Available online at www.sciencedirect.com

ScienceDirect

EconomiA 16 (2015) 32–45

ECONOMIA

www.elsevier.com/locate/econ

Basic interest rate, bank competition and bank spread in personal credit operations in Brazil: A theoretical and empirical analysis

Guilherme Jonas Costa da Silva[a,*], Lívia Abrão Steagall Pirtouscheg[b]

[a] *Federal University of Uberlândia, Brazil*

[b] *Post-Graduation Program in Economy of the Federal University of Uberlândia, Brazil*

Received 19 March 2014; received in revised form 23 September 2014; accepted 29 December 2014
Available online 30 January 2015

Abstract

The debate on the strategy of banking spread reduction in Brazil has been extended for a long time and was fundamentally concentrated in macroeconomics aspects. This paper has the goal of evaluate the new policy of banking spread reduction implemented by the federal government, which has added microeconomic aspects to this tendency. In order to do so, a mathematical model was presented that combines microeconomics aspects, such as was developed by Nakane (2001), with macroeconomics aspects, originally presented by Ho and Saunders (1981). This model was tested for the 25 largest banks in the period of March 2009 to March 2013, using the Panel Data Methodology. The GMM System model was the one that best fitted the data gathered and the results showed that both aspects are relevant in explaining the banking spread in Brazil, and should not be analyzed separately, as is frequently made in the literature, considering the econometric problems related to the omission bias of relevant variables.

JEL classification: C33; D43; E43

Keywords: Banking spread; Basic interest rate; Competition; Panel data; Brazil

Resumo

O debate acerca da estratégia de redução do *spread* bancário no Brasil estendeu-se por um longo período e concentrava-se fundamentalmente em aspectos macroeconômicos. Este artigo tem por objetivo avaliar a nova política de redução do *spread* bancário implementada pelo governo federal, a qual adicionou os aspectos microeconômicos. Para atingir este objetivo, foi apresentado um modelo matemático que combina aspectos microeconômicos, desenvolvido por Nakane (2001), com aspectos macroeconômicos, originalmente apresentados por Ho & Saunders (1981). Este modelo foi testado para os 25 maiores bancos no período de março de 2009 a março de 2013, utilizando a metodologia de Dados em Painel. O Modelo *GMM System* foi o que mais se adequou aos dados analisados e seus resultados mostraram que ambos aspectos são relevantes para explicar o *spread* bancário no Brasil e

* Corresponding author. Tel.: +55 34 88445264.
E-mail address: guilhermejonas@ie.ufu.br (G.J.C. da Silva).
Peer review under responsibility of National Association of Postgraduate Centers in Economics, ANPEC.

http://dx.doi.org/10.1016/j.econ.2014.12.001
1517-7580

não devem ser analisados separadamente, como é frequentemente realizado pela literatura, em função dos problemas econométricos relacionados ao viés de omissão de variáveis relevantes.

Palavras-chave: Spread Bancário; Taxa Básica de Juros; Competição; Dados em Painel; Brasil

1. Introduction

The theory of the banking firm has undergone several changes in its evolution. In its early days, it was dominated by neoclassical thought. In this perspective, the commercial banks were regarded as mere financial intermediaries and unable to influence real economic variables such as employment and output. In its evolution, were presented diverse perspectives on the determinants of banking spread and, currently, the literature recognizes the importance not only of macroeconomic aspects, but also of the microeconomic ones.

Banking spread in Brazil has been for long at high levels and, although with a downward trend in recent years, it still remains at a relatively higher level when compared to the values observed in the rest of the world. A commonly used explanation is that high levels of basic interest rate cause the high levels of banking spread in the country. However, an important current of thought – pioneered by Bresnahan (1982) and Lau (1982) – considers that the microeconomic factors play a fundamental role in understanding the banking spread. This consideration gains more relevance when observing the measures recently adopted by the government of Dilma Rousseff in Brazil, which sought to promote greater competition between banks by using public banks as boosters of private banks.

The measures adopted by the Brazilian government are still in the evaluation process and it is hoped that this strategy is effective in reducing the level of banking spread. Thus, understanding the behavior of banking spreads can allow the government to perfect their strategies for reducing spread signaling, for example, whether these measures can further reduce the spread in the country, if additional measures are necessary or whether new measures should be implemented to present best results.

This study aims to empirically analyze the current strategy to reduce the spread in Brazil in a perspective still little explored in the literature, which are considered both the micro and macroeconomic determinants of the variable. These results may help the government to identify the most effective strategies for reducing the banking spread in the country. Evidently, the decisions taken by the Brazilian government to reduce the variable into consideration leaves room to extensive discussions which are not limited to the theoretical realm, spreading to discussions of a political and even social nature.

This work is dedicated to analyze the possible determinants of the Brazilian banking spread and observe the relevance of their impacts in this variable, by observing the effects of lower interest rates and increased competition stimulated by public banks. It is intended to test the hypothesis that both factors – microeconomic and macroeconomic – are capable of affecting the banking spread, using the methodology of panel data for 25 commercial banks from the period that goes from the first quarter of 2009 to the first quarter of 2013. For this, we estimated the following models: GMM Difference and GMM System.

