Differentiated Impact of Spread Determinants by Personal Loan Category: Evidence from the Brazilian Banking Sector

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Abstract

The present article studies the determinants of banking spreads, allowing for the possibility that the impact of some of these determinants on spreads may differ according to the particular loan type. This concern is fostered by both theoretical and empirical evidence supporting the general idea that the heterogeneity of banks' loan portfolios should be taken into account when studying the drivers of spread. This approach is distinct from previous work in the literature, usually utilizing a single interest margin per bank, in order to measure the impact of its determinants. Using a dataset of observations on various personal loan categories and the Difference GMM approach, the present study estimates that marginal effects of, respectively, banks' risk aversion, credit risk, and market share on spreads differ significantly according to whether the loan is a consumer loan, a paycheck-linked credit line or a revolving credit line for individuals. These findings suggest, accordingly, that central banks and regulatory agencies should observe the composition of banks' loans portfolios when writing their policies aiming at spread reduction.

Keywords: Spread; Personal loans; Financial sector.
JEL classification: G21; C23; E44.

1 Introduction

Financial intermediation has long been acknowledged as a fundamental tool of economic development, namely since Adam Smith (1776) noted that Scottish banks were the reason for the growth of his country. In an early study, Bernanke (1983) argued that a tightening of credit caused by the increase in the real costs of intermediation between banks and borrowers helped turn the sharp deceleration of 1929-30 into a protracted depression. Due to its importance, policymakers have long monitored the effectiveness of financial intermediation. Banking spreads, in turn, are viewed by the World Bank (2005), as a quantitative measure of financial intermediation efficiency, which refers to the ability of the financial sector to provide high-quality products and services at the lowest possible cost. Accordingly, more efficient banking markets exhibit narrower spreads.

The empirical literature on banking spreads usually analyzes the behavior of spreads by using data extracted from financial statements (e.g., Almeida and Divino, 2015; Entrop *et al*., 2015). According to Brock and Suarez (2000), the main reason for this practice is that, in most cases, banks' statements do not detail interest rates charged on loans and paid on deposits. Thus, spreads are computed on the basis of accounting information, in an effort to obtain an "implicit" interest rate spread charged by each bank. Most studies devoted to estimating the determinants of spread utilize as a proxy for the spread the net interest margin (NIM), defined as the ratio of the difference between total interest income and total interest expense, to the interest-bearing assets.(1) The goal of this approach is to obtain an average interest rate margin (or an average spread).

The above practice can be problematic for two reasons. Firstly, as several studies claim, spreads behave differently according to whether they are computed from accounting data or on the basis of the difference between the lending interest rate and deposit interest rate. For example, Afanasieff *et al*. (2002) argue that actual interest rates are more likely to be influenced by changes in the economic environment than by interest, income and expenses. Almeida and Divino (2015), in turn,

(1) Examples of studies using NIM as a proxy for the spread are provided by Ho and Saunders (1981), Demirguç-Kunt *et al*. (2004), Claeys and Vennet (2008), Lepetit *et al*. (2008), Gelos (2009), Chortareas *et al*. (2012), and Nguyen (2012).

distinguish the spread computed by means of actual interest rates (termed "*ex-ante*" spread) from the spread computed by means of accounting data (termed "*ex-post*" spread). According to these authors, the former is more volatile because it reflects the expectations of the banks with respect to the granting of credit before it is effectively granted. The *ex-post* spread tends to be more stable, since it supposedly represents the effective result of the financial intermediation activity.

Secondly, banks offer a multitude of financial products and services, charging varying rates that can behave in different ways. According to Allen (1988), this heterogeneity leads to better risk management by the banks, making it possible to reduce spreads. In this sense, using an accounting average instead of individual spreads can be overly reductive, precluding the observation of possibly unique characteristics of the various types of loans and the analysis of how these characteristics impact their interest spread.

Empirical studies that employ the concept of banking spread as defined by the World Bank (World Bank, 2005) – that is, the difference between the lending interest rate and the deposit interest rate – are scarce in the literature devoted to estimating spread determinants.[2] The few examples found are studies produced by central banks and multilateral bodies, which are institutions with access to supervisory data (International Monetary Fund, World Bank, European Central Bank, among others). For example, Catão (1998) uses interest rates on loans and deposits aggregated by currency (the Argentine peso and the US dollar) to examine the causes of high spreads in Argentina. Agénor *et al*. (1999) employ the same database to analyze the effects of fluctuations in the country's economic output on banking spreads. Corvoisier and Gropp (2001) use aggregate lending rates per country in order to study the impact of increased bank concentration on loan pricing. Afanasieff *et al*. (2002) and Bignotto and Rodrigues (2005) collect interest rate averages used in deposits and loans per bank in order to examine the causes of high level of spreads in Brazil.

The present study analyzes the impact of the determinants of spread for different types of personal loans, using the World Bank definition of banking spread. The empirical model adopted in the present paper is mostly based on the study by

[2] Some studies use the term "spread" to refer to measures taken from accounting data. This is the case of Brock and Suarez (2000) and Peria and Mody (2004).

Ho and Saunders (1981) and some of its extensions, like Allen (1988). Ho and Saunders (1981) adapted a bid-ask market price-setting model for bonds to explain banking spread behavior. However, their study assumes that banks have only one kind of loan. Allen (1988) extended their model considering the loan heterogeneity that exists in banks' loan portfolios.

