the coefficients on *SHOCKS* (negative and significant) leave no doubt that the period of crises discourages credit granted.

In contrast to the coefficients on *IR* for credit granted, in the case of credit spread the coefficients are positive and significant which, in turn, suggests that an increase in the monetary policy interest rate is associated with an increase in the credit cost for both households and firms (see tables 3 and 4). The negative coefficients on *GROWTH* (significant in most models) are in agreement with the view that economic growth is associated with the increase of wealth in the economy and thus leads to a lower spread. Although coefficients on *DEFAULT* are positive, statistical significance is observed only for households. This result suggests that in the case of firms, spread is explained by other factors. In contrast to the previous case (credit granted), the coefficients on *BOVESPA* are negative and significant, and the coefficients on *EMBI+* are positive and significant. Furthermore, the positive and significant coefficients on *SHOCKS* indicate that the periods of crises provoke an increase in spread.

Table 1 - *Credit granted estimations - households (June 2001 – December 2012)*

Regressors	OLS			GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	8.4583***	8.2747***	8.1475***	8.5607***	7.7777***	7.7739***
	(0.8723)	(1.0653)	(0.8748)	(0.7911)	(09003)	(0.6228)
IR_{t-1}	-0.0063	-0.0010	0.0006	-0.0063	-0.0076	-0.0116
	(0.0361)	(0.0425)	(0.0368)	(0.0325)	(0.0344)	(0.0314)
$GROWTH_t$	1.0815***	1.0675***	1.0321***	1.2461***	1.1365***	1.2106***
	(0.1758)	(0.1756)	(0.1760)	(0.2488)	(0.1561)	(0.2077)
$DEFAULT_{t-1}$	-0.1871***	-0.1799***	-0.1674***	-0.1849***	-0.1846***	-0.1837***
	(0.0336)	(0.0385)	(0.0368)	(0.0292)	(0.0292)	(0.0272)
$BOVESPA_t$		0.0084			0.0142	
		(0.0281)			(0.0221)	
$EMBI+_{t-1}$			-0.0219			-0.0192
			(0.0191)			(0.0135)
SHOCKS	-8.1278***	-8.0162***	-7.0415***	-9.3689***	-8.1745***	-6.7023***
	(2.0694)	(2.1170)	(2.3964)	(1.8522)	(1.4621)	(1.7822)
Adj. R^2	0.49	0.49	0.50	0.49	0.51	0.52
J-statistic				19.4340	22.2537	19.8683
P(J-statistic)				0.11	0.27	0.34
Inst. Rank				18	25	24

Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. GMM1 – one-step GMM estimation - Robust (Newey-West) standard errors are in parentheses. P(J-statistic) report the respective p-valued of the J-test.

Table 2 - *Credit granted estimations - firms (June 2001 – December 2012)*

Regressors	OLS			GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	4.8374***	4.7071***	4.5913***	5.2065***	4.0905***	4.5455***
	(1.0606)	(1.2774)	(1.0294)	(0.7461)	(0.7625)	(0.5743)
IR_{t-1}	-0.0954**	-0.0926**	-0.0972**	-0.0841**	-0.0781**	-0.0967***
	(0.0395)	(0.0419)	(0.0396)	(0.0363)	(0.0338)	(0.0366)
$GROWTH_t$	0.7553***	0.7484***	0.7286***	0.9362***	0.7466***	0.6682***
	(0.2151)	(0.2324)	(0.2286)	(0.2908)	(0.2189)	(0.2227)
$DEFAULT_{t-1}$	-0.1274***	-0.1286***	-0.1354***	-0.1157***	-0.1256***	-0.1310***
	(0.0183)	(0.0167)	(0.0184)	(0.0151)	(0.0132)	(0.0174)
$BOVESPA_t$		0.0066			0.0419*	
		(0.0335)			(0.0247)	
$EMBI+_{t-1}$			-0.0195			-0.0315
			(0.0221)			(0.0208)
SHOCKS	-6.5941	-6.4351***	-5.2704**	-9.9714***	-6.7132***	-5.7283**
	(1.7448)	(1.8904)	(2.3638)	(2.2248)	(2.2941)	(2.8506)
Adj. R^2	0.45	0.45	0.45	0.38	0.40	0.41
J-statistic				16.5900	16.3991	16.7913
P(J-statistic)				0.28	0.43	0.54
Inst. Rank				19	22	24

Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. GMM1 – one-step GMM estimation - Robust (Newey-West) standard errors are in parentheses. P(J-statistic) report the respective p-valued of the J-test.

