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Deposits channel of monetary policy and flight to quality in corporate bank loans

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1. Introduction

Credit rationing situations may be due to lenders' refusal to grant credit to applicants who seems similar to other borrowers, even in the face of desire of the rejected ones to pay a higher interest rate for using credit and/or offer guarantees at levels higher than those required by lenders (Stiglitz and Weiss, 1981). According to the economic-financial literature, the companies that are most likely to be credit restricted are small and medium-sized ones (Levenson and Willard, 2000; Beck and Demirguc-Kunt, 2006), young enterprises and those owned by the founders.

For Berger and Udell (2002) small companies are more dependent on bank financing, given that, unlike large companies, they face difficulties in accessing the capital market in order to raise funds through the issuance of shares or bonds. Such difficulties are due to imperfections in the market, such as information asymmetry and moral risk which, the more intense the higher the external financing premium. According to those authors, potential lenders of small business increase the cost of loans or refuse financing proposals, insofar as they cannot readily check the quality of the investment project (adverse selection problem) or are suspicious that borrowed funds will be diverted to alternative projects (moral hazard problem).

In addition to these aspects, other factors increase the credit risk of small and medium-sized companies and, consequently, increase the external financing premium of these agents, making them more likely to be "credit-restricted". Examples of these factors are as follows: higher bankruptcy rates compared to large companies, greater volatility of profits due to limitations in opportunities to diversify their products and customers, less financial capacity to survive during crisis and difficulties in offering accepted assets as guarantees for loans (Kumar and Francisco, 2005). Banks, for being experts in reducing problems of information asymmetry, are the actors capable of reducing the external financing premium for those agents, in such a way that bank credit becomes a more viable alternative than financing through the capital market.

Monetary policy actions can intensify situations of credit rationing, i.e., they can widen the gap between the supply and demand for credit in the market, due to the negative impacts on the willingness of banks to grant new loans and/or renew existing operations (McCallum, 1991). Thus, in theory, the impact of the effects of monetary policy on borrowers with limited access to the capital market is expected to be stronger than the impact on unrestricted borrowers, given that the formers are more dependent on bank credit (Gertler and Gilchrist, 1994). Consequently, it can be argued that changes in monetary policy through the credit channel have more significant effects on small and medium-sized companies than on large corporations (Gilchrist and Zakrajsek, 1995, Domaç, 1999, Boivin, Kiley and Mishkin, 2011).

The process through which monetary policy decisions are transmitted into changes in the rate of economic growth and inflation as called monetary transmission mechanism (Taylor, 1995). It works through several channels, among which the credit channel stands out for attributing to financial institutions an important role in the process of transmitting the effects of monetary policy. Initially explored by Bernanke and Blinder (1988), the credit channel of the monetary policy considers bank loans as an element that propagates and amplifies the effects of changes in interest rates and, therefore, as a relevant variable to explain the functioning of monetary policy.

Oliner and Rudebusch (1996) assign a relevant role for small companies in the functioning of the credit channel. In order to investigate the existence of this channel and examine whether small companies respond to monetary shocks unlike large companies, those authors used a sample of more than 7,000 companies established in the United States, in the period 1958-1992. They concluded that the credit channel exists in the transmission of the effects of monetary

policy and that it operates mainly through small companies. Their results suggest that, in the face of a contractionary monetary policy, small companies face a reduction in external sources of financing and thereby reduce their investments, whereas the same does not happen with large companies, in view of less dependence on bank credits by the latter.

A recent approach on the topic of monetary transmission mechanism is the deposits channel of monetary policy proposed by Drechsler, Savov and Schnabl (2017), whose theoretical precepts suggest that in the face of an increase in the basic interest rate, banks widen their deposit spreads (difference between the risk-free rate and the deposit rate). This leads to a contraction in deposits and, consequently, a reduction in the amount of bank credit in the economy, given that deposits are the main banks' funding. In addition, the theory proposes that the intensity of the outflows of deposits is related to the level of deposit market concentration, being more intense in more concentrated areas.

In this context, we purpose to test the hypothesis that large companies suffer less from the impact of credit rationing than companies of other sizes, when such rationing results from the effects of the deposits channel of monetary policy. Although the asymmetric effects of monetary policy in favor of large companies have already been addressed by the economic-financial literature (Gilchrist and Zakrajsek, 1995; Boivin et al., 2011; Leon, 2015), to the best of our knowledge, there are no studies that test the asymmetry of these effects considering the impacts arising from the deposits channel. Therefore, the work innovates by testing the asymmetric effects of monetary policy changes on credit for companies through the deposits channel, based on the premise that large companies, because they have lower monitoring costs, are less affected by credit rationing caused by monetary policy actions.

In addition, the work contributes to the literature related to the theme "flight to quality" (Lang and Nakamura, 1995; Bernanke, Gertler, and Gilchrist, 1996; Domaç, 1999; Kandrac, 2012) insofar as, when analyzing the credit behavior for companies of different sizes, tests whether the effects of monetary policy transmitted through the deposits channel are relevant to explain the differences between the evolution of the amount of credit for large companies and for companies of other sizes.

The paper is organized as follows: In the first section is presented a theoretical review of the topic; in the second section we present methodology, description of the data, constitution of the sample, and describe the variables and economic model; the third section discusses the results; and, finally, in the last section, final considerations about the work are considered.

2. Related literature

From the 1970s onwards, the importance of the complete markets and perfect information paradigm was reduced due to the emergence of information asymmetry concepts and agency theory. As a result, the role of credit and financial intermediaries in the functioning of the economy started to be assessed differently, gaining relevance in the development of new theories in economics and finance.