To achieve the objectives and test the hypothesis of the paper, in addition to this introduction, the paper is structured in four sections. Section 2 presents the theoretical and empirical research about the determinants of banking spread as well as the mathematical model to substantiate the analysis. In sequence, the discussion turns to the methodology to be employed. In Section 4, the empirical analysis of the determinants of banking spread in the Brazilian economy will be conducted. Finally, we present the concluding remarks.

2. An exposition of the main theoretical and empirical determinants of banking spreads

The theoretical discussion about the banking firm has been predominantly presented by neoclassical intellectuals, and its origin refers to what Tobin (1963) conventionally called the "old vision" of the banking firm, where banks were seen as "a monopolistic entity and 'quasi-technical' currency creators" (Paula, 1999, p. 5), able to create money without limit, although this process is restricted by the legal reserve requirements imposed by the monetary authorities. In the "new vision", the role of financial intermediaries becomes the simultaneous satisfaction of the portfolio preferences of two types of individuals or firms having, on one side, lenders, and on the other, the takers. In this new perspective, banks acted as risk neutral intermediaries and sought to minimize the costs associated with the risk of illiquidity and maximize profitability.

From Tobin's (1963) theory of the banking firm came the modern neoclassical theory of the banking firm, whose main representative is the work of Klein (1971). The modern theory of the banking firm seeks to establish the role of market structure and competition within the structural relationships faced by commercial banks, treating them as rational agents in an environment of risk and uncertainty. His theory of the banking firm studies the process of determining the price charged for the services offered. On the role of structure and competition in the model, it is observed that three types of variables must be considered in the analysis of the fees that the bank offers to deposits. These are: the economic variables, the market structure and the degree of interbank competition. The banking spread reflects the degree of monopoly of the bank, therefore, is an increasing function of the degree of concentration of the banking sector as a whole (Silva et al., 2007).

The theory of the banking firm evolved further with contributions from Ho and Saunders (1981), who introduced to this theory the role of macroeconomic aspects. In this approach, the bank is seen as a "mediator" – exchange deposits for loans – and this task is surrounded by uncertainty, since deposits tend to arrive at a different time from when the demands for loans are made. Thus, "the bank will demand a positive interest spread or fee as the price of providing immediacy of (depository and/or loan) service in face of the (transactions) uncertainty generated by asynchronous deposit supplies and loan demands" (Ho and Saunders, 1981, p. 583) and also by uncertainty about the rate of return on loans. The optimal mark-up for deposit and loan depends on four factors, according to Ho and Saunders (1981): (i) the degree of bank management risk aversion; (ii) the market structure in which the bank operates; (iii) the average size of bank transactions; and (iv) the variance of interest rates. However, for this approach of Ho and Saunders (1981), unlike in Klein (1971), the bank is not risk neutral, but averse to it and seeks to maximize the expected profit utility.

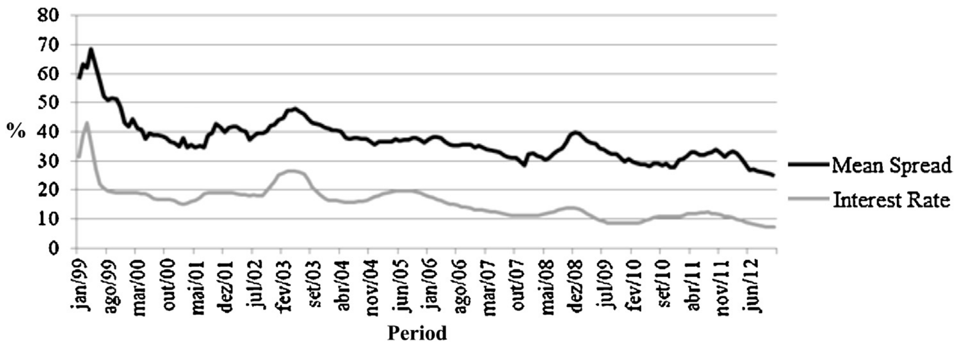
Although Ho and Saunders (1981) have introduced in his theory the role of the market structure in which the bank operates, Bresnahan (1982) and Lau (1982) went further, presenting microeconomic factors related to competition in the banking sector as fundamental to understanding the behavior of bank spread. The theorem developed by Lau (1982) seeks to identify the degree of competitiveness through price and production data for the industry. In this model, the degree of competitiveness of an industry is a constant that ranges from zero (perfect competition) to one (monopoly). Bresnahan (1982) argues that oligopolistic solution can be estimated and identified by traditional econometric methods. All models with which they dealt had the market price and quantity determined by the intersection of the demand function with the supply function.