Table 3 - *Credit spread estimations - households (June 2001 – December 2012)*

Regressors	OLS				GMM			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	-3.9004*	-4.8408***	-1.9510	-2.9284	-3.3179***	-4.7801***	-2.0838	-2.8105**
	(2.0491)	(1.6102)	(2.2440)	(1.9408)	(1.2487)	(1.0503)	(2.2583)	(1.1561)
IR_{t-1}	0.3662***	0.3826***	0.3068***	0.3434***	0.4047***	0.3853***	0.3304***	0.3706***
	(0.0626)	(0.0558)	(0.0561)	(0.0590)	(0.0368)	(0.0404)	(0.0544)	(0.0298)
$GROWTH_t$	-0.4718**	-0.6087***	-0.3432	-0.3138	-0.5469**	-1.0062***	-0.5563*	-0.2703
	(0.2277)	(0.2266)	(0.2184)	(0.2129)	(0.2287)	(0.2117)	(0.3464)	(0.1912)
$DEFAULT_{t-1}$		0.2891***				0.2707***		
		(0.0658)				(0.0360)		
$BOVESPA_t$			-0.1017**				-0.0824*	
			(0.0408)				(0.0381)	
$EMBI+_{t-1}$				0.0862***				0.0921***
				(0.0260)				(0.0197)
SHOCKS	8.2357**	6.6048**	6.3847*	3.5237	8.3708***	7.8794***	6.3160	2.7062
	(3.7831)	(3.1961)	(3.4348)	(3.2328)	(2.8448)	(2.2959)	(6.3032)	(2.1429)
Adj. R^2	0.55	0.69	0.60	0.61	0.55	0.69	0.61	0.62
J-statistic					18.1874	20.4064	14.8756	18.6278
P(J-statistic)					0.79	0.62	0.24	0.72
Inst. Rank					28	28	17	28

Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. GMM1 – one-step GMM estimation - Robust (Newey-West) standard errors are in parentheses. P(J-statistic) report the respective p-valued of the J-test.

Table 4 - *Credit spread estimations - firms (June 2001 – December 2012)*

Regressors	OLS				GMM			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	1.3792	1.3973	4.1616*	3.5618**	0.0292	0.0880	2.1340	2.7461***
	(1.6691)	(1.6419)	(2.4700)	(1.5436)	(0.8786)	(0.9464)	(1.4244)	(0.9520)
IR_{t-1}	0.2215***	0.2263***	0.1369	0.1705***	0.1874***	0.1824***	0.1107*	0.1414***
	(0.0683)	(0.0771)	(0.0962)	(0.0630)	(0.0363)	(0.0455)	(0.0570)	(0.0412)
$GROWTH_t$	-0.5006	-0.5069	-0.3171	-0.1458	-1.4326***	-1.1655***	-1.0840***	-0.3996*
	(0.3359)	(0.3187)	(0.2483)	(0.1963)	(0.3642)	(0.3521)	(0.3810)	(0.2182)
$DEFAULT_{t-1}$		0.0055				0.0024		
		(0.0365)				(0.0235)		
$BOVESPA_t$			-0.1451*				-0.1177**	
			(0.0756)				(0.0461)	
$EMBI+_{t-1}$				0.1936***				0.1701***
				(0.0411)				(0.0248)
SHOCKS	18.4288***	18.2509***	15.7868***	7.8474*	26.8169***	26.1599***	23.0818***	14.1207**
	(5.4799)	(5.4849)	(4.6300)	(4.4825)	(1.8819)	(2.3768)	(3.2124)	(3.3924)
Adj. R^2	0.49	0.44	0.53	0.68	0.37	0.39	0.48	0.66
J-statistic					15.4914	16.6635	15.9785	17.8038
P(J-statistic)					0.93	0.89	0.77	0.72
Inst. Rank					29	30	26	27

Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. GMM1 – one-step GMM estimation - Robust (Newey-West) standard errors are in parentheses. P(J-statistic) report the respective p-valued of the J-test.

3.2. Effect of IR on CREDG and on SPREAD (June 2001 – August 2015)

This section provides evidence on the effect of the monetary policy interest rate on credit granted and on credit spread for the period June 2001 to August 2015. This period comprehends a worsening of the economic and political crisis in Brazil (after 2012) and also corresponds to the change of the methodology regarding credit granted and credit spread.

Regarding the estimations for credit granted, such as observed for the shorter sample case, the coefficients on *IR* are negative for both households and firms. Moreover, statistical significance of the coefficient on *IR* is observed only for firms (see tables 5 and 6). In brief, this is additional evidence that an increase in the monetary policy interest rate causes a contractionary effect on the volume of loans granted. Regarding the coefficients of the other variables in the models, in general, no significant changes in relation to those presented in the previous section are observed. The exceptions are the coefficients on *BOVESPA* and *EMBI+* that become significant for both households and firms.