The concept of information asymmetry refers to the difference between the levels of information of individuals operating in a given market, i.e., the information is asymmetric when some individuals who operate in a given market have more information than other ones who operate in the same market. In the credit market, information asymmetry is present and more intense insofar that potential borrowers have more information about their default probabilities than lenders, either because the latter are not able to discriminate among potential borrowers with different characteristics those who are unable to honor the credit commitment, or because they cannot adequately monitor the behavior of borrowers after granting credit (Currie and Messori, 1998).

The agency theory assumes that the information is asymmetric to analyze the relationship between two parties, one called the agent and the other called the principal. In the credit market, for example, the "principal" is represented by the lender and the "agent" by the borrower, with the granting of credit being the instrument that establishes the relationship between them (Bernanke, Gertler, and Gilchrist, 1996). The principal-agent relationship, as a rule, is established in a contract, in which the principal always makes a concession to the agent with the hope that he will act in the best possible way to meet his needs. The reason for the establishment of a contract in the formalization of this relationship is due to the risk of the agents acting for their own benefit and not with a focus on the principal's interest, considering that the information is asymmetric between these actors. Therefore, according to the agency theory, the principal always incurs a cost to collect and treat the relevant information in the monitoring of the agents' actions and, in addition, establishes mechanisms (contracts, systems, etc.) to control the opportunistic behavior of the agents (Jensen and Meckling, 1976).

Within the scope of contract theory, it is common to distinguish two problems resulting from information asymmetry: moral hazard and adverse selection. Moral hazard arises when consumers (or sellers) of a given good or service take certain actions that can influence the terms and results of a transaction, but such actions cannot be controlled or monitored without cost by the sellers (or by consumers). Adverse selection, in turn, arises when each consumer (or seller) of a given good or service knows elements that are not known by the sellers (or consumers), and these elements influence the terms and results of the transactions (Currie and Messori, 1998).

In the credit market, both adverse selection and moral hazard are present and influence their functioning. Potential borrowers have better information about their own financial situation than the financial institutions that provide credit, which characterizes the information asymmetry problem in this market. Adverse selection occurs when financial institutions can grant credit to those individuals who, since the beginning of the transaction, have not been willing to honor the commitment to return the borrowed funds. Moral hazard, in turn, arises from the misapplication of borrowed funds, such as, for example, the use of funds in high-risk activities with a high potential for return, which can generate large losses to borrowers, impairing their cash flow and, consequently, their ability to pay.

Akerlof (1970), in a seminal work about the theme, used the example of used cars to explain how asymmetric information influences the dynamics of functioning in different markets. The assumption is that in the used car market, salespeople know the car better than potential buyers, so that setting low prices does not necessarily increase the demand for goods, as advocated by the mainstream. The reason for this result is that very low prices can signal to potential buyers that the car is not a good product and discourage your purchase, instead of stimulating it as expected by conventional theory. Thus, as a result of information asymmetry, price is no longer a marker for supply and demand and, at the limit, there may not be a price that balances the used car market. In this extreme situation of lack of balance between supply and demand, the used car market can be taken to its complete ruin.

Akerlof (1970) then proposes that, in order to overcome the problems of information asymmetry and avoid the ruin of the market, some institutions should be created to reduce the adverse effects of these problems, such as the offer of guarantees by the sellers, the promotion of the brand quality of the company that offers the product to the market and the registration of licenses in competent authorities for the exercise of professional activities. In the credit market, specifically, the literature that developed after Akerlof's paper (eg, Leland and Pyle, 1977; Stiglitz and Weiss, 1981; Diamond, 1984; Sharpe, 1990; Bernanke, 1993; Qian and Strahan, 2007; Crawford, Pavanini and Schivardi, 2018) focused on two mechanisms that reduce the information asymmetry problems: the existence of banks or other financial intermediaries and the structure of financial contracts.

Banks and other financial intermediaries (pension funds, insurance companies, brokers, etc.) are specialists in obtaining and processing information, evaluating projects and potential borrowers, and monitoring debtors after granting credit. These characteristics give these agents advantages in reducing problems of information asymmetry and, consequently, make them more efficient in the credit creation process and in the ability to provide liquidity to the market. Because they are the agents that have the ability to both take deposits and grant loans, banks have advantages in the financial intermediation process and are considered by the literature as the main agents in the credit creation process (Bernanke, 1993; Molnár, 2018).

For Stiglitz and Weis (1981), the reduction of informational problems in the credit market can occur with the manipulation of interest rates on loans by banks. According to those authors, for a given level of collateral required by lenders, an increase in the interest rate on loan operations causes an adverse selection of borrowers, considering that, as loans become more expensive, more and more, it will be those agents with riskier investment projects that will be willing to take resources, since they are the ones that have the highest expected rates of return on investment and, therefore, can support the highest financial expenses. Thus, in balance, lenders establish an interest rate that causes an excess demand for loans in the market, in order to identify those borrowers with high risk investment projects and restrict their access to the credit market (Stiglitz and Weiss, 1981).

Such actions result in situations of credit rationing, in this case called borrower rationing (Kirschenmann, 2016), and which occurs at the moment when among a set of loan applicants who appear to be identical, some receive the desired funds and others do not, even in the face of the rejects' willingness to pay a higher interest rate for granting credit and/or offering collaterals at levels higher than those demanded by lenders.