The model developed by Panzar and Rosse (1987) follows the movement of the industrial organization literature, abandoning the traditional approach of Structure–Conduct–Performance and the treatment of market structure as endogenous, affected by the degree of competition among its participants (Martins, 2012) To Bikker and Haff (2000), "these New Empirical Industrial Organization approaches test competition and the use of market power, and stress the analysis of banks' competitive conduct in the absence of structural measures" (Bikker and Haff, 2000, p. 17).

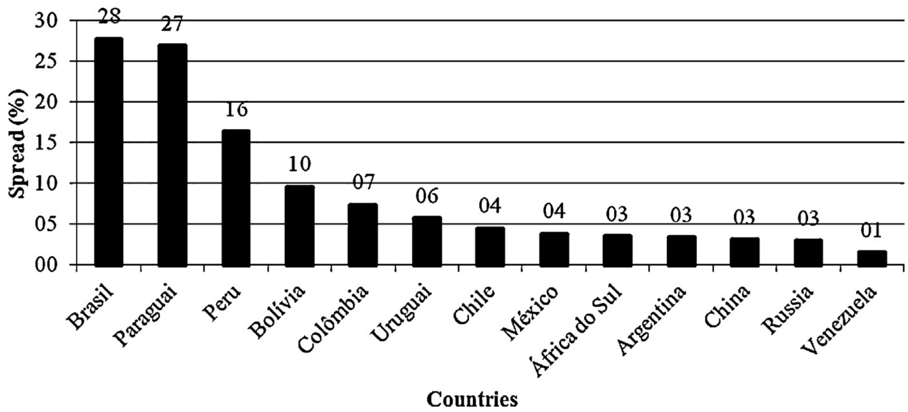
The Post Keynesian theory of the banking firm, originally developed by Oreiro (2004) and Silva and Oreiro (2007), advances in the analysis of the determinants of bank spread in Brazil as it demonstrates that "a permanent reduction of banking spreads can be obtained through a policy of lower interest rates and/or through a change in social conventions regarding the "safe" or "normal" value of the interest rate" (Silva and Oreiro, 2007, p. 43).

Silva et al. (2007) make the macroeconomic aspects more relevant because they consider the history of macroeconomic instability of the Brazilian economy and its high levels of bank spreads in international terms. An extremely used variable to measure the stability of the Brazilian economy is the interest rate, which is believed to be largely responsible for the high levels of bank spread. Below this comparison is made, where it is found that, in fact, the trajectories of these two variables have similar behavior (see Graph 1).

Empirically, an important part of the papers on the determinants of bank spread in the Brazilian economy uses the two-stage method of Ho and Saunders (1981) to separate the macroeconomic determinants of the microeconomic. An example of a study using this methodology is developed by Afanasieff et al. (2002), which makes use of panel data to uncover the main determinants of bank spread in Brazil. In this paper, the authors take into account the variables that address the characteristics of banks, macroeconomic conditions, the deposit insurance regulation, overall financial structure and the legal and institutional indicators. The results show that "the pure spreads are sensitive to both, market structure and volatility effects, and also that the effects are quite heterogeneous across countries" (Afanasieff et al., 2002, p. 10). Note that despite the downward trend observed in the banking spread in Brazil, these rates remain



Graph 1. Selic interest rate (% p.m.) and mean banking spread rate (% p.m.): 1999–2012.
Source: Own elaboration using data from the Central Bank of Brazil.



Graph 2. Spread in Brazil and in selected countries: 2012. *Source*: DIEESE – Rede de Bancários (2013).

extremely high when compared to international standards and that this difference cannot be explained by inflation, as shown in Chart 2.

The work developed by Nakane (2001) and Belaisch (2003) closely follow the microeconomic approach. Both sought, although using different methodologies to analyze the determinants of bank spread in Brazil. Their conclusions are similar: the market structure in the Brazilian banking sector is not in any of the two extremes, i.e., corresponds neither to a monopoly/cartel nor to a model of perfect competition. Thus, the structure turns out to be not perfectly delimited, being acknowledged as a structure of oligopoly, since studies show evidence of some market power in this industry. To Belaisch (2003), the Brazilian banking system has a non-competitive market structure, which may be the explanatory factor for the low rate of banking intermediation and for the relative inefficiency of the Brazilian banking sector. Belaisch's (2003) hypothesis is that a non-competitive market structure may justify high rates of bank spread, discouraging deposit volumes and higher loans. The results show that Brazilian banks have oligopolistic behavior, given that the hypotheses of monopolistic behavior and a perfectly competitive demeanor in the banking system are rejected.

Nakane (2001) also conducts an empirical test that allows him to analyze the degree of competition in the Brazilian banking sector. The result found was that the market structure of this industry is highly competitive, although not perfectly competitive, but it is also not a monopoly or cartel as advocated by the general thought. The methodology used to identify and measure the degree of competition in an industry was an adaptation of the methodology developed by Bresnahan–Lau which seeks to test the significance of market power in banking intermediation in Brazil. The demand function for long-term bank loans is represented by the following expression:

$$\ln L = \alpha_1 r^L + \alpha_2 \ln Y + \alpha_3 (r^L \ln Y) \quad (2.1)$$

where L is the aggregate amount of bank loans in real terms, r^L is the interest rate of the loan market in real terms, Y is an indicator of economic activity, and α_1, α_2 and α_3 are coefficients to be estimated. The interaction term between r^L and L rotates the demand curve for bank loans, which allows the identification of the parameter of market power.