Table 5 - *Credit granted estimations - households (June 2001 – August 2015)*

Regressors	OLS			GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	5.6462***	4.7199***	5.3757***	5.6814***	4.6164***	5.5130***
	(1.0470)	(1.1289)	(0.9721)	(0.8598)	(0.8503)	(0.7544)
IR_{t-1}	-0.0543	-0.0180	-0.0245	-0.0507	-0.0030	-0.0437
	(0.0362)	(0.0407)	(0.0372)	(0.0323)	(0.0335)	(0.0296)
$GROWTH_t$	0.9905***	0.9232***	0.9008***	0.8311***	0.6770***	0.8277***
	(0.1478)	(0.1530)	(0.1499)	(0.1953)	(0.1719)	(0.2263)
$DEFAULT_{t-1}$	-0.1651***	-0.1259***	-0.1305***	-0.1469***	-0.1065***	-0.1430***
	(0.0430)	(0.0453)	(0.0414)	(0.0296)	(0.0321)	(0.0255)
$BOVESPA_t$		0.0577*			0.0660***	
		(0.0301)			(0.0234)	
$EMBI+_{t-1}$			-0.0505**			-0.0366**
			(0.0211)			(0.01583)
SHOCKS	-4.7940***	-4.2637**	-2.8483	-7.9985***	-8.0588***	-4.4642*
	(1.8225)	(2.0230)	(2.2807)	(2.4924)	(2.0161)	(2.4403)
Adj. R^2	0.31	0.34	0.35	0.30	0.34	0.38
J-statistic				22.0509	22.4493	22.0709
P(J-statistic)				0.11	0.13	0.11
Inst. Rank				20	22	21

Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. GMM1 – one-step GMM estimation - Robust (Newey-West) standard errors are in parentheses. P(J-statistic) report the respective p-valued of the J-test.

Table 6 - *Credit granted estimations - firms (June 2001 – August 2015)*

Regressors	OLS			GMM		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	2.8881***	2.2904**	2.6796***	3.4157***	2.6241***	3.1617***
	(1.0309)	(1.1316)	(0.9510)	(0.7048)	(1.0013)	(0.5989)
IR_{t-1}	-0.1482***	-0.1337***	-0.1372***	-0.1475***	-0.1243***	-0.1504***
	(0.0403)	(0.0425)	(0.0400)	(0.0278)	(0.0321)	(0.0302)
$GROWTH_t$	0.6627***	0.6356***	0.6141***	0.3817*	0.3229	0.2333
	(0.1820)	(0.1961)	(0.1888)	(0.2217)	(0.2425)	(0.2366)
$DEFAULT_{t-1}$	-0.1483***	-0.1559***	-0.1600***	-0.1255***	-0.1355***	-0.1486***
	(0.0220)	(0.0207)	(0.0228)	(0.0127)	(0.0146)	(0.0172)
$BOVESPA_t$		0.0370			0.0503*	
		(0.0343)			(0.0303)	
$EMBI+_{t-1}$			-0.0382*			-0.0436**
			(0.0209)			(0.0213)
SHOCKS	-3.6198**	-2.8247	-1.5789	-8.3769***	-7.2542*	-3.5118
	(1.7483)	(1.8379)	(2.1460)	(2.2074)	(3.8891)	(3.3443)
Adj. R^2	0.39	0.40	0.41	0.31	0.33	0.36
J-statistic				20.8938	20.4533	19.9359
P(J-statistic)				0.34	0.31	0.40
Inst. Rank				24	24	25

Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. GMM1 – one-step GMM estimation - Robust (Newey-West) standard errors are in parentheses. P(J-statistic) report the respective p-valued of the J-test.

The results of the credit spread estimations for both households and firms confirm those observed for the shorter sample. In other words, the positive and significant coefficients on *IR* denote that an increase in the monetary policy interest rate provokes an increase in the credit

spread (see tables 7 and 8). Regarding the coefficients of the other variables in the models, the estimations with the extended period show no significant changes in relation to those presented in the analysis for the shorter sample.