The present contribution to the extant literature can be considered to be two-fold. Firstly, it offers additional evidence regarding the determinants of banking spreads, using actual interest rates in the computation of the dependent variable rather than proxies computed by averages of accounting data. Spreads computed using loan and deposit rates are arguably a better measure of banking efficiency than NIM, which is used in previous studies (Agapova and McNulty, 2016). This is only possible with disaggregated data, obtained in the present case from the Central Bank of Brazil. Secondly, to the best of the present authors' knowledge, this is the first study to try and estimate the effect of the determinants of banking spread for each loan category (or group of loan categories). No previous study has considered the potential heterogeneity that exists among loans' interest spreads when estimating the impact of their determinants (despite theoretical suggestions for doing so – see Allen, 1988). Given that the literature on banking spreads is used to formulate public policy recommendations, the study of the determinants of spread for different loan categories can have relevant implications for the specification and use of empirical spread models.

The dataset used in the study, concerning Brazilian financial institutions, is rather informative as the Brazilian banking sector maintains one of the world's largest interest rate spreads (interest rate charged on loans minus interest rate paid on deposits). For example, in 2016, the country's average spread was 39.65%, while the world average was 5.74%.[3] According to Nakane and Costa (2005), the Brazilian average is calculated using interest rates as low as those charged in the developed markets, from which a huge variation in the Brazilian context can reasonably be suspected.[4]

[3] International Monetary Fund, International Financial Statistics, and data files, available on http://data.worldbank.org/indicator/FR.INR.LNDP?view=map (Accessed July 2018).

[4] The multiplicity of rates that contribute to the Brazilian average is highlighted in the study by Nakane and Costa (2005). According to their study, Brazil ranks third among the countries with the largest spreads in the world, only behind Zimbabwe and Angola, with an average spread of 42.8% in

The remainder of the paper is organized as follows. Section 2 surveys the theoretical and empirical literature on the determinants of banking spread. Section 3 details the variables, data, and econometric model used in the study. Section 4 presents and comments on estimation results. Section 5 concludes the paper and suggests future research.

2 Literature Review. The Main Determinants of Banking Spreads.

The theoretical basis used in the study of banking spreads was first established by Ho and Saunders (1981). Building on the literature regarding the determinants of the purchase price of securities, these Authors formulated a model in which the bank is considered a dealer in the credit market, exclusively engaged in financial intermediation activities (deposit-taking and lending).[5] In this model, both the supply of deposits and the demand for loans follow a random pattern, so that the time of entry and exit of funds cannot be predicted by the bank. Because of this uncertainty, the bank, which is viewed as a risk-averse entity, is encouraged to seek compensation for the risk of having a depositor claiming his funds before a borrower repays the loan. This compensation is the difference between the interest rate charged from loans and the interest rate paid on deposits. According to these Authors, such margin of interest must exist even in a scenario of intense competition, due to the uncertainty in the transactions; this margin due to transactions' uncertainty is termed "pure spread".

The original theoretical model of Ho and Saunders (1981) has subsequently been extended in several studies. For example, Allen (1988) introduces loan heterogeneity in the model, concluding that the pure spread may be reduced when cross-elasticities of demand between bank products are considered. Angbazo (1997) includes credit risk as a variable defining the pure spread, and Maudos and Guevara (2004) consider the operating costs of the intermediation activity in the fundamental equation. In this latter version of the model, the spread determinants are: i. competitive market structure; ii. average operating costs; iii. the degree of risk aversion

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the period from 2002 to 2004. The data were obtained from the International Monetary Fund. In the calculation of this average interest rates as low as 6% were used.

[5] Regarding this literature, see also Ho and Stoll (1980), Ho and Stoll (1981) and Stoll (1978).

by the bank; iv. the interest rate volatility in the money market; v. credit risk; vi. interaction between credit risk and interest rate volatility; and vii. average size of lending and deposit operations. More recently, Valverde and Fernández (2007) add non-traditional assets of banks to the essential portfolio of financial institutions and Entrop *et al.* (2015) explicitly include the mismatch of loan and deposit maturities in the original model of Ho and Saunders (1981).[6]

In addition to formulating the theoretical model of spreads' determinants, Ho and Saunders (1981) measure some practical implications of their suggested model, to which effect they adopt a two-step approach. In the first step, the pure spread is estimated for a set of 53 American banks, using quarterly data from 1976 to 1979. In this first stage, some attributes not considered in the theoretical model but perceived as impacting banks' interest margins are employed to isolate the "pure spread". In a second step these "pure spreads" estimated in the first stage are used to estimate the impact of the interest rate volatility on the spread.

Several authors address the original model of Ho and Saunders (1981) and its extensions. However, and in spite of the theoretical proposal made by Allen (1988), loan heterogeneity has not yet been considered in the literature.[7] The lack of informative data may help explain this apparent neglect; since banks do not usually disclose interest rates by type of loan, estimating the impact of determinants of interest margins by bank product is impractical.[8] Nonetheless, taking into account loan heterogeneity when estimating spreads' determinants appears as a crucial issue: indeed, as the demand for different financial products is interdependent, raising the interest rate on one type of loan implies a decrease in the demand for it and an increase in the demand for alternative loans. Actually, this diversification among several products allows the bank to better manage its risk exposure and, consequently, also enables a reduction of pure spread.

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[6] Non-traditional assets include mainly derivatives used as hedging instruments.

[7] His general proposal notwithstanding, Allen (1988) does not suggest specific types of loan, which can be of any kind (for example, consumer and commercial loans) as long as their demand is interdependent.

[8] As mentioned in Section 1, even the studies that compute the spread using the interest rates actually charged do not analyze the behavior of spreads by operation.