In the sequel, Nakane (2001) specifies the bank behavior, assuming that a bank i is able to accumulate an amount D_i of deposits in real terms by committing to pay r^D as real interest, which is limited by a compulsory reserve rate μ. Besides the compulsory reserves, bank assets consist also by bank loans and public bonds, with r^B being the real interest rate charged by public bonds. Then, the bank's balance sheet i is given by:

$$D_i = \mu D_i + L_i + B_i \tag{2.2}$$

with B being the amount of public bonds held by the bank i in real terms. From this equation, we can obtain:

$$B_i = D_i - \mu D_i - L_i$$

So that:

$$r^B B_i = r^B (D_i - \mu D_i - L_i)$$

As:

$$\begin{aligned}
\pi_i &= r^L L_i + r^B B_i - r^D D_i - C(L_i, D_i) \\
\pi_i &= r^L L_i + r^B (D_i - \mu D_i - L_i) - r^D D_i - C(L_i, D_i) \\
\pi_i &= r^L L_i + r^B D_i - r^B \mu D_i - r^B L_i - r^D D_i - C(L_i, D_i) \\
\pi_i &= (r^L - r^B) L_i + [(1-\mu) r^B - r^D] D_i - C(L_i, D_i)
\end{aligned} \tag{2.3}$$

Eq. (2.3) defines the profit function in real terms for a single bank i, where $C(L_i;D_i)$ is the resource cost incurred by bank i to accumulate D_i deposits and provide L_i loans. It is assumed that this cost function is additively separable in its arguments. Nakane (2001) asserts that the rate r^B is exogenous, which allows dealing with the deposit and loan markets separately, and disregards issues of market power. Thus, the first order condition in the loan market is:

$$\frac{\partial \pi_i}{\partial L_i} = r^L - r^B + L_i \frac{\partial r^L}{\partial L_i} - \frac{\partial C_i}{\partial L_i} = 0 \tag{2.4}$$

The marginal loan function can be described by:

$$\frac{\partial C_i}{\partial L_i} = \beta_1 \ln L_i + \beta_2 w + \beta_3 z_i \tag{2.5}$$

where w is the price of entry, z_i is a controlling factor of the quality of results, measured by loan losses, and β_1, β_2 and β_3 are coefficients to be estimated. Consider that the controlling factor of the quality of the results, z_i, is represented by those that influence the volume and conditions on which credit is offered. According to Ho and Saunders (1981, pp. 587–588), z_i can be represented by the interest rate risk, the credit risk and the variance of the interest rate on loans and deposits, which is related to the profitability.

In other words, the analysis proposed in this paper is that macroeconomic instability can affect bank spread through these channels. In recent years, a vast empirical literature regarding the determinants of banking spread has been developed with the intention of empirically testing the theoretical model of bank spread developed by Ho and Saunders (1981)[1]. Some of the most important works in this line of research are McShane and Sharpe (1985), Angbazo (1997), Saunders and Schumacher (2000) and Maudos and Guevara (2004).

In this paper, the variables chosen to represent z_i were: the basic interest rate, the default rate for individuals and the profit rate of each commercial bank. The point of intercept incorporates the idea that the price of products and services

[1] Thus, to Oreiro et al. (2006) this methodology has the advantage of separating the influence of the pure spread of macroeconomic variables (such, as an example, the volatility of interest rates) from the influence of microeconomic variables (such as the market structure of the banking sector) [2006, p. 615].

offered must be greater than its marginal cost to make this banking firm willing to enter the market. The other variables will be incorporated as defined previously. Thus:

$$\frac{\partial C_i}{\partial L_i} = \beta_1 w + \beta_2 \ln L_i + \beta_3 Selic + \beta_4 Inadpf + \beta_5 Varlucro \tag{2.5'}$$

Note that the theory of the banking firm aforementioned combines the elements developed by Nakane (2001) with elements presented by Ho and Saunders (1981), who consider the macroeconomic variables important when explaining the behavior of the rate of return on bank loans. In this proposal, the basic interest rate is used to represent the interest risk, as it is the opportunity cost for the commercial bank for lending to the public. The credit risk can be captured by the default rate of the individual. Finally, the variance of the interest rate on loans and deposits, which is related to the variation of profit.