Table 7 - *Credit spread estimations - households (June 2001 – August 2015)*

Regressors	OLS				GMM			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	-1.2717	-1.2196	0.7735	-0.7986	-1.6730	-1.7733	1.4348	-0.6936
	(2.0163)	(1.8298)	(2.2905)	(1.9762)	(1.2481)	(1.4203)	(1.8579)	(1.3262)
IR_{t-1}	0.3976***	0.4386***	0.3306***	0.3552***	0.4043***	0.4248***	0.3463***	0.3752***
	(0.0559)	(0.0541)	(0.0510)	(0.0587)	(0.0448)	(0.0433)	(0.0449)	(0.0402)
$GROWTH_t$	-0.6091***	-0.7305***	-0.4983**	-0.4811**	-0.5064**	-0.7179***	-0.3590	-0.3457*
	(0.2105)	(0.2108)	(0.1977)	(0.2133)	(0.2325)	(0.2096)	(0.2255)	(0.1922)
$DEFAULT_{t-1}$		0.2831***				0.2814***		
		(0.0957)				(0.0624)		
$BOVESPA_t$			-0.1264***				-0.1223***	
			(0.0452)				(0.0330)	
$EMBI+_{t-1}$				0.0863**				0.0846***
				(0.0337)				(0.0246)
SHOCKS	5.0517	2.1090	2.9978	1.1132	7.1549*	3.7481	2.2096	1.5272
	(3.7017)	(3.5196)	(3.3786)	(3.3770)	(3.8722)	(3.7481)	(4.4901)	(3.5577)
Adj. R^2	0.48	0.57	0.53	0.52	0.48	0.58	0.55	0.53
J-statistic					17.7727	18.2814	16.5685	17.4495
P(J-statistic)					0.53	0.63	0.62	0.74
Inst. Rank					23	26	24	27

Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. GMM1 – one-step GMM estimation - Robust (Newey-West) standard errors are in parentheses. P(J-statistic) report the respective p-valued of the J-test.

Table 8 - *Credit spread estimations - firms (June 2001 – August 2015)*

Regressors	OLS				GMM			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Constant	-0.7409	-0.7421	0.3477	0.1717	-2.0594*	-2.1890**	-1.2797	-0.8571
	(1.6966)	(1.7019)	(2.5736)	(1.7674)	(1.1597)	(1.1042)	(1.8506)	(1.2138)
IR_{t-1}	0.2077***	0.2173***	0.1720*	0.1260**	0.1408***	0.1562***	0.1597**	0.1038*
	(0.0587)	(0.0665)	(0.0887)	(0.0638)	(0.0388)	(0.0459)	(0.0705)	(0.0544)
$GROWTH_t$	-0.2559	-0.2658	-0.1969	-0.0090	-0.7609***	-1.0506***	-0.7644**	-0.4241
	(0.2943)	(0.2882)	(0.2325)	(0.1810)	(0.2889)	(0.2879)	(0.3862)	(0.2638)
$DEFAULT_{t-1}$		0.0145				0.0078		
		(0.0383)				(0.0230)		
$BOVESPA_t$			-0.0673				-0.0295	
			(0.0797)				(0.0646)	
$EMBI+_{t-1}$				0.1665***				0.1196**
				(0.0466)				(0.0349)
SHOCKS	20.8977***	20.5295***	19.8044***	13.3013***	32.4282***	31.2070***	30.3839***	25.0119***
	(5.8785)	(6.0278)	(5.8606)	(4.5936)	(2.2517)	(2.4202)	(3.9330)	(3.5606)
Adj. R^2	0.41	0.41	0.42	0.56	0.34	0.34	0.36	0.50
J-statistic					19.6779	21.6517	18.9800	21.4426
P(J-statistic)					0.84	0.75	0.70	0.72
Inst. Rank					31	32	28	31