The foregoing arguments naturally suggest that spreads charged by banks behave differently according to the type of financial product. Accordingly, when studying the formation of spread and its determinants, one should take into account the fundamental possibility that the impact of spreads' drivers can be different among the various categories of loans. In any event, one should note that this general conjecture may not apply evenly to every attribute influencing spread formation. Indeed, some attributes can be expected to impact the value of spread differently, according to loan type, whereas, for other determinants, their influence can be reasonably expected to be rather uniform across different loan categories.

Risk aversion and credit risk are two examples of attributes that seem to fall within the former case. Risk aversion is a fundamental determinant of banking spread in theoretical models. The bank is viewed as a risk-averse institution and the most risk-averse banks tend to charge higher spreads (Maudos and Guevara, 2004). Thus, a positive relation between risk aversion and spreads is expected. However, the contribution of risk aversion to spread formation can vary substantially if there are distinct features in the loans regarding the mismatch between the inflow and outflow of funds from the bank. As previously stated, in theory the spread essentially exists because banks face the risk of having a depositor claiming his funds before a borrower repays the credit.

Some loan categories provide clear examples of the previous discrepancy. Take, for instance, a revolving credit available in a deposit account, where the date of funds' disbursement is not pre-defined (interest only starts to accrue from the moment the borrower withdraws or transfers the funds) and the same happens with the reimbursement (there is no formal due date after the funds begin to be used). This case differs from such loans as, *e.g.*, consumer loans, payroll-linked loans or retirement-benefit-linked loans, all having well-defined disbursement and reimbursement dates. In the former case (revolving credit), the risk of mismatch is essentially different from that under the latter types of loans – clearly, it is higher. Therefore, one can expect an economically higher impact of risk aversion on revolving credit's interest spread than on the spread for other loan categories.

The risk of default (that is, the credit risk) was considered by Angbazo (1997) among the determinants of pure spread, along with interest rate volatility. Accord-

ing to this Author, the optimal spread represents an insurance not only against interest rate volatility but also against the risk of default by the borrowers. Thus, a positive relationship between spreads and credit risk is expected. However, similarly to risk aversion, the impact of credit risk on spread formation may differ depending on the nature of the loan. Three categories of loans included in the present study refer to payroll-linked or retirement-benefit-linked loans, with the installment paid through a direct debit when the individual receives his monthly salary or pension, whereas the remaining two categories (revolving credit and consumer loans) do not have this automatic debit feature and depend on the borrower's initiative to repay the loan. The contribution of credit risk to spread formation may reasonably be expected to be different across these two groups of borrowers, as one group features a collateral that is absent in the other group. Specifically, one can expect the impact of credit risk on spreads to be higher for revolving credit and consumer loans than for the remaining three categories.

Market share is also an attribute that can be expected to influence spread behavior differently, according to loan category. As noted by Maudos and Guevara (2004), the bank is able to charge higher spreads if it holds a prominent position in the market. However, gains of scale experienced by such banks should allow for spreads' reduction. These antagonistic incentives should be reflected in different management decisions for different products. In other words, for some products the bank would use its market power to impose higher spreads and thus raise its revenues, while, for others, scale gains from market power would be used to reduce spreads. *A priori*, it makes sense that, given the risk-averse stance of banks, this positive relationship between market share and spreads occurs for riskier products, that is, those with higher spreads – *e.g.*, revolving credit and consumer credit. The reduction, in turn, would be applied to products that are perceived with lower risk – *e.g.*, payroll-linked and retirement-benefit-linked loans.

Conversely, several other potential determinants of spreads can reasonably be supposed to influence their value quite uniformly across different loan types. This is the case, for instance, of market interest volatility, the main determinant in the theoretical model of Ho and Saunders (1981). As argued by these Authors, this volatility is what regulates the movements of deposits' supply and demand for loans, whose risk of mismatch generates the need to charge an interest margin. Accordingly, the

higher this volatility the higher the spread – as mentioned, uniformly across different loan categories. Another example of this stable relationship is provided by operational costs (Maudos and Guevara, 2004). Indeed, operational costs must be covered in some way, and spread is the fundamental source of revenue. Thus, banks with higher operational costs logically need to work with larger spreads to cover these costs. As stressed by Maudos and Guevara (2004), even in the absence of market power and any type of risk, a positive spread is needed to cover operational costs. There is no rationale supporting the idea that operational costs will have varying impacts on the spreads of different types of loans.

A uniform positive relationship is also expected of spreads and such attributes as managerial quality, implicit interest payments to depositors, banking reserve requirements, and inflation. As management decisions affect the composition of assets which are earning high interests (Angbazo, 1997), higher managerial quality must yield higher spreads. Implicit interest payments represent the cost of services provided to customers and for which no amount is charged. The more interested the bank is in disputing customers with competitors, the higher these expenses (Lin *et al*., 2012). This should result in higher spreads as a compensation for the increase in these expenses. Banking reserve requirements represent an opportunity cost for the banks. The increase in this cost should encourage the bank to augment spreads in response. A higher inflation rate, in turn, tends to spur spreads so as to shield banks against currency devaluation. Also, the size of operations is expected to hold a negative relationship with loan spreads given the gains in scale earned as banks expand their operations.