Substituting (2.5′) in (2.4):

$$\frac{\partial \pi_i}{\partial L_i} = 0$$

$$(r^L - r^B) + L_i \left(\frac{\partial r^L}{\partial L_i}\right) - (\beta_1 w + \beta_2 \ln L_i + \beta_3 Selic + \beta_4 Inadpf + \beta_5 Varlucro) = 0$$

From this we obtain:

$$(r^L - r^B) = (\beta_1 w + \beta_2 \ln L_i + \beta_3 Selic + \beta_4 Inadpf + \beta_5 Varlucro) - L_i \left(\frac{\partial r^L}{\partial L_i}\right) \tag{2.6}$$

Resuming Eq. (2.1):

$$\ln L = \alpha_1 r^L + \alpha_2 \ln Y + \alpha_3 (r^L \ln Y) \tag{2.1}$$

$$\alpha_1 r^L + \alpha_3 (r^L \ln Y) = \ln L - \alpha_2 \ln Y$$

$$(\alpha_1 + \alpha_3 \ln Y) r^L = \ln L - \alpha_2 \ln Y$$

$$r^L = \frac{\ln L - \alpha_2 \ln Y}{(\alpha_1 + \alpha_3 \ln Y)}$$

$$\frac{\partial r^L}{\partial L_i} = \left(\frac{1}{L_i} x \frac{\partial L}{\partial L_i}\right) \left(\frac{1}{\alpha_1 + \alpha_3 \ln Y}\right)$$

Considering that $\partial L/\partial L_i = \lambda$:

$$\frac{\partial r^L}{\partial L_i} = \left(\frac{\lambda}{L_i}\right) \left(\frac{1}{\alpha_1 + \alpha_3 \ln Y}\right) \tag{2.7}$$

Substituting (2.7) in (2.6):

$$\begin{gathered}(r^L - r^B) = (\beta_1 w + \beta_2 \ln L_i + \beta_3 Selic + \beta_4 Inadpf + \beta_5 Varlucro) - L_i \left(\frac{\lambda}{L_i}\right) \left(\frac{1}{\alpha_1 + \alpha_3 \ln Y}\right) \\ r^L - r^B = \beta_1 w + \beta_2 \ln L_i + \beta_3 Selic + \beta_4 Inadpf + \beta_5 Varlucro) - \lambda \left(\frac{1}{\alpha_1 + \alpha_3 \ln Y}\right)\end{gathered} \tag{2.8}$$

The parameter λ measures the percentage of the banking market response to a 1% increase in the supply of loans by bank *i*. In other words, it measures the average degree of market power in the industry. If its value is equal to one, there is a case of monopoly or cartel, and if it is equal to zero, a case of perfect competition.

The results found by Nakane (2001) when estimating the equations via two-stage least-squares estimator (2SLS) were as follows: (i) the bank interest spread adjusts more quickly to deviations from the long-run equilibrium than the demand for bank loans; (ii) the bank interest spread increases when the amount of extended loans rises, when the price of inputs is higher, and when default losses increase; (iii) the value obtained for the market power parameter was 0.0017, implying that Brazilian banks do not behave perfectly competitively, but also do not behave as a cartel, and its market structure remains unidentified. This last point is the main conclusion of this paper. The results also show that market power in Brazilian banking sector is more pronounced in the long-term rather than in the short-term (Nakane, 2001).

Afanasieff et al. (2002) obtained results that show a relatively more important role of the macroeconomic determinants of bank spread, although in the authors' conclusion it was mentioned that these factors may have reached their "limit" of influence, being necessary to make alterations in the microeconomic scenario in order to reduce the level of banking spread in Brazil. Therefore, a model that takes into account both macroeconomic and microeconomic aspects may present a solution to the issue of the high level of banking spread in Brazil.

In fact, the interest rate should be controlled as it determines the floor, since theoretically represents the minimum that the rate of spread can reach, but it should not be overlooked the role of competition in the banking sector to change the maximum levels of this rate charged by banks. Recently, the Brazilian government used the national public banks – *Banco do Brasil (Brazil's Bank)* and *Caixa Econômica Federal* (Brazilian Federal Savings Bank) – to stimulate competition and to put pressure on private banks to reduce their banking spreads and increase the Credit/GDP ratio.

Programs like *Banco do Brasil*'s "Bom Pra Todos" ("Good For All") and *Caixa Econômica Federal*'s "Caixa Melhor Crédito" (loosely translated as "Bank Better Credit") – both started in April 2012 – seek to reverse the spread behavior practiced by the banking sector by encouraging competition. The measures adopted by the government met resistance in the Brazilian Federation of Banks (Febraban) who presented 20 proposals for improvements to reduce banking spreads that did not involve a reduction in interest rates, such as measures that affected the individual default or a reduction in reserve requirements and taxation. However, private banks relented and followed the movement of public banks, reducing their interest rates after the analysis of the measures implemented by the government. The goal of the Brazilian government is to improve the volume and conditions of bank loans in the economy. It is noteworthy that these measures adopted by the government were taken not only in order to reduce the banking spread in Brazil, but also to encourage investment and productive activity in the country. This question has always been among the priorities of economic policy, but after the 2008 crisis, has become greater.