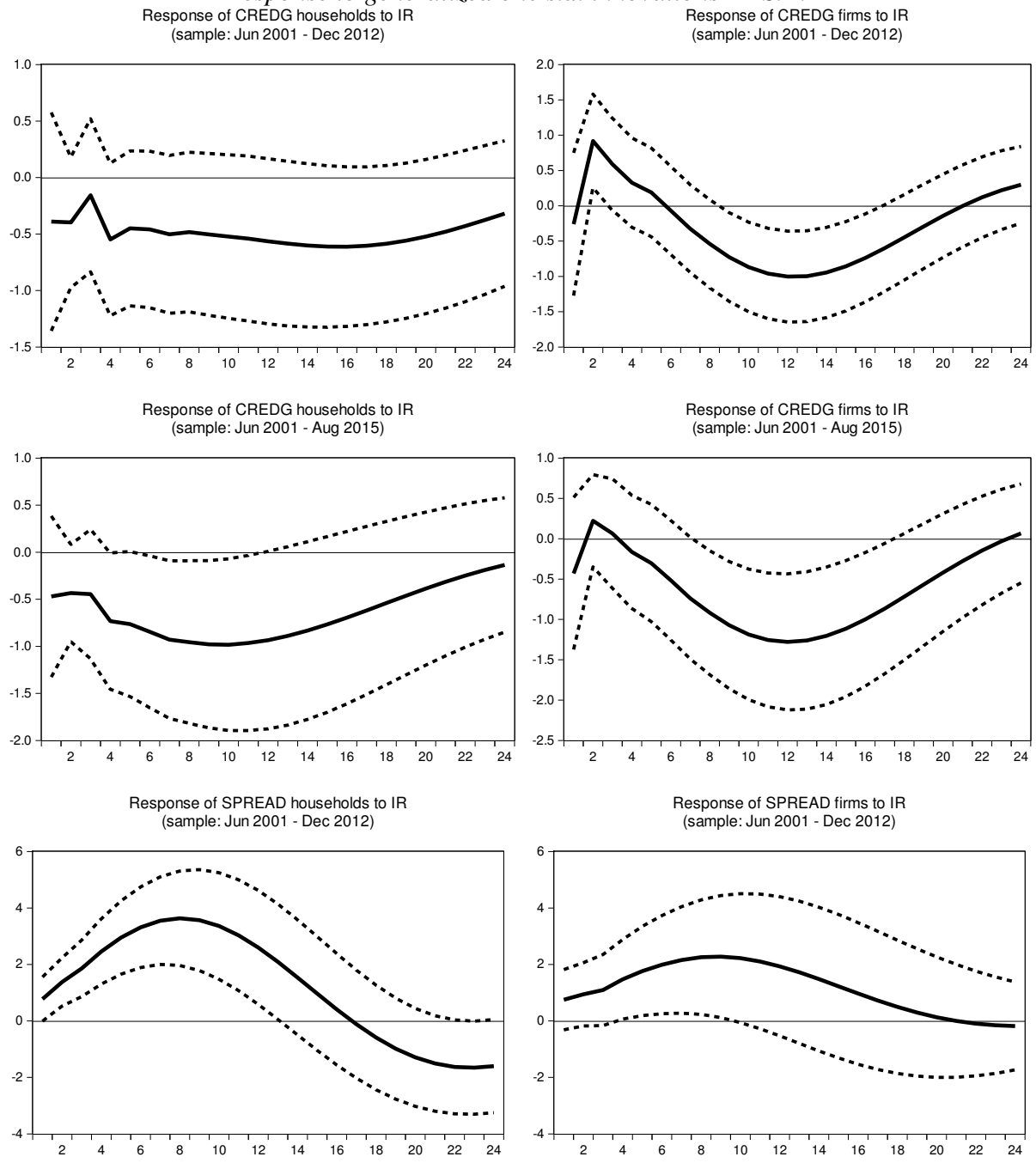
Note: Marginal significance levels: (***) denotes 0.01, (**) denotes 0.05, and (*) denotes 0.10. GMM1 – one-step GMM estimation - Robust (Newey-West) standard errors are in parentheses. P(J-statistic) report the respective p-valued of the J-test.

3.3. Impulse-response analysis

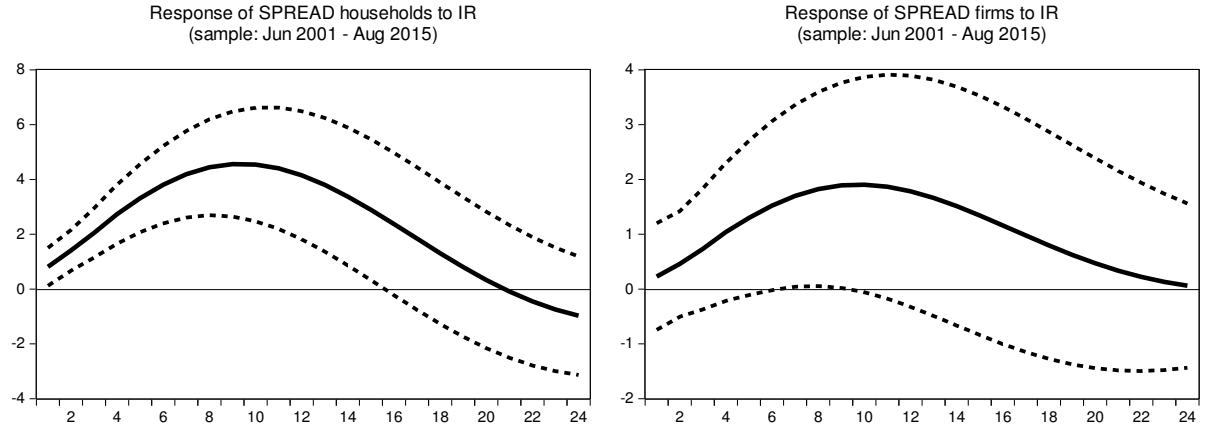
Taking into account the models in the previous subsections, the analysis is extended providing new evidence regarding the relevance of the effect of the monetary policy interest rate under a dynamic perspective through VAR models. Figure 3 shows the results of the generalized impulse-response functions and are plotted out to the 24th month.[8]

Figure 3

Response to generalized one s.d. innovations ±2 S.E.