According to the economic-financial literature, the companies most likely to be restricted to credit are small and medium-sized ones (Levenson and Willard, 2000; Beck and Demirguc-Kunt, 2006), young enterprises and whose owned by the founders, in view of these be the most susceptible agents to suffer from the problems arising from information asymmetry. The data exposed in Kumar and Francisco (2005), which used information from 1,642 companies contained in the Investment Climate Assesment Servey on Brazil, prepared by the World Bank in 2003, suggest the adequacy of these concepts in the literature to the Brazilian case. According to those authors, 54% of the large companies in the sample did not submit a loan proposal to a financial institution because they declared that they did not need the funds, against 39% of micro companies. Only 2.7% of large companies had rejected loan proposals, compared to 9.4% of micro companies. Approximately 18% of large companies did not apply for loans even with the need for funds, against 38% of micro companies, with high interest rates being the main reason for not submitting credit proposals. These data reveal that micro companies, when compared to large ones, although they have a greater need for loans, suffer more credit restrictions, either because their proposals are rejected, or because they do not submit loan proposals for fear of being rejected or because they consider their conditions inappropriate.

Gómez (2018), in order to verify the impacts of credit restrictions on investment, working capital and growth of small and medium-sized companies in Europe, used the information from the Survey on the Access to Finance of Small and Medium Sized Enterprises (SAFE) and considered a sample of 5,000 companies, distributed in twelve countries, in the period from 2014 to 2016. As restricted companies, the author considered those ones that were in at least one of the following situations: requested external financing, but were rejected; received only a part of the requested external financing; they did not accept the credit offered because they considered the interest rate too high; and/or did not apply for external financing because they believed they would be rejected (classified by the author as “discouraged borrowers”).

The results presented by Gómez (2018) reveal that the restriction of bank credit has important effects on investment in fixed assets, in working capital and in the growth of

companies. For companies that presented some type of restriction to bank credit in the period, an average probability of 2.1% reduction in investments and 2.9% reduction in labor was estimated (proxy used for the variable company's growth). The results of the restriction of bank credit on working capital obtained by the authors were not statistically significant.

Galdelman and Rasteletti (2017) used data from Uruguayan companies in the period 1997-2008, compiled in surveys conducted by the National Statistics Institute of Uruguay, to assess whether the level of informality in a sector directly or indirectly affects the investment decision of companies, through access to bank credit. The results obtained by the authors reveal that companies operating in more formal sectors are less restricted than companies operating in sectors with higher levels of informality. However, formality does not necessarily translate into investment decisions. According to the results obtained by the authors, it was not possible to identify a direct effect of informality on companies' investment decisions, but there is evidence that credit restriction, indirectly, negatively affects these decisions.

Monetary policy actions can intensify situations of credit rationing, i.e., it can widen the mismatch between the supply and demand for credit in the market, due to the negative impacts it has on the willingness of banks to grant new loans and/or renew existing ones (McCallum, 1991). A monetary tightening policy, for example, which causes a decrease in the amount of resources reserved for loans by financial institutions, negatively impacts the supply of credit in the market, as some borrowers do not have their requests for renewed loan operations accepted and others have their requests for new loans rejected (Blinder and Stiglitz, 1983).

In view of this evidence, it can be inferred that the monetary policy actions transmitted through the credit channel intensify credit rationing and aggravate the credit restriction scenario. The effects of this process are more present in small and medium-sized companies due to the fact that these agents are financially more restricted than large corporations (Beck and Demirguc-Kunt, 2006), being possible to assume, therefore, that monetary policy, through credit channel, has more significant effects on small and medium-sized companies than on large ones (Gilchrist & Zakrajsek, 1995; Boivin et al., 2011).

According to Domaç (1999), an additional reason for small and medium-sized companies to be affected disproportionately by the effects of the monetary policy credit channel stems from the possibility that monetary tightening is followed by “flights to quality” of bank loans. More specifically, that author suggest that banks can respond to monetary restrictions not only by restricting the overall supply of credit, but by adopting stricter lending policies for those customers considered less able to meet credit obligations, that is, for those customers with a higher level of risk, less capitalized and less capacity to offer collaterals.

Lang and Nakamura (1995), in turn, when specifically evaluating situations of “flight to quality” in the banking market suggest that, in the context of models that consider markets with imperfect information and heterogeneous borrowers, the situations of monetary tightening causes a “flight to quality” by the financial intermediaries, that is, they cause an increase in the preference of these intermediaries to invest their assets in government bonds or in less risky loans. According to those authors, the implication of the “flight to quality” is that, in situations of monetary tightening the amount of credit they call “insurance” (defined as loans whose financial cost is less than the prime rate + 1%), generally related to large loan operations, increases proportionally to the amount of credit considered “unsecured”. Their results suggest that smaller and more risky borrowers are disproportionately affected in the early stages of monetary tightening episodes.

Bernanke et al. (1996) associate “flight to quality” situations with agency theory when formulating the theory of the financial accelerator. For those authors, changes in the credit market amplify and propagate the effects of real or monetary shocks (concept of financial accelerator) and agents subject to high agency costs are more affected in this process. In situations of worsening macroeconomic conditions, agents with high agency costs (consumers,

small businesses and companies with weak balance sheets) experience reduced access to credit when compared to agents with lower agency costs. Thus, when there is a prospect that agency costs for loans will rise (increased risk of bankruptcy, for example), lenders reduce the granting of credit to firms that require more intense monitoring and invest a larger share of their savings in safer alternatives.

A similar conclusion is presented by Kandrac (2012) in a study developed with the objective of empirically testing the balance sheet channel of monetary policy for the US economy. According to that author, in response to movements in the tightening of monetary policy, banks exhibit a significant flight towards quality and decrease the proportion of credit granted to borrowers considered to be of high agency cost (high- agency-cost borrowers, according to the name given by the author). As a strategy to identify this effect, Kandrac (2012) used as a dependent variable in his model the ratio between the total commercial and industrial loans (C&I) directed to small businesses and the total commercial loans for companies of each bank (variable called SBL, small-business-loan-to-total). It is worth mentioning that the criterion for classifying the loan as directed to small businesses is the value of the operation and not the size of the borrower, being classified as loans directed to small businesses those with a value less than US$1 million.