3. Methodology

For the empirical analysis, the methodology used will be static and dynamic panel data. The "panel data suggest the existence of differential characteristics of individuals, understood as' basic statistical unit" (Marques, 2000). A set of panel data, as explained by Wooldridge (2006), "consists of a time series for *each* member of the cross section data set", and the same units of a cross section is observed over a particular period. One of the benefits of using panel data is that observation over time allows you to control certain unobservable characteristics of the chosen variable, solve the problem of omitted variables and also allows to "somehow fix the inconsistency of the estimated parameters of the models" (Silva and Martins, 2012, p. 17). In addition, the largest number of observations increases the degrees of freedom and efficiency of the estimated parameters, reducing the collinearity problem between explanatory variables (Silva and Cruz, 2004).

The panel data static models can be subdivided into fixed effects models and random effects models, the explanatory variables being independent of the terms of disturbance. Of course, if one or more regressors are endogenous it is necessary to apply the method of instrumental variables. In static models only contemporaneous explanatory variables affect the dependent variable (Wooldridge, 2006), in dynamic models is obtained the advantage of observing how the lagged variables – both the dependent variable as the explanatory – can help explain the dependent variable. This is a breakthrough of this model in relation to static models, given that many economic relationships are dynamic in nature. As discussed by Baltagi (2001), these dynamic relationships are characterized by the presence of the lagged dependent variable among the regressors. For dynamic models with panel data can be made the GMM (Generalized Method of Moments) estimate that seeks "to find a consistent estimator with a minimum of restrictions over the moments" (Marques, 2000, p. 41). A generic equation for this model can be presented as

$$y_{it} = \alpha_i + \delta y_{it-1} + \beta x_{it} + u_{it}, \text{ with } i = 1, 2, \ldots, N \text{ and } t = 1, 2, \ldots, T. \tag{3.1}$$

where δ is a scalar, x_{it} are the explanatory variables and u_{it} is the error term.

The GMM Difference estimator – also known as the Arellano–Bond estimator – seeks to address the problem of endogeneity with the technique of instrumental variables. This methodology suggests the estimation in two steps. The

Table 1
Result of the estimation of the static model with panel data and random effects. Dependent variable: natural logarithm of the loan's operation for individuals (*Lnopcred*). March 2009 to March 2013.

Variables	Results RE
Spread	4.741**
	(1.996)
Lnpib	2.217***
	(0.49)
SpreadLnpib	−0.381**
	(0.153)
_cons	−14.66**
	(6.432)
Observations	425
Id number	25
Test Wald chi^2	70.78
Prob > chi^2	0
R^2 within	0.1595
R^2 between	0.1392
R^2 overall	0.0100

Source: Own elaboration using data from BCB and IPEADATA.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

problem encountered in GMM Difference is that in most cases the error term is correlated with the lagged dependent variable. Considering this, the Arellano–Bover/Blundell–Bond estimator was designed aiming to improve the model:

> The estimator Arellano–Bover/Blundell–Bond (also known as GMM-System estimator) increases the Arellano–Bond estimator (known as GMM-Difference estimator) with a additional assumption that the first differences of the instrumental variables are uncorrelated with the fixed effects. This allows the use of more instruments, which can greatly improve efficiency (Silva and Martins, 2012, p. 21).

This extension aims to provide more consistent and efficient estimators, showing that the first-difference estimators of Arellano and Bond are biased due to the use of weak instruments or problems with measurement errors (Baltagi, 2001). The GMM System estimator also improves accuracy and reduces the bias in finite samples. The use of these two methods requires to its' validation the crucial assumption that the instruments are exogenous. To check the validity of the joint moment conditions it is used the difference in Hansen Test for restrictions of over-identification.

3.1. Specification and definition of variables

For simplicity, it is assumed that the capture rate (r^D) is negligible, and, therefore, the lending rate (r^L) is equal to the spread rate. Thus, the following equation is used to find values of the parameters α_1 and α_3:

$$Lnopcred = \alpha_1 Spread + \alpha_2 Lnpib + \alpha_3 (SpreadLnpib) \tag{3.2}$$

where *Lnopcred* is logarithm of the aggregate amount of bank loans in real terms; *Spread* is the spread rate; *Lnpib* is logarithm of the of economic activity; and, finally, SpreadLnopcred is product of *Spread* with *Lnopcred*.

Performing a multiple linear regression and considering random effects, the result of which is shown in Table 1, it is obtained:

$$Lnopcred = -14.66 + 4.74 Spread + 2.21 Lnpib - 0.38 (SpreadLnpib) \tag{3.2'}$$

Then there is the equation for dynamic models, which includes a lag of the dependent variable as an independent variable ($Spread_{it-1}$). Thus, the regression equation is:

$$Spread_{it} = \beta_0 + \beta_1 Spread_{it-1} + \beta_2 Lnopcred_{it} + \beta_3 Selic_{it} + \beta_4 Inadpf_{it} + \beta_5 Varlucro_{it} - \lambda\left(\frac{1}{\alpha_1 + \alpha_3 Lnpib}\right) + \mu_{it} + \vee_{it} \tag{3.3}$$

This equation takes as reference the model Nakane (2001), considering adaptations based on the work of Ho and Saunders (1981), and *Spread*, *Lnopcred*, *Selic*, *Inadpf* and *Varlucro* are defined below. β_0 is the entry price, β_1 is the sensitivity of the spread to loans. μ_{it} is the non-observed error of a specific unit and $\vee_{it}$ is the idiosyncratic individual error.