[8] The results of the VAR stability test are provided in figure A.1 (appendix).



In general, the results on the effect of the monetary policy interest rate on credit granted are in consonance with those observed in the previous OLS and GMM models. In relation to the households, although a positive shock on the interest rate is associated with a negative effect on credit granted, statistical significance is observed only for the extended sample and at six months after the shock. The analysis regarding firms indicates that, independent of the sample in consideration, an unexpected positive shock on the monetary policy interest rate provokes a significant decrease in the credit granted after one semester.

Regarding the households, independent of the sample, the effect of a positive shock on the monetary policy interest rate provokes a significant increase in the credit spread that abides for more than 12 months. A significant increase in the credit spread is also observed when firms are considered in the analysis, however, the significant effect is shorter than those for households.

In brief, the impulse-response results suggest that an unexpected positive shock on the monetary policy interest rate decreases credit granted and it increases credit spread for both households and firms. Therefore, it is one more evidence of the relevance of the interest rate on credit channel even when the data is disaggregated for households and firms.

4. Conclusion

Based on the data available from TSMS/CBB and IPEAdata, this study analyzed the credit channel for households and firms in Brazil. In particular, the effect of the monetary policy interest rate on credit granted and on credit spread, taking into account disaggregated information for households and firms, is investigated. The findings denote that while there is a difference in the significance of the impact of the monetary policy interest rate on households and firms for the analysis of the credit granted, the relevance of the interest rate on credit spread is observed for both households and firms.

The results presented in this study suggest that the Brazilian monetary policy interest rate is not essential to explain the credit granted to households but it is relevant to the determination of credit granted to firms. It is important to note that these results are observed (OLS and GMM regressions) for both sample periods in the analysis (June 2001 to December 2012 and June 2001 to August 2015). In brief, the results indicate that the policy of encouraging the consumption via credit implemented by Lula's government in response to the subprime crisis was independent of the actions of the central bank in the search for the inflation target. In general, the results from impulse-response analysis, especially for firms, also confirm the idea that the monetary policy interest rate is relevant for the determination of the credit granted in the Brazilian economy. Furthermore, independent of the sample period under consideration, the results from the regressions for the credit spread also indicate that the monetary policy interest

rate is relevant for its determination. In particular, the magnitude of the coefficients in the regressions, as well as the impulse-response analysis, indicate that, in the case of households, an increase in the spread caused by an increase in the interest rate is greater than that observed on firms.

Based on the empirical evidence in this study, it is possible to conjecture that monetary policy actions must be concerned with the effect on credit granted to firms. This finding is in consonance with the bank lending channel. While households have access to especial credit lines (e.g., payroll lending, mortgages, real estate financing, etc.), small firms are subject to the problems of asymmetric information. Hence, if the objective of the policymaker is to use a credit policy with effects that abides over time, this monetary policy channel cannot be neglected.

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Appendix

Table A.1 - *Sources of data and description of the variables*

Variable name	Variable description	Data source
$CREDG_{FIRMS}$	(June 2001-December 2012) - Credit operations with nonearmarked funds - Consolidate grantings (accumulated in the month) - Legal entities total. (June 2001-August 2015) -Nonearmarked new operations - Series chained to reference credit - Non-financial corporations - Total	TSMS/CBB
$CREDG_{HOUSEHOLDS}$	(June 2001-December 2012) - Credit operations with nonearmarked funds - Consolidate grantings (accumulated in the month) - Individuals total. (June 2001-August 2015) -Nonearmarked new operations - Series chained to reference credit - Households - Total	TSMS/CBB
$SPREAD_{FIRMS}$	(June 2001-December 2012) - Credit operations with nonearmarked funds (preset, postset and floating rate) - Average spread - Legal entities total. (June 2001-August 2015) - Credit operations with nonearmarked funds (preset, postset and floating rate) - Average spread - Legal entities total; and Average spread of nonearmarked new credit operations - Non-financial corporations – Total.	TSMS/CBB
$SPREAD_{HOUSEHOLDS}$	(June 2001-December 2012) - Credit operations with nonearmarked funds (preset rate) - Average spread - Individuals total. (June 2001-August 2015) - Credit operations with nonearmarked funds (preset rate) - Average spread - Individuals total; and Average spread of nonearmarked new credit operations - Households – Total.	TSMS/CBB
GROWTH	Economic growth from the Gross Domestic Product (monthly) deflated by official price index (IPCA)	TSMS/CBB
IR	Interest rate - Selic accumulated in the month in annual terms	TSMS/CBB
$DEFAULT_{FIRMS}$	(June 2001-December 2012) - Credit operations with nonearmarked funds - Percentage of portfolio in arrears of more than 90 days - Legal entities total. (June 2001-August 2015) - Credit operations with nonearmarked funds - Percentage of portfolio in arrears of more than 90 days - Legal entities total; and Percent of nonperforming loans of nonearmarked credit operations outstanding - Non-financial corporations – Total.	TSMS/CBB
$DEFAULT_{HOUSEHOLDS}$	(June 2001-December 2012) - Credit operations with nonearmarked funds - Percentage of portfolio in arrears of more than 90 days - Individuals total. (June 2001-August 2015) - Credit operations with nonearmarked funds - Percentage of portfolio in arrears of more than 90 days - Individuals total; and Percent of nonperforming loans of nonearmarked credit operations outstanding - Households – Total.	TSMS/CBB
BOVESPA	Bovespa - monthly index	TSMS/CBB
EMBI+	Emerging Markets Bond Index Plus Brazil	IPEAdata