Psillaki and Eleftheriou (2015) identified the phenomenon of flight to quality in the French credit market when investigating the impact of the global financial crisis on the allocation of credit to small and medium-sized companies, considering a sample of 6,552 companies operating in the period 2001-2009. According to those authors, during the crisis period (2007 to 2009) large companies received a larger share of bank credit than smaller companies, supporting the hypothesis that in bad times credit flows away from those borrowers with higher agency costs.

In general, the theory recommends that, in the face of episodes of economic retraction and consequent monetary tightening, small and medium-sized companies suffer a more severe credit restriction than large companies. In addition, given the fact that companies of this size are more dependent on bank credit than large corporations, credit rationing has a more effective negative impact on their growth rate, investments and current operations.

3. Data and methodology

3.1. Data base

The database created for carrying out the tests comes from the Credit Information System of the Central Bank of Brazil (SCR) and presents the balances of the active loan portfolios for companies at the end of the period, divided by size (large, medium, small and micro companies) and by bank, in the period between June 2012 (beginning of the series' release by the Central Bank of Brazil) and December 2018, quarterly.

Companies whose annual gross revenue exceeds R$300 million (local currency) or total assets exceed R$240 million are classified as large; as medium, those companies whose annual gross revenue is greater than R$ 4.8 million and less than or equal to R$300 million, provided that their total assets do not exceed R$240 million; small companies whose annual gross revenue is greater than R$360 thousand and less than or equal to R$4.8 million; finally, as micro those companies whose annual gross revenue is equal to or less than R$360 thousand.

The database used in the estimation of the results was made up of 1,902 observations, relating to 92 banks, in the period between June 2012 and December 2018, with balances of the credit portfolios at the end of each month, with quarterly periodicity.

3.2. Model specification and selection of variables

To test the differences in intensity of the effects of changes in monetary policy through the deposits channel on stock of corporate bank loans due to the monitoring cost resulting from the size of the companies, the following model will be used, based mainly on Kandrac (2012):

$$\%cred\_HAC_{jt} = \Phi\ \%cred\_HAC_{jt-}\ + \beta_1 Selic_t\_x\_Bank\_HHI_{j,t-1} + \beta_2 Bank\_HHI_{j,t-1} + \theta_t + \gamma \sum_{n=1}^{N} (Controls_n)_{it} + \varepsilon_{jt}$$

Where:

- $\%cred\_HAC_{jt}$ measures the proportion of balances of active credit portfolios for legal entities classified as high-agency-cost borrowers - micro, small and medium-sized companies - in the total active credit portfolio for companies of each bank "j", at the end of the "t" period. The variable is calculated according to the following ratio:

$$\%cred\_HAC_{jt} = \frac{Total\ Balance\ of\ the\ Active\ Credit\ Portfolio\ for\ Micro, Small\ and\ Medium\ Enterprises_{it}}{Total\ Balance\ of\ the\ Active\ Credit\ Portfolio\ for\ Micro, Small, Medium\ and\ Large\ Companies_{it}}$$

The option of using the name High-Agency-Cost (HAC) for micro, small and medium-sized companies, following the nomenclature proposed by Kandrac (2012), was considered the most appropriate in this paper due to the existence of different methodologies to define the size business. By deduction, the name of Low-Agency-Cost (LAC) was attributed to large companies, inspired by the economic-financial literature that suggests that these companies have lower monitoring costs because they are less exposed to market imperfections, i.e., because they present in a lesser proportion problems of information asymmetry and moral hazard (Bernanke et al., 1996; Domaç, 1999; Berger and Udell, 2002; Cenni, Monferrà, Salotti, Sangiorgi and Torluccio, 2015).

- $\%cred\_HAC_{jt-1}$ is the same variable specified in the previous item, but lagged by 1 period of time (one quarter), which gives the data panel a dynamic characteristic. The expected relationship of this variable with the dependent variable is positive, given that the proportion of credit for HAC companies is expected to persist over time;
- $Bank\_HHI_{j,t-1}$ is the average of the Herfindahl-Hirschman Indexes (IHH) for the total bank deposits held at branch "i" calculated for each county "k" in the time period "t" ($Branch\_HHI_{i(k)t}$), weighted by the participation of each branch in the total deposits of bank "j". The variable is lagged in 1 period (1 quarter). A negative value for the coefficient of this variable indicates that the greater the market power over deposit of a bank, the smaller the proportion of its loan portfolio applied to companies with high monitoring costs (and vice versa);
- $Selic_t\_x\_Bank\_HHI_{j,t-1}$ is the interaction between the basic interest rate of the Brazilian economy (Selic Rate) in the "t" period with the weighted average of the Herfindalh-Hirschman Index in the bank deposit market for each bank belonging to the sample in the "t – 1" period. The expected relationship of this variable with the response variable is negative, considering that the theory proposes that in the face of increases in the basic interest rate, banks "fly" to quality and reduce the granting of loans to companies with higher monitoring costs (Lang, & Nakamura; Bernanke et al., 1996; Domaç, 1999; Kandrac, 2012). Therefore, it is expected that the coefficient of this variable will be negative, in order to indicate that, in the face of interest rate increases, the proportion of credit for HAC companies in the total active bank loan portfolio decreases;