3 Variables, Data and Econometric Model.

3.1 Variables and Data

The dependent variable in the present study consists on the interest rate spread, computed as the difference between the average interest rate charged on each loan category and the Financial Basic Interest Rate (TBF). The TBF is computed by the

Central Bank of Brazil using a sample comprising the 30 biggest banks in the country. It is based on the average deposit rate for certificates or bank deposits receipts. The computation of the dependent variable follows the definition established by the World Bank (2005) for banking spread, that is, the difference between lending and deposit interest rates. While the lending rates are available on a bank-specific basis, the deposit interest rates are not, so a proxy – the TBF – is used for the latter. Nevertheless, this should not be a cause for concern since the TBF is considered by the Central Bank of Brazil as the proxy for the deposit interest rate offered by the national banking sector. A summary of the covariates used in the study, with a brief definition and corresponding reference in the key literature, is shown in Table 1.

Table 1
Definition of Independent Variables and Literature Reference

Variable	Description	Reference
RkAv	Equity/total assets	Arnold and van Ewijk (2012); Demirguç-Kunt *et al*. (2004)
CrRk	Percentage of families' income earned in the previous twelve months	Lin *et al*. (2012); López-Espinosa *et al*. (2011)
MktSh	Credit operations of the bank *i*/Total credit operations of Brazilian banking sector	Chortareas *et al*. (2012); Nguyen (2012)
ItRk	Moving standard-deviation of the Brazilian interbank market interest rate considering the last four quarters	Almeida and Divino (2015)
OpCost	Total operating expenses/total assets	Entrop *et al*. (2015)
MgmQty	Earning assets/total assets	Lin *et al*. (2012); Angbazo (1997)
Size	Logarithm of total credit operations	Maudos and Fernández de Guevara (2004)
ImpInt	(Non-interest expenses – non-interest revenues)/total earning assets	Lin *et al*. (2012); Entrop *et al*. (2015)
OppCost	Non-interest bearing reserves/total earning assets	Entrop *et al*. (2015)
Infl	Quarterly variation of consumer price index	López-Espinosa *et al*. (2011); Claeys and Vennet (2008)
NTA	Non-interest income/total operating income	Afanasieff *et al*. (2002)
GDPg	Quarterly nominal growth rate of GDP	Chortareas *et al*. (2012)

The degree of risk aversion (*RkAv*) is measured by the ratio of equity over total assets. Credit risk (*CrRk*) is proxied by the percentage of families' committed income, earned in the previous twelve months. This choice of proxy for credit risk is different from what is used in previous studies (*e.g.*, Lin *et al*., 2012; López-Espinosa *et al*., 2011), which proxy credit risk for all banking operations with the ratio between loan loss reserves and gross credit operations. This ratio refers to all the operations held by a bank. Since the present study focuses on the operations with individuals, the percent commitment of families' income earned in the previous twelve months seems a more adequate choice. One other reason for preferring families' indebtedness is the way spread is computed, with actual interest rates in lieu of accounting data. Since these interest rates reflect banks' expectations with respect to the granting of credit before it is actually granted (Almeida and Divino, 2015), indebtedness is more informative about the probability of future delinquency by individuals than a hindsight accounting ratio.

The covariate market share (*MktSh*) is computed as the ratio of credit operations of each bank to total credit operations from the Brazilian banking sector. The volatility of the market interest rate (*ItRk*) is measured by the moving standard deviation of the interest rate on the interbank operations of the Brazilian market considering the last four quarters. The covariate operating costs (*OpCost*) is measured by the ratio of total operating expenses to total assets. The management quality (*MgmQty*), in turn, is proxied by the ratio of earning assets to total assets.[9] The reasoning underlying the use of this proxy is that efficient managers will pursue the highest possible interest revenue, which naturally leads to a higher proportion of interest-bearing assets (Angbazo, 1997). *Size* is the logarithm of total credit operations. The covariate implicit interest payments (*ImpInt*) is measured as the ratio of the difference between non-interest expenses and non-interest revenues to total earning assets. This approach tries to capture the cost of services provided to customers, for which there is no charge. The covariate opportunity cost of holding reserves (*OppCost*) is computed as the ratio of non-interest bearing reserves to total

[9] Earning assets are assets that generate income like interest or dividends. Loans and securities are the main examples of bank earning assets, among others, like leased or rented buildings that earn income.

earning assets. The rate of inflation (*Infl*) is measured by the quarterly variation of the Brazilian consumer price index. The attribute non-traditional assets (*NTA*) is measured as the ratio of non-interest income to total operating income. Finally, Gross Domestic Product growth (*GDPg*) is represented by the quarterly nominal variation of the economic activity. In this regard, the traditional approach in the literature uses real growth of the GDP (*e.g.*, Chortareas *et al*., 2012). The use of nominal variation is due to a lack of real growth data on a quarterly basis.

The present study uses panel data from the Central Bank of Brazil on interest rates charged by seven Brazilian banks in five categories of loans directed to individuals (revolving credit, retirement-benefit linked loans, payroll-linked loans to civil servants, payroll-linked loans to private sector workers, and consumer loans)[10], from January 2012 to December 2017 on a quarterly basis. The interest rates reported by the financial institutions to the Central Bank of Brazil correspond to the average rates used in the various operations carried out by the banks for each category of loan. In order to get a completely balanced panel of interest rate spreads, quarterly averages were computed from the disclosed data, resulting in 120 observations (24 observations for each of the five loan categories) for each of the seven banks, with a grand total of 840 observations. [11]

The Central Bank of Brazil collects data related to interest rates charged by more than 200 financial institutions. Nonetheless, the Brazilian banking industry is heavily concentrated, with only five banks accounting for 86% of the outstanding commercial loans by the end of September 2016. Due to this high concentration, most of the smaller banks do not report observations for many of the categories analyzed. Those banks with few observations were dropped from the sample. The available sample then comprises seven banks. It can be considered representative of the Brazilian financial sector, as these seven banks account for 85,7% of the total assets and 88,7% of the outstanding credit operations held by commercial institutions in the country, in December 2016.[12] Two of the banks are state-owned, and one is a foreign bank with operations in Brazil.