Note: TSMS/CBB - Time Series Management System/Central Bank of Brazil.

Table A.2: *AIC, SIC, and HQ criteria for VAR*

	June 2001 – December 2012											
	$CREDG_{HOUSEHOLDS}$			$CREDG_{FIRMS}$			$SPREAD_{HOUSEHOLDS}$			$SPREAD_{FIRMS}$		
Order	AIC	SIC	HQ	AIC	SIC	HQ	AIC	SIC	HQ	AIC	SIC	HQ
0	28.464	28.640	28.536	29.982	30.158	30.054	21.311	21.444	21.365	21.555	21.688	21.609
1	22.221	22.751	22.436	24.304	24.833	24.519	16.489	16.820	16.624	17.481	17.812	17.615
2	20.634	21.517*	20.993*	22.876	23.758*	23.234	15.203	15.732*	15.418*	15.852	16.382*	16.067
3	20.536	21.771	21.038	22.670	23.906	23.172	15.179*	15.907	15.474	15.763*	16.491	16.059*
4	20.449	22.037	21.094	22.507*	24.095	23.152*	15.220	16.146	15.596	15.822	16.749	16.199
5	20.572	22.513	21.361	22.517	24.458	23.305	15.235	16.360	15.692	15.895	17.020	16.352
6	20.370*	22.664	21.302	22.513	24.807	23.445	15.204	16.528	15.742	15.834	17.157	16.371
	June 2001 – August 2015											
	$CREDG_{HOUSEHOLDS}$			$CREDG_{FIRMS}$			$SPREAD_{HOUSEHOLDS}$			$SPREAD_{FIRMS}$		
Order	AIC	SIC	HQ	AIC	SIC	HQ	AIC	SIC	HQ	AIC	SIC	HQ
0	28.759	28.912	28.821	30.256	30.409	30.318	21.875	21.990	21.922	21.859	21.973	21.906
1	22.051	22.509	22.237	24.380	24.837	24.566	16.416	16.701	16.532	17.481	17.767	17.597
2	20.484	21.247*	20.794	22.870	23.632*	23.179	15.166*	15.623*	15.351*	15.907	16.364*	16.092
3	20.318	21.385	20.751	22.673	23.741	23.107	15.189	15.818	15.445	15.809*	16.438	16.064*
4	20.132	21.504	20.689*	22.500	23.873	23.057*	15.219	16.019	15.544	15.845	16.646	16.170
5	20.227	21.904	20.907	22.512	24.190	23.193	15.240	16.212	15.634	15.842	16.814	16.237
6	20.054*	22.036	20.858	22.460*	24.442	23.264	15.200	16.344	15.664	15.814	16.957	16.278

Note: (*) denotes lag order selected by the criterion.