- θ_t: represents the time fixed effects and has the objective to capture any and all shock in the dependent variable that simultaneously affected all banks in the sample and, therefore, to control for time-invariant characteristics and for macroeconomic shocks.
- The control variables, based on the literature (Almeida and Divino, 2017; Fucidji and Prince, 2009; Vasconcellos, Fucidji, Scorzafave, and Assis, 2004), are:
    - Size (Tam_{jt}): given by the natural logarithm of the total assets of bank "j" at the end of period "t". A negative sign is expected for its coefficient, indicating that the larger the bank the smaller the proportion of the loan portfolio directed to HAC companies;
    - Bank $Spread_{jt}$: given by the difference between the average rate obtained with credit operations and the funding cost, represented by the Selic rate, for bank "j" to which branch "i" belongs, at the end of period "t". The average rate of loans is measured as the ratio between income from financial intermediation and the total volume of credit operations. A positive relationship with the response variable is expected, given that theoretically credit operations for HAC companies tend to have higher external financing premiums (Bernanke and Gertler, 1995; Berger and Udell, 2002) and, consequently, greater spread credit. The higher the bank spread, the greater the proportion of the loan portfolio applied to HAC companies (positive relationship between variables);
    - Securities ($Securities_{jt}$): represented by the ratio between the amount recorded in securities and the total assets of each bank "j" to which the branch "i" belongs, at the end of the period "t". According to Araújo (2013), smaller proportions of securities transactions indicate less preference for liquid assets, in favor of credit transactions. Thus, a negative relationship with the dependent variable is expected, since an increase in the application of banking assets in securities implies a decrease in the total credit portfolio and, according to the theory, in small and medium credit rationing situations companies are more affected than large companies. Therefore, a reduction in the proportion of loans to these companies (HAC companies) is expected in the banks' total credit portfolio when banks direct funds to securities instead of investing in credit operations:
    - Funding $expenses_{jt}$: given by the ratio between funding expenses and total liabilities of bank "j" to which branch "i" belongs at the end of period "t". The higher the funding expenses, the lower the banks' profit from credit operations, so that a negative relationship with the response variable is expected, for the same reason as reported for the previous variable.
    - Credit $Risk_{jt}$: given by the ratio between the Provision for Credit Losses (PCL) and the total loan operations net of the provision of bank "j" to which branch "i" belongs, at the end of period "t". Credit risk can be understood as a measure of the quality of the credit portfolio of institutions, i.e., the higher the risk the lower the quality of loans granted. Thus, a positive relationship with the response variable is expected, as, in theory, the higher the credit risk the greater the proportion of credit for HAC companies in the bank's total portfolio. This is because, theoretically, credit operations for HAC companies present higher levels of risk than credit operations for LAC companies.

Parameter estimation will be performed using the System Generalized Method of Moments (hereinafter referred to as GMM-Sys), developed by Arellano and Bover (1995) and Blundell and Bond (1998) for the treatment of models of dynamic panel. The dynamic panel instrument captures the persistence of the response variable, in this case represented by the proportion of credit for HAC companies ($\%cred\_HAC_{jt}$) in each bank, by including lags of that proportion ($\%cred\_HAC_{jt-1}$) as explanatory variables in the regression model. In addition, GMM-sys uses the first difference transformation to control for the unobserved heterogeneities (fixed effects) of the banks and, at the same time, uses the lags of the dependent variable and the control

variables as instrumental variables to control for other endogeneity problems, such as omitted variable bias, simultaneity and regressor measurement errors.

According to Roodman (2009), the GMM-sys estimators were developed to be applied in the following situations: 1) Data panel with short periods of time (small T) and large number of individuals (large N); 2) linear functional relationship between variables; 3) variable responses depending on your own past achievements; 4) independent variables that are not strictly exogenous, i.e., that are correlated with the past values and, possibly, with the present values of the error term; 5) existence of individual fixed effects (endogeneity not observed); and 6) heteroscedasticity and autocorrelation within individual data, but not among individuals.

The database for estimating our model fits these situations in view of the following characteristics: 1) the database consists of 27 time periods (T = 27) and 92 individuals (N = 92); the functional relationship between the independent variables and the response variable ($\%cred\_HAC_{jt}$) is linear; 3) the response variable ($\%cred\_HAC_{jt}$) depends on your past achievements, in view of the assumption of the time persistence of the ratio between HAC deposits and total deposits; 4) the control variables (Size, Bank Spread, Securities, Funding Expenses, Credit Risk and Bank_HHI) are potentially influenced by their past and present values and, potentially, influence their future values; and 5) there is endogeneity not observed in the model due to the omission of important variables for the explanation of the dependent variable, such as the banks 'operating strategies, differences in loan opportunities and changes in companies' business decisions.

The estimation of parameters with the use of GMM-sys begins with the transformation of all variables in the model by first differences (differences in variables in relation to their lagged values) or by orthogonal deviations (differences in variables in relation to the average of all the future available observations of these same variables), constituting a new equation called "transformed equation", in which unobserved heterogeneity (fixed effect) is eliminated. Then, a system of two equations is formed - the original and the transformed equation - and the lagged values of the regressors are used as instruments to estimate the parameters of the transformed equation and the lagged values of the variables in first differences (or orthogonal deviations) as instruments to estimate the parameters of the original equation. In addition, those variables considered strictly exogenous (such as time dummies, for example), in the sense that they are not correlated with the error term at all times of time (past, present and future) are also used as instruments in the equations transformed and original (Roodman, 2009; Magee, 2013).

In view of the use of lagged variables as instruments, the proper use of GMM requires the correct identification of the degree of endogeneity of each of the variables considered in the model. In this way, the variables are classified into three types: predetermined, endogenous and strictly exogenous. The predetermined variables are those potentially correlated with the past values of the structural error term, but not correlated with the present and future values of that term. In turn, the endogenous variables are those potentially correlated with the past and present values of the structural error term, but not with the future values of that term. Finally, the variables considered strictly exogenous, as already mentioned in the previous paragraph, are those potentially not correlated with the term structural error, neither in the past, nor in the present nor in the future (Arellano, 2003).