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[10] For more details about the considered categories of loans directed to individuals, see below.

[11] The banks are: Banco Bradesco, Banco Santanter do Brasil, Banco do Estado do Rio Grande do Sul, Caixa Econômica Federal, Banco do Brasil, Itaú Unibanco, and Banco Safra.

[12] Data available at https://www3.bcb.gov.br/informes/relatorios (Accessed February 2018).

The Brazilian Central Bank collects data for seventeen loan categories directed to individuals. The categories for which at least one observation per quarter is not reported were also dropped from the sample. The sample used in the study comprises three major groups of loans, aggregating the following categories: i. revolving credit (credit available in deposit accounts allowing for the loan amount to be withdrawn or transferred, repaid and redrawn again whenever and as often as the borrower wishes, without a fixed number of payments until the arrangement expires); ii. three categories grouped into one due to a common feature – the instalments are directly debited in the individual's monthly paycheck or pension: payroll-linked loans for civil servants; payroll-linked loans for private sector workers; and retirement benefit-linked loans; iii. consumer loans (credit granted to individuals for personal, family or household expenses with monthly payments).

In January 2012 there was a change in the Central Bank of Brazil's disclosure methodology, which explains the period considered in the present study. The institution initiated the disclosure of interest rates per loan category in January 2009, but only for four loan categories directed to individuals. As of January 2012 this number increased to seventeen. Only one of the loan categories analyzed in the study has data available in the period 2009-2012, which precludes the comparison with other categories before 2012.

Data used to compute bank-specific variables were extracted from monthly financial statements also reported to the Central Bank of Brazil by the financial institutions under Document 4010.[13] Information regarding each financial institution, rather than the financial conglomerate, was used here because the present focus is solely on credit operations. Since financial conglomerates may include data related to brokers, investment banks, foreign branches, etc., banks with an active loan portfolio seem more adequate for this empirical analysis. The data used in the computation of interest risk volatility was collected from the time series management system available in the Central Bank of Brazil's website.[14] In order to maintain the uni-

[13] Document 4010 is a form containing information on the financial institution's balance sheet and income statement. Data available at http://www4.bcb.gov.br/fis/cosif/balancetes.asp (Accessed April 2018).

[14] Data available at https://www.bcb.gov.br/?SERIESTEMP (Accessed April 2017).

formity of all variables, quarterly averages were computed using monthly data. Table 2 presents the account codes used to compute the variables regarding the banks, as presented in Table 1.

Table 2
Account's numbers in Document 4010

Item	Account number
Non-interest bearing reserves	11000006
Earning assets	12000005/13000004/16000001/17000000/ 18100002/18200005
Credit operations	16000001
Total assets	39999993
Equity	60000002
Operating revenues	71000008
No interest revenues	71700009/71800002/71900005
No interest expenses	81600003/81700006/81800009/ 81900002
Operating expenses	81000005

Table 3 displays descriptive statistics for all variables. The heterogeneity among loans' spreads is rather high: spreads vary from a minimum 8.6%, for payroll-linked loans for civil servants, to a maximum of 436.7%, for revolving credit. The latter exhibits a notoriously high average spread of 207%. By comparison, the range of spreads for consumer loans is considerably smaller, but still with a 59.2% average. Spreads are smallest for categories with installments directly debited from salary or retirement pension. The variation of the average spreads is lower for these three categories, suggesting somewhat similar levels of risk. Still, payroll-linked loans for civil servants show a smaller average spread (14.7%) than retirement benefit-linked loans (17.8%), which, in turn, have a smaller average spread than payroll-linked loans for private sector workers (25.5%). Two bank-specific variables exhibit a high degree of variation, reflecting the heterogeneity of the seven banks included into the sample. For example, *MtkSh* has a maximum value of 21.91, 32 times higher than its minimum of .67, which shows the disparity in the market power of the banks in the sample. The difference between maximum and minimum values in *OppCost* also shows that the efficiency in the management of banking reserves varied considerably within the panel. Other variables like *RkAv* and *OpCost* show substantial –

though smaller – variation. The lowest dispersions (relative to the variable's average) are observed for *Size*, *MgmQty*, *NTA*, and *ImpInt*, suggesting that these are aspects in which banks do not differ much. As for macroeconomic attributes, *CrRk* is relatively stable, with a minimum of 41.24 and a maximum of 46.21. The remaining variables suggest that the Brazilian economy experienced a roller coaster-type movement during the considered time span, with *ItRk* going from zero to 2.26, *GDPg* varying from –8.57 to 9.08 and *Infl* going from a low of 0.92 to a 16.21 high.