Table A.3: *Unit root tests (ADF and PP)*

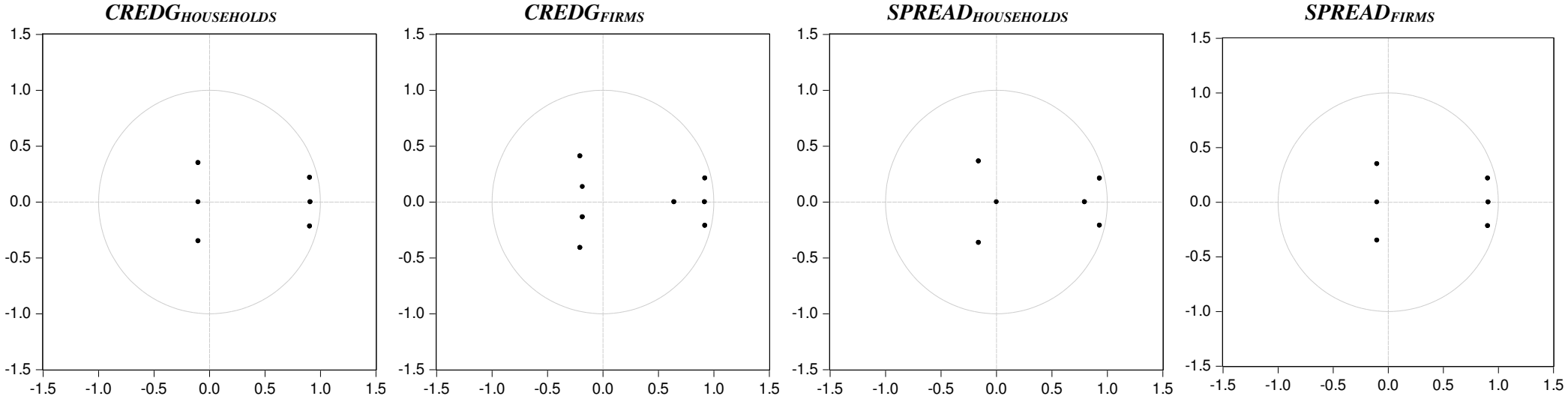
	ADF				**PP**				**KPSS**			
	June 2001 – December 2012											
Series	I/T	Lags	t-stat.	Critical value 5%	I/T	Band	Adj. t-stat.	Critical value 5%	I/T	Band	Adj. t-stat.	Critical value 10%
BOVESPA		1	-2.289	-1.943		6	-2.422	-1.943	I	9	0.168	0.347
$CREDG_{HOUSEHOLDS}$		2	-2.067	-1.943	I	7	-7.575	-2.882	I	9	0.079	0.347
$CREDG_{FIRMS}$		2	-3.074	-1.943		7	-6.009	-1.943	I	9	0.170	0.347
$DEFAULT_{HOUSEHOLDS}$		5	-5.502	1.943		8	-2.398	-1.943	I	9	0.118	0.347
$DEFAULT_{FIRMS}$		4	-4.639	-1.943		8	-2.783	-1.943	I+T	9	0.067	0.119
EMBI+		0	-2.514	-1.943		2	-2.773	-1.943	I	9	0.094	0.347
GROWTH		0	-15.168	-1.943		7	-15.399	-1.943	I	15	0.197	0.347
IR		1	-5.531	-1.943		8	-2.755	-1.943	I+T	9	0.070	0.119
$SPREAD_{HOUSEHOLDS}$		1	-2.722	-1.943		7	-3.065	-1.943	I	9	0.054	0.347
$SPREAD_{FIRMS}$		0	-2.289	-1.943		3	-2.528	-1.943	I	9	0.096	0.347
	June 2001 – August 2015											
BOVESPA		1	-2,560	-1.943		6	-2,698	-1.943	I+T	10	0,126	0,119
$CREDG_{HOUSEHOLDS}$		2	-2,223	-1.943	I	7	-7,491	-2.878	I+T	10	0,113	0,119
$CREDG_{FIRMS}$		2	-3,072	-1.943		7	-6,658	-1.943	I+T	9	0,095	0,119
$DEFAULT_{HOUSEHOLDS}$		5	-5,999	1.943		9	-2,708	-1.943	I+T	10	0,057	0,119
$DEFAULT_{FIRMS}$		13	-3,098	-1.943		9	-3,076	-1.943	I+T	10	0,104	0,119
EMBI+		0	-2,674	-1.943		0	-2,674	-1.943	I	10	0,131	0,347
GROWTH		1	-12,560	-1.943		8	-18,457	-1.943	I	22	0,324	0,347
IR		1	-5,292	-1.943		9	-3,008	-1.943	I	10	0,129	0,347
$SPREAD_{HOUSEHOLDS}$		1	-2,536	-1.943		7	-3,039	-1.943	I+T	10	0,072	0,119
$SPREAD_{FIRMS}$		0	-2,709	-1.943		4	-2,821	-1.943	I	10	0,125	0,347

Note: Note: Trend (T) and intercept (I) are included based on Schwarz criterion. ADF – the final choice of lag was made based on Schwarz criterion. PP and KPSS – spectral estimation method is Bartlett kernel and the Newey West Bandwidth is used.

Figure A.1

Inverse roots of AR characteristic polynomial

June 2001 – December 2012



June 2001 – August 2015