Among the variables included in the model, the time dummies (time fixed effects) are considered strictly exogenous and the other variables are considered endogenous. Such classifications are due to the potential correlation that these variables have with the variables omitted (not time fixed) in the model, such as the bank's operating strategies, differences in loan opportunities, changes in corporate strategies, among others. While the passage of time does not correlate with these variables at any point in time (past, present and future), the other variables are potentially influenced by the past and present values of these variables and, potentially, influence such variables in the future.

The methodology adopted for the construction of the transformed equations is the orthogonal deviations. According to Roodman (2009), the transformation in first difference suffers from the loss of data in unbalanced panels, because, when not finding the lagged value for a given observation the transformation could not be done and the information is disregarded in the calculation process. On the other hand, the transformation by orthogonal deviations, regardless of the number of gaps in the data panel, considers all observations in the calculation process (except the last of each individual), minimizing data loss and preserving the sample size in panels unbalanced. Thus, the choice for orthogonal deviations in the estimation of parameters is justified by the fact that the panel constituted by the sample is unbalanced, that is, it does not have equal amounts of observations for all banks over time.

In addition, we opted the GMM two-step estimator instead of the GMM one-step ones. According to Windmeijer (2005), in its construction the GMM one-step estimator uses weighting matrices that are independent of the estimated parameters, while the GMM two-step estimator weighs the current conditions by a consistent estimation of its covariance matrices. The two-step GMM estimator is robust to any patterns of heteroscedasticity and cross-correlation and is asymptotically efficient, but its standard errors tend to show a downward bias. However, Windmeijer (2005) mitigated this problem by proposing a finite sample correction for the covariance matrix (Roodman, 2009), so that the estimates obtained by the robust two-step estimator became more efficient than those obtained with the robust one-step estimator, especially for the case of GMM-sys.

4. Results

4.1. Descriptive statistics

Table 1 shows, for each of the variables of interest (except control variables), the number of observations, the mean, the standard deviation and maximum and minimum values:

Table 1 – Descriptive statistics

Variables	Obs.	Mean	Stand. Dev,	Min	Max
%cred_HAC	1,902	0.59	0.319	0	1
Selic	1,902	10.22	2.902	6.40	14.15
Bank HHI	1,902	0.172	0.067	0.11	0.516

Notes: (1) %cred_HAC represents the tatio between the balances of active credit portfolios for companies classified as high agency cost borrowers (HAC) and the total balance of the active credit portfolio for companies, maintained by each bank "j" at the end of period "t" (2) Selic is the Brazilian basic daily interest rate effectively calculated on the last business day of the "t" period and capitalized per year; (3) Bank_HHI is the weighted average of the Herfindahl-Hirschman Indexes for each bank "j".

The simple correlation matrix between the variables is shown in table 2:

Table 2 – Simple correlation matrix

	$Bank\ HHI_{t-1}$	$Selic_t$ x $Bank\_HHI_{t-1}$	Selic	%cred_HAC
$Bank\ HHI_{t-1}$	1			
$Selic_t$ x $Bank\_HHI_{t-1}$	0.799	1		
	0			
Selic	0.0474	0.597	1	
	0.04	0		
%cred_HAC	0.348	0.282	0.0291	1
	0	0	0.2	

Notes: the values below each correlation coefficient refer to the respective levels

of statistical significance.

The expected correlation between the variables "%cred_HAC" and "Selic" was negative, in view of the premise that in the face of interest rate increases, the theory advocates that banks direct their resources towards higher quality assets (more insurance). Although positive, the correlation coefficient found between these variables is statistically insignificant, requiring more robust tests to determine this relationship.

The same negative relationship was expected between the variables "%cred_HAC" and "Selic_x_Bank_HHI", which would indicate a reduction in the proportion of credit for HAC companies in the face of an increase in the interest rate. Nevertheless, the correlation is positive and statistically significant, although it is low [0.282]. In the next sections, additional tests will be presented for a better analysis of the results.

4.2. Results

To analyze the asymmetry of the impacts of changes in monetary policy on the volume of credit due to the size of the borrowing companies, bank credit data for companies from the Central Bank's Credit Information System (SCR) were used, adjusted by the IPCA (consumer price index) for the December 2018 base date. The results were estimated according to model presented in subitem 3.2. In addition to the variables of interest and the time fixed effects, the control variables listed in that subitem were included in the estimation.

The two-step GMM-sys estimator was used with transformation of the model variables by orthogonal deviations, considering robust standard errors. Time dummies were treated as strictly exogenous variables and were used as standard instruments in both equations (level and transformed). The other variables were considered endogenous and their lagged values in 2 and 3 periods were used as instruments in the transformed equation, while their lagged values in differences in 1 period were used as instruments in the level equation.

To give robustness to the results, the parameters were estimated with six variations of the original model, according to information contained in columns 2 to 7 of table 3. In the first variation (column 2) the modification was limited to include the Selic variable as an independent variable in the model , despite its effect having already been absorbed by the fixed effects of time, and treating it as a standard instrument (strictly exogenous variable) both in the level equation and in the transformed equation.

In the second variation (column 3) the results were obtained using the GMM-sys one-step estimator, keeping the other specifications of the original model. In the third and fourth variation of the model (columns 4 and 5) the estimates were performed with the exclusion of the set of control variables. In this case in column 4 the Arellano-Bond test (second order serial correlation) was rejected only at the significance level of 5% and in column 5, due to the increase in the instruments used in the transformed equation (lagged values in 2, 3 and 4 periods of the endogenous variables, instead of the lag in 2 and 3 periods only) and the inclusion of the second lag of the variable of interest among the regressors of the original equation, the second order serial correction was rejected above the 10% significance level (more precisely, at the significance level of 55%), which it is more appropriate.