Table 3
Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Min.	Max.
Spread (%)					
Revolving credit	206.99	198.50	90.85	53.27	436.73
Payroll-linked loans (civil servants)	14.73	14.07	3.41	8.61	29.90
Payroll-linked loans (private sector)	25.52	24.59	7.39	14.57	45.11
Retirement benefit-linked loans	17.76	17.39	3.26	9.96	39.48
Consumer loans	59.15	59.29	17.51	10.76	106.24
RkAv	1.42	1.26	.69	.38	3.53
CrRk	44.03	44.17	1.63	41.24	46.21
MktSh	7.93	6.35	6.71	.67	21.91
ItRk	.92	.87	.57	.00	2.26
OpCost	.38	.32	.18	.15	1.07
MgmQty	15.46	14.99	3.58	6.71	26.15
Size	8.54	8.20	3.75	3.43	16.79
ImpInt	.22	.20	.20	-.41	1.04
OppCost	1.22	1.15	.73	.14	5.16
Infl	6.39	5.74	3.40	.92	16.21
NTA	23.49	23.81	5.87	9.67	39.07
GDPg	-.06	.41	4.06	-8.57	9.08

3.2 Econometric Model

The main objective of the present study is to assess whether the impacts of the determinants of banking interest spreads differ across loan categories. To this effect, the following panel data regression model is adopted:

$$
\begin{aligned}
Spread_{it} = \ & \alpha_i + \\
& \beta_1 RkAv_{it} + \beta_2 (RkAv_{it} \times D2_i) + \beta_3 (RkAv_{it} \times D3_i) + \\
& \gamma_1 CrRk_{it} + \gamma_2 (CrRk_{it} \times D2_i) + \gamma_3 (CrRk_{it} \times D3_i) + \\
& \delta_1 MktSh_{it} + \delta_2 (MktSh_{it} \times D2_i) + \delta_3 (MktSh_{it} \times D3_i) + \\
& \epsilon ItRk_t + \zeta OpCost_{it} + \eta MgmQty_{it} + \theta Size_{it} + \\
& \kappa ImpInt_{it} + \lambda OppCost_t + \lambda Infl_t + \\
& \mu NTA_{it} + \ \nu GDPg_t + \xi Spread_{i,t-1} + u_{it}.
\end{aligned}
\tag{1}
$$

In this equation, $Spread$ represents banking spread and covariates' acronyms are as defined in Table 1; $D2$ denotes a dummy variable, equal to one if the loan is a payroll-linked loan (for civil servants or private sector workers) or a retirement benefit-linked loan ($D2 = 0$, otherwise); the dummy variable $D3$ equals one if the loan is a consumer loan ($D3 = 0$, otherwise). The indices (i,t) refer, respectively, to each pair bank/loan type (index i), and quarter (index t).[15] As usual, Greek letters denote unknown parameters to be estimated. The unobserved terms, α_i and u_{it}, denote, respectively, an individual effect (time-invariant, $\alpha_{it} = \alpha_i$, $\forall t$) and the error term.

The specification of model (1) reflects the above discussion (Section 2) regarding the possible distinction of covariates' marginal effects on banking spreads. As previously stated, not all covariates are expected to impact spreads differently across loan categories – indeed, only the covariates *RkAv*, *CrRk*, and *MktSh* are allowed to have such a differentiated impact, as evidenced by their corresponding interactions with the dummy variables $D2$ and $D3$ (in contrast with the remaining covariates, which are supposed to affect spreads evenly, irrespective of loan type). Following previous studies showing an inertial effect of the spread (*e.g.*, Almeida

[15] The consideration of the pair bank/loan type as the basic cross sectional unit (rather than solely the bank) enables the specification of a univariate regression model easily addressed with current econometrics packages (such as, *e.g.*, Stata). Otherwise, one would have to specify a multivariate regression model for panel data, with five dependent variables (five interests' spreads) for each cross-sectional unit (bank) in each period.

and Divino, 2015; Chortareas, *et al.*, 2012), a dynamic approach is employed with inclusion of the lagged spread as an additional covariate ($Spread_{i,t-1}$, also supposed to affect spreads uniformly across loan types).

The consideration of three major loan categories (revolving credit is the base loan category, for which $D2 = D3 = 0$) is due to the following main reasons: firstly, as already mentioned, revolving credit is distinct from other loans with regard to its disbursement and reimbursement dynamics. Secondly, there is a substantial difference between the spread of revolving credit and the spreads of other categories – for the former the average interest rate spread is 207.0%, while the second highest mean is 59.2%. As already mentioned, payroll-linked loans for civil servants or private sector workers and retirement benefit-linked loans are grouped due to their similarities (being repaid through a direct debit in the borrower's salary or retirement pension). Consumer loans are considered separately because they do not share this feature of payment by debit in paycheck.

The inclusion of a lagged dependent variable generates a problem of correlation with the compound error term, $\alpha_i + u_{it}$, that is not overcome by conventional panel data methods, such as least-squares dummy variables. In order to address this issue, an estimator developed by Arellano and Bond (1991), known as Difference GMM, is used. This estimator is adequate for short panels, with covariates that are not strictly exogenous, as is the case of the present study. The method differences all variables and uses the generalized method of moments (GMM) estimator that instruments the differenced variables with all their available lags in levels. Previous studies regarding determinants of NIM (*e.g.*, Maudos and Solís, 2009; Almeida and Divino, 2015) have used an extension of this estimator proposed by Arellano and Bover (1995) and by Blundell and Bond (1998), the so-called System GMM. This method adds an equation in levels, increasing the number of instruments to be used and thus improving efficiency. However, for System GMM to be more efficient than the original estimator, the panel must be stationary. As the macroeconomic time series included in model (1) can display some kind of trend, unit root tests are employed, to guide the choice between Difference GMM or System GMM. The stationarity of the time series variables is evaluated by the tests proposed by Elliott, Rothenberg and Stock (1996), which use generalized least squares and show better statistical power than the original augmented Dickey-Fuller test. Arellano and Bond

(1991) suggest a Sargan (1958) test to check the exogeneity of the group of instruments; however, since this test is not robust to heteroskedasticity and autocorrelation, a Hansen (1982) test, which is not subject to those limitations, is applied instead (e.g., Almeida and Divino, 2015). The autocorrelation test suggested by Arellano and Bond (1991) for linear GMM regressions on panels – especially important when lags are used as instruments – is also employed. Usually, the null hypothesis of no first-order autocorrelation is rejected, which is expected because both $\Delta\epsilon_{i,t} = \epsilon_{i,t} - \epsilon_{i,t-1}$ and $\Delta\epsilon_{i,t-1} = \epsilon_{i,t-1} - \epsilon_{i,t-2}$ share the common term $\epsilon_{i,t-1}$. A second-order autocorrelation test is therefore performed and if the null hypothesis is not rejected, the moment conditions are considered valid.