The table below defines the variables used to construct the model, specifying the source from which they were extracted and the code by which they were treated in the regression

Frame 1 – Variables' definition

Variable code	Variable name	Source
Spread	Individuals' interest rate for personal loans	Central Bank of Brazil
Lnopcred	Loans' operations logarithm for each bank	Central Bank of Brazil
Selic	Basic interest rate – *Selic*	Central Bank of Brazil
Inadpf	Individual default rate	Central Bank of Brazil
Varlucro	Variation rate of net profit of each bank	Central Bank of Brazil
Rzpib	$1/\alpha_1 + \alpha_3 \cdot Lnpib$	Central Bank of Brazil
Lnpib	Gross Domestic Product (GPD) logarithm	Central Bank of Brazil

Source: Own elaboration.

Spread is the dependent variable and, in this paper, is represented by the individuals' interest rate for personal loans;
Lnopcred is the logarithm of loan operations for each of the twenty-five commercial banks and allows noticing how the changes in bank spread relate to the level of credit offered by commercial banks, showing whether there are or not scale gains;
Selic is the Brazilian basic interest rate, *Selic*;
Inadpf is the default level for individual and represents credit risk. This variable is relevant for its' weight in the composition of banking spread;
Varlucro is the rate of change in net profits for each of the twenty-five commercial banks and seeks to capture variation in the interest rates of loans and deposits;
Rzpib is the ratio of 1 on $\alpha_1 + \alpha_3 \cdot Lnpib$, considering the parameters found in Eq. (3.2′) and the logarithm of GDP (Gross Domestic Product);
Lnpib is the logarithm of GDP (Gross Domestic Product).

It is believed that there are problems of endogeneity in the relation between *Spread* and *Lnopcred*, *Inadpf* and *Varlucro*. In the case of variable *Lnopcred*, there is a reverse causality relation, since *Lnopcred* affects *Spread* and vice versa. Variables *Inadpf* and *Varlucro* can be considered endogenous, since past and current values of these variables are theoretically part of the value of the banking spread. These reasons lead to the need for the use of dynamic models in this analysis to correct these problems of endogeneity present in the model. Furthermore, there is the possibility of omission bias, which means that some omitted variable may be correlated with one or more variables in the model.

The data used here were extracted from the Central Bank of Brazil time series database and from IPEADATA, from March 2009 to March 2013, with quarterly data, amounting to a total of 17 quarterly observations. This time period was restricted by the lack of information on the variable banking spread provided by the Central Bank of Brazil, and it is expected that in future analyzes the number of commercial banks can be expanded to compensate for the short time horizon. The total number of observations was 425. The panel data are unbalanced, i.e., the information of each bank is available for all periods. Table 2 shows the descriptive statistics and variables used in the model and includes the mean, standard deviation, minimum and maximum values reached by these variables, and the total number of observations (N), the total number of banks (n) and the total number of periods (T).

Table 2
Descriptive statistics of variables used in econometric models: March 2009 to March 2013.

Variable	Mean	Stand. dev.	Min.	Max.	Observations
Id					
Overall	13	7.2196	1	25	$N = 425$
Between		7.3598	1	25	$n = 25$
Within		0.0000	13	13	$T = 17$
Spread					
Overall	2.80539	0.9876	0.710	6.360	$N = 425$
Between		0.8899	0.961	4.715	$n = 25$
Within		0.4618	1.496	5.996	$T = 17$
Lnopcred					
Overall	13.7708	1.7305	10.292	17.729	$N = 425$
Between		1.6110	11.496	16.837	$n = 25$
Within		0.7052	12.420	17.370	$T = 17$
Selic					
Overall	9.84529	1.6610	7.130	12.560	$N = 425$
Between		0.0000	9.845	9.845	$n = 25$
Within		1.6610	7.130	12.560	$T = 17$
Inadpf					
Overall	7.28612	0.8341	5.833	8.433	$N = 425$
Between		0.0000	7.286	7.286	$n = 25$
Within		0.8341	5.833	8.433	$T = 17$
Varlucro					
Overall	−0.2189	5.5470	−72.903	44.365	$N = 425$
Between		1.8354	−6.821	4.819	$n = 25$
Within		5.2466	−66.301	41.895	$T = 17$
Lnpib					
Overall	13.1679	0.2007	12.577	13.355	$N = 425$
Between		0.0000	13.168	13.168	$n = 25$
Within		0.2007	12.577	13.355	$T = 17$
Rzpib					
Overall	−5.1337	5.2729	−25.406	−2.986	$N = 425$
Between		0.0000	−5.134	−5.134	$n = 25$
Within		5.2729	−25.406	−2.986	$T = 17$

Source: Own elaboration using Stata and data from BCB and IPEADATA.