Column 6 presents the results obtained using the one-step GMM difference estimator (GMM-dif), with the use of values at the level of endogenous variables lagged in 2, 3 and 4 periods as instruments in the transformed equation. It's worth noting that, in this case, the result of the variable of interest ($Selic_t$_x_$Bank_HHI_{j,t-1}$) is only statistically significant if the second lag of the dependent variable is included in the model. Finally, in a last variation of the model (column 7), the orthogonal deviations lagged in two periods of the endogenous variables were considered as instruments for the transformed equation, instead of their level values.

The estimation results are presented in the table 3:

Table 3 – Deposit channel, corporate credit operations and flight to quality

	$\%cred\_HAC_{j,t}$						
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Selic_t$_x_Bank_$HHI_{j,t-1}$	-0.125**	-0.125**	-0.143***	-0.162***	-0.155***	-0.107*	-0.238*
	(0.055)	(0.055)	(0.053)	(0.055)	(0.054)	(0.059)	(0.129)
$\%cred\_HAC_{j,t-1}$	0.711***	0.711***	0.689***	0.660***	0.490***	0.447**	0.604***
	(0.110)	(0.110)	(0.107)	(0.098)	(0.185)	(0.213)	(0.197)
$\%cred\_HAC_{j,t-2}$					0.081	0.061	
					(0.084)	(0.091)	
$Selic_t$		0.024					
		(0.048)					
F test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hansen test (p-value)	0.244	0.182	0.244	0.279	0.204	0.104	0.187
Arellano-Bond test for AR(1)	0.000	0.000	0.000	0.000	0.002	0.004	0.000
Arellano-Bond test for AR(2)	0.107	0.107	0.125	0.084	0.553	0.575	0.140
Observations	1,753	1,753	1,753	1,783	1,675	1,564	1,753
GMM	Systemic	Systemic	Systemic	Systemic	Systemic	Differences	Systemic
Estimator	*two-step*	*two-step*	*one-step*	*two-step*	*two-step*	*one-step*	*two-step*
Laglimits	(2_3)	(2_3)	(2_3)	(2_3)	(2_4)	(2_4)	(2_2)
Controls	Yes	Yes	Yes	No	No	Yes	Yes
Numbers of groups	86	86	86	87	85	83	86
Numbers of instruments	47	47	47	32	33	45	40

Source: prepared by the authors. Notes: (1) The values in parentheses represent robust standard errors; (2) Levels of significance: * p <0.1, ** p <0.05 and *** p <0.01; (3) The data used in the estimates are quarterly and refer to the period between June 2012 and December 2018; (4) ($\%cred\_HAC_{j,t-1}$) and ($\%cred\_HAC_{j,t-2}$) represent the proportion of the balances of active credit portfolios for legal entities classified as high-agency-cost borrowers - micro, small and medium-sized companies - in the total active loan portfolio of companies, of each bank "j", at the end of the periods "t-1" and "t-2", respectively; $Selic_t$_x_Bank_$HHI_{j,t-1}$ is the interaction between the basic interest rate of the Brazilian economy (Selic rate) in the "t" period with the weighted average of the Herfindalh-Hirschman index in the bank deposit market, attributed to each bank belonging to the sample, lagged in 1 period; (5) regressions 1, 2, 3, 6 and 7 include the following controls (coefficients not shown): Bank $spread_{j(i)t}$ (difference between the average rate of credit operations and the cost of funding per bank), $Securities_{jt}$ (ratio between the amount recorded in securities and total assets per bank), Funding $Expenses_{jt}$ (ratio between funding expenses and total liabilities per bank), Credit $Risk_{jt}$ (ratio between PCL and total loan operations net of the provision, per bank) and $Size_{jt}$ (natural logarithm of the total assets of each bank "j" at the end of period "t"); (6) the negative signs for the coefficients related to the variable "$Selic_t$_x_Bank_$HHI_{j,t-1}$" observed in all scenarios indicate that, in the face of increases in the Selic rate, banks that, on average, capture deposits in counties with higher concentration indexes (with greater market power over deposits) reduce the proportion of credit directed to companies with a high-agency-cost (HAC companies) in their total loan active portfolios, when compared to banks that, on average, also capture deposits in counties with lower rates of concentration (with less market power over deposits).

In all the scenarios considered in the table 3, the following characteristics are observed that validate the results obtained:

- the estimated values for the variable of interest ($Selic_t$_x_Bank_$HHI_{j,t-1}$) were shown to be statistically significant at the 1% significance level in scenarios 3, 4 and 5, at the significance level of 5% in scenarios 1 and 2 and, at the significance level of 10% in scenarios 6 and 7;
- the number of groups is greater than the number of instruments in all cases. This is desirable according to Roodman (2009), because the proliferation of instruments can cause an over-adjustment in endogenous variables and fail to purge their endogenous components;
- the F test rejected the null hypothesis that the parameters estimated together are equal to zero. This means that at least one explanatory variable is statistically significant to explain the

variability of the dependent variable in each model, with such regression models being statistically significant for forecasting purposes (Fávero, 2015);

- Hansen's J test of overidentification of restrictions did not reject the null hypothesis that "all overidentification restrictions are valid", that is, that the instruments are valid insofar as they are not correlated with the error term. In addition, except for scenario 4, the p-values of this statistic were below 0.25, the maximum limit suggested by Roodman (2009) for the validity of the test. According to Roodman (2009), p-values above 0.25 (or below 0.10) for Hansen's J test are signs of potential problems resulting from the proliferation of instruments.
- The first order serial correlation test of the error term [AR (1)], whose null hypothesis is "absence of autocorrelation", was rejected at the significance level of 1% in all estimates. In turn, the second order serial correlation test of the error term [AR (2)], whose null hypothesis is "absence of autocorrelation", was not rejected at the significance level of 10% in practically all estimates (exception only in scenario 4, whose rejection occurs at the 8.4% significance level). According to Cameron and Trivedi (2009), these results reveal that the error term is not serially correlated and that the estimates are consistent.