4 Empirical Results and Discussion

The empirical analysis starts with the unit root tests of the time series included in in model (1). The results of these tests are reported in Table 4. The fourth lag reported is in accordance with the quarterly basis of the dataset. One can notice that the null hypothesis of the presence of a unit root is not rejected for all the variables. This finding suggests that Difference GMM is more appropriate than System GMM, which assumes the stationarity of the panel.

Table 4
Time series unit root tests

Variable	Lags	DF-GLS t-Stat	5% Critical Value
CrRk	4	-1.83	-3.02
ItRk	4	-1.62	-3.02
Infl	4	-1.08	-3.02
GDP	4	-1.16	-3.02

Null hypothesis: presence of unit root

Table 5 displays the estimated parameters of model (1). The main hypothesis of the study – that some attributes have a differentiated impact on the interest rate spread according to loan category – appears to be confirmed by empirical results. For example, the interaction terms of the variables $RkAv$, $CrRk$, and $MktSh$ with the

dummy variable $D2$ (payroll-linked loans and retirement benefit-linked loans) are statistically significant. This means that the marginal effects of these variables on the spread of the three grouped categories differ from the marginal effects of the same variables on the spread of revolving credit for individuals. In addition, the interaction terms of $CrRk$ and $MktSh$ with $D3$ (consumer loans) are also statistically significant, which means that the marginal effects of these two variables on the spread of consumer loans differ from the marginal effects of the same variables on the spread of revolving credit. One can notice that, in the case of $RkAv$, its estimated coefficients for the basis loan category and the interaction term with $D3$ are not statistically significant, which means that this variable does not influence the interest rate spreads of revolving credit and consumer loans, but impact the spread of the three grouped categories.

Table 5

Determinants of Interest Rate Spreads – Estimation Results

Variable	Coeff. Estimate	Corrected Std. Errors
$RkAv_{it}$	17.31	12.60
$RkAv_{it} \times D2_i$	-15.09**	7.39
$RkAv_{it} \times D3_i$	-26.83	74.06
$CrRk_{it}$	5.77***	1.54
$CrRk_{it} \times D2_i$	-6.63***	1.40
$CrRk_{it} \times D3_i$	-5.76**	2.40
$MktSh_{it}$	11.86***	4.57
$MktSh_{it} \times D2_i$	-11.27**	5.02
$MktSh_{it} \times D3_i$	-11.25*	6.18
$ItRk_t$	-.49	.48
$OpCost_{it}$	4.10**	1.99
$MgmQty_{it}$	-.06	.38
$Size_{it}$	14.97	21.85
$ImpInt_{it}$	2.98	1.82
$OppCost_{it}$	.36	.71
$Infl_t$	.29***	.10
NTA_{it}	.02	.04
$GDPg_t$	-.14***	.07
$Spread_{i,t-1}$	1.06***	.03

Notes: The two-step Difference GMM estimator with robust errors is used.
*/**/***: statistical significance at 10%/5%/1%, respectively.
Arellano-Bond AR(1): p-value = .011; Arellano-Bond AR(2): p-value = .619. Hansen overidentification test: p-value = .137.

Although the estimated coefficient of the interaction term $RkAv_{it} \times D2_i$ is negative, the relationship between risk aversion and the spread of the three grouped categories is positive (since adding the coefficients of $RkAv_{it}$ and $RkAv_{it} \times D2_i$ one obtains a positive estimate), in line with expected results. Similarly, the overall credit risk has the expected positive relationship with the spread of revolving credit, but a negative relationship with the spread of the three grouped categories. It may seem counterintuitive that the increase in the families' indebtedness level reduces the spread of some loan categories, but one must remind that these categories have a reimbursement mechanism – a direct debit on monthly salary or pension – that lowers substantially their credit risk. Conversely, revolving credit does not have the same guarantee. This result suggests a cross-subsidization between loan categories through the spread charged, and this is the first study to show some evidence in this respect. As for consumer loans – other loan category that does not have the guarantee of a direct paycheck debit – the sum of the estimated coefficient of the interaction term with $D3$ and the estimated coefficient of the basis loan category is positive but approaches zero, which means that the spread of revolving credit loans probably subsidy the spread of the remaining personal loan categories should the credit risk increase. The relationship between the banks' market share and the spreads of all categories analyzed, in turn, is positive (the coefficient of the interaction terms is negative, but the sum is positive). This is in contrast with the expectable negative relationship between the bank's market share and the spread of the categories linked to salary or retirement benefit. However, this can be explained by the prevalence of the market power effect over the scale gains effect. In other words, banks use their market power to increase spreads of all five categories, albeit with varying intensities depending on the category. Moreover, the impact of a bank's market share on the spread of revolving credit is substantially higher than the impact on the spread of the remaining loan categories, which is indicative that the cross-subsidization effect hypothesized in Section 2 is present.