For scenario 1, considered the most appropriate for the reasons already explained in the previous paragraphs, the variable of interest ($Selic_t$_x_$Bank_HHI_{j,t-1}$) is statistically significant below the 5% significance level (more specifically, at a significance level of 2.6%) and its negative sign suggests the following: in view of an increase of 1 bps in the Selic rate, on average and *ceteris paribus*, banks that raise deposits in more concentrated counties show a reduction of up to 12.5% of the proportion of the active loan portfolio for HAC companies in the total of the active loan portfolio for companies, when compared to banks that raise deposits in less concentrated counties. It is worth noting that this percentage applies to the extreme case of banks whose average HHIs are equal to 1 and 0.

More specifically, the results suggest that, on average and *ceteris paribus*, a bank whose variable "Bank_HHI" is equal to a standard deviation above the average (Bank_HHI = 0.24) reduces the proportion of credit by approximately 3 bps for companies considered HAC in the total of their active corporate loan portfolio [= (0.125x0.24) x100], while a bank whose same variable is equal to a standard deviation below the average (Bank_HHI = 0.11), presents reduction of approximately 1.4 bps [= (0.125x0.11) x100] of this same proportion.

These results suggest that, in the face of changes in the basic interest rate banks have asymmetric behavior in relation to the granting of credit to large companies (LAC) vis-à-vis the granting of credit to companies of other sizes (HAC), being that the intensity of this asymmetry varies with the degree of market power over deposits. The lesser impact of monetary policy changes on credit to large companies is not necessarily an innovation, considering the literature on the topic presented in the theoretical foundation (Gertler and Gilchrist, 1994; Gilchrist and Zakrajsek, 1995; Oliner and Rudebusch, 1996; Domaç, 1999; Boivin et al., 2011). However, to the best of our knowledge, this is the first study that shows evidence that differences in market power over deposits between banks have an influence on this process.

In general, the results obtained in the estimates reveal that, in the face of an increase in the interest rate (monetary tightening), banks, on average, present a flight to quality behavior and reduce the proportion of credit granted to companies with higher risk and high agency cost or, on the other hand, increase the proportion of credit for companies with lower risk and low agency cost. However, these effects of the interest rate on the behavior of banks are only valid when considering the interaction of the rate with the weighted average of the concentration index in the deposit market, attributed to each bank. As a result, the results obtained reveal that the flight movement towards the quality of banks resulting from changes in monetary policy is more intense in those banks that, on average, raise funds in markets with higher concentration on deposits, that is, in those banks that have greater market power over deposits.

This implies that banks use their market power on deposits to intensify flight behavior for quality in the face of tightening situations. This result fits the theory related to the theme (Lang and Nakamura, 1995; Bernanke, Gertler, and Gilchrist, 1996; Domaç, 1999; Kandrac, 2012), but innovates by associating flight to quality intensity with market power over deposits exercised by banks. The results obtained in the estimates are robust and expand the understanding of the effects of monetary policy through the deposit channel, insofar as they explore the asymmetry of the impacts of this channel on the volume of credit due to the potential cost of monitoring companies. In addition, they contribute to the understanding of the reasons why the evolution of credit portfolios for large companies and for SMEs companies are divergent in some periods, as observed in sub-item 4.2. They also collaborate with the credit rationing literature by identifying which monetary policy actions influence the availability of credit in the economy and, specifically, the availability of credit to companies in Brazil.

5. Conclusion

For being more exposed to problems arising from information asymmetry, companies classified as high-agency-cost (HAC) are more likely to be credit restricted at the same time that they are more dependent on bank financing as they face difficulties in accessing the capital market in order to raise funds. Monetary policy actions can intensify situations of credit rationing and, theoretically, their impacts on borrowers with limited access to the capital market should be stronger when compared to unrestricted borrowers, since the former are more dependent on bank credit. So, also in theory, changes in monetary policy through the credit channel have more significant effects on HAC companies than on LAC ones.

The process through which monetary policy decisions are transmitted into changes in the rate of economic growth and inflation is called as monetary transmission mechanism and a new approach on this theme is the deposits channel of monetary policy, proposed by Drechsler et al. (2017). Based on this new credit channel, we tested whether LAC companies suffer less than HAC ones the impacts on credit availability resulting from monetary tightening situations whose effects are propagated through the deposits channel of monetary policy. The sample of balances of the active loan portfolios for companies divided by size and banks was taken from Credit Information System of Central Bank of Brazil database and was composed of 1,902 observations, relating to 92 banks, in the period between June 2012 and December 2018. Parameter estimation was performed using the GMM-Sys.

The results show that in the face of monetary policy actions, such as an increase in the interest rate, banks, on average, present a flight to quality behavior and reduce the proportion of credit granted to companies with higher risk and high agency cost. In addition, there is evidence that the banks' movement of flight to quality resulting from changes in monetary policy is more intense in those banks that, on average, raise funds in markets with higher concentration indexes on deposits, that is, in those banks that have greater market power over deposits. This implies that banks use their market power on deposits to intensify flight to quality situations in the face of monetary tightening.

These results contribute to the literature on the subject of credit rationing in Brazil and to the literature related with the flight to quality of bank loans. Besides, the work innovates by proposing an original approach to test the asymmetric effects of monetary policy changes on corporate credit.

The research is limited by the unavailability of data on lending to companies at the county level by size of borrower. Although this limitation has not compromised the analysis of the results, access to this data would allow additional considerations to be made.

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