In what concerns the control variables included in equation (1) – volatility of market interest rate, operating costs, managerial quality, size of operations, implicit interest payments, opportunity cost of holding reserves, inflation, non-traditional assets, and GDP growth rate – coefficients' estimates statistically relevant are in accordance with expectations. *OpCost* shows a positive relationship with interest rate spreads, a result already observed in previous studies about NIM determinants (e.g., Entrop et al., 2015; Nguyen, 2012). $Infl$ has an estimated positive relationship with spreads, in line with the results observed by Claessens *et al*. (2001) and Claeys and Vennet (2008) for the relation between this covariate and NIM. The estimated sign of $GDPg$ is negative, as observed in the studies by Kasman *et al*. (2010) and Entrop *et al*. (2015), regarding the relationship between GDP growth and NIM. Finally, the result for the coefficient of the lagged dependent variable, $Spread_{i,t-1}$, confirms the expected inertial effect of the spread, as already observed for NIM by Chortareas *et al*. (2012) and by Almeida and Divino (2015).

The remaining control variables do not prove relevant. This result is somehow expected, if one considers the way in which the model's variables are computed and the sample characteristics. Many of the independent variables are computed from accounting data, which have a hindsight profile (like the volatility of market interest rate). In addition, the sample is restricted to operations with individuals. The share of free funding operations with individuals (where the loans of the sample used in the present study are included) accounted for 26% of the total credit operations in 2014 (Banco Central do Brasil, 2014).[16] As the main result of this study confirms, the impacts of various spread determinants differ according the loan category. This means that a cross-subsidization effect may exist between operations with firms and operations with individuals (or between free funding operations and directed funding operations), so that the total operating costs do not impact substantially the movement of the spreads of the five loan categories analyzed in the present study.

The diagnostic tests on the residuals indicated that there is no evidence of second-order serial correlation at 5% confidence level. The Arellano-Bond AR(1) test suggested first-order autocorrelation, but this was already expected (see Section 3) and should not be a concern. The Arellano-Bond AR(2) test showed a p-value of

[16] Free funding operations are operations not stimulated by the central bank. They stand in opposition to directed funding operations, like housing financing.

0.619, not rejecting the null hypothesis of no autocorrelation. Thus, the moment conditions assumed by GMM estimation are considered valid. In addition, the Hansen test statistic indicates the exogeneity of instruments used. These diagnostic tests suggest that the model is well specified and that the results reported in Table 5 are reliable.

5 Concluding Remarks

Previous articles on banking spreads use one single interest margin per bank to measure the impact of its determinants. The present study claims that some of these attributes can have a specific influence on spreads, according to the loan category. Therefore, when studying the behavior of banking spreads, the diversity of interest rates existing in a bank's loan portfolio should be taken into consideration.

The present text considers the theoretical model proposed by Ho and Saunders (1981) and some of its extensions, analysing the impact of the determinants of spread for different types of personal loans in the context of the Brazilian banking sector. In particular, the paper assesses the hypothesis that the marginal effects of risk aversion, credit risk, and market share differ for several credit lines directed to individuals. These lines of credit include the following categories: a group of loans comprising payroll-linked and retirement benefit-linked loans (both for civil servants and for private sector), revolving credit, and consumer credit.

The empirical results of the paper somehow confirm the above expectations. Indeed, the marginal effects of, respectively, banks' risk aversion, banks' market share and Brazilian families' credit risk on the spread of the paycheck-linked loans differ significantly from the corresponding marginal effects on the spread of revolving credit. In addition, the marginal effects of families' overall credit risk and banks' market share on the spread of consumer loans differ significantly from the corresponding marginal effects on the spread of revolving credit. These results suggest that the study of the determinants of spreads should consider the heterogeneity existing in a bank's loan portfolio, especially in a context of high spreads like that of the Brazilian banking sector.

Data gathered from financial statements only provide averages of the spreads charged in many loan categories, which naturally precludes the design of policies addressing specific characteristics of credit lines. Central banks and governments

should observe the composition of banks' loans portfolio when writing their regulations. In view of the evidence that the level of equity impacts differently the spread of different loan categories, a smaller level of equity could thus be allowed by regulative authorities in exchange for a reduction of the spreads specifically in the categories where this relationship is relevant. Likewise, information systems could be designed in order to keep a record on how an individual's debt affects her/his credit risk. Such systems could be a regulatory prerequisite for granting loans whose spreads suffer the greatest impact of credit risk, so as to encourage the reduction of spreads for less indebted people. Also, competition from smaller banks could be stimulated in order to control the impact that banks' market power has on spreads fixation. This can be done, for example, by removing bureaucratic barriers, so that more financial institutions can grant revolving credit to individuals, the loan category most influenced by banks' market power.

Naturally, the present study is not without limitations, which should be kept in perspective. The first limitation is related to the restriction of the sample to Brazil. Unfortunately, it was not possible to include other countries in the study, given that, to our knowledge, the disclosure of interest rates charged per loan category is not available on any international database. The second limitation regards the computation of some variables. As discussed in the previous section, the spread computed on the basis of actual interest rates reflects expectations regarding the future, whereas accounting data refer to the past. Another limitation lies in the lack of information about the relative weight of the loan categories analyzed, within the total operations directed to individuals. This issue hinders more compelling suggestions regarding a cross-subsidization effect that may exist among loan categories. These are limitations that, in any event, may foster subsequent research on the determinants of banking spreads.

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