The results show that the highest averages are reached by the logarithm of loans, the basic interest rate and the default of individual. The largest standard deviation was found in the rate of change of the net income for each commercial bank, reflecting the recent environment of economic uncertainty and differences between these banks.

4. Presentation and discussion of results

The results of dynamic models, GMM Difference and GMM System, are exposed simultaneously with the difference in Hansen Test in Table 3. This test makes the comparison between these two models and its null hypothesis is that the instruments are valid.

The variables *Spread* and *Lnopcred*, *Inadpf* and *Varlucro* were considered endogenous, since the error term may contain variables that affect the rate of profit of banks as well as amount of loans and the default rate and are not included in the theoretical model.

For the dynamic model GMM Difference, shown in the second column of Table 3, the number of instruments was 12 and the *p*-value for the chi^2 test was zero, indicating that the model variables have statistical significance and are able to explain in some measure, the dependent variable *Spread*. The most significant variables were lagged *Spread*, *Selic*, *Inapf* and *Rzpib*. *Inadpf*'s coefficient has a negative value, as is also the case for *Rzpib*. This shows that the higher

Table 3
Result of the dynamic regression models estimations with panel data using GMM Difference and GMM System and of Hansen Test. Dependent variable: individual interest rate for credit operations (Spread). March 2009 to March 2013.

Variables	GMM Difference	GMM System
Spread L1.	0.657***	0.661***
	(0.0756)	(0.0787)
Lnopcred	0.0335	0.0396
	(0.0342)	(0.0296)
Selic	0.0298*	0.0305**
	(0.0167)	(0.0128)
Inadpf	−0.0675**	−0.0748***
	(0.0306)	(0.0277)
Varlucro	−0.0101	−0.00812
	(0.0103)	(0.0109)
Rzpib	−0.0554***	−0.0594***
	(0.0154)	(0.0162)
_cons	–	0.403
	–	(0.688)
Observations	375	400
Id number	25	25
Wald chi^2	164.64	242.39
Prob > chi^2	0	0
AR(1)z	−2.55	−2.58
AR(2)z	−1.09	−1.13
AR(1)P > z	0.011	0.01
AR(2)P > z	0.275	0.259
Hansen chi^2	11.17	15.16
Hansen P > chi^2	0.083	0.126
Hansen Test excluding group chi^2		11.6
Hansen Test excluding group P > chi^2		0.071
Difference test chi^2	–	3.56
Difference test P > chi^2	–	0.469
Estimation type	Difference	System
Number of instruments	12	17
Instruments	L(1/3).(L.spread L.lnopcred L.inadpf L.varlucro) colapsado	L(1/3).(L.spread L.lnopcred L.inadpf L.varlucro) colapsado

Source: Own elaboration using data from BCB and IPEADATA.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

the default rate for individuals, the lower the level of banking spreads, as banks tend to realize that the best solution is to facilitate payment, renegotiating the debts of debtors and reducing the spreads charged to facilitate payment and increase the bank's revenue. The increase in profits of banks allows them to reduce their spreads to gain market share. Regarding the variable *Rzpib*, its negative coefficient is consistent with that found by Nakane (2001), which means that Brazilian banks do not behave competitively, but the results indicated that banks are approaching an oligopoly.

Observing tests Arellano–Bond AR (1) and AR (2), which seek to show whether there is or not a correlation of the explanatory variables with the residue, it is possible to note that AR (1) takes on a low p-value of 0.011, showing that there is high correlation as AR (2) has a high p-value of 0.275, meaning that there is not a high correlation. These results match what is expected from the results of this model. Analyzing the test Hansen, note that the p-value of the chi^2 test obtained a high value (0.083), meaning that the null hypothesis should be rejected, i.e., the instruments are valid and are not correlated with the error term of the difference equation, and the endogeneity bias was discarded.

The final model presented herein is the dynamic model GMM System displayed in the third column of Table 3 that, as mentioned earlier, represents an attempt for improving the GMM Difference model in which, in most cases, the error term was correlated with the lagged dependent variable. This model is also more suitable, as it reduces the bias in finite samples as occurs in this case, resulting in more efficient estimators that have a lower variance.

Table 4
Results of the estimations of regression models with panel data OLS pooled and fixed effects considering the lagged dependent variable. Dependent variable: individual interest rate for credit operations (Spread). March 2009 to March 2013.

Variables	OLS pooled	FE
Spread L1.	0.917***	0.655***
	(0.0167)	(0.034)
Lnopcred	0.00963	−0.0103
	(0.0096)	(0.0224)
Selic	−0.0072	0.0207
	(0.0139)	(0.0135)
Inadpf	−0.113***	−0.0753***
	(0.0295)	(0.0277)
Varlucro	0.00055	0.0004
	(0.0028)	(0.0027)
Rzpib	−0.0477***	−0.0547***
	(0.0146)	(0.0136)
_cons	0.764**	1.215***
	(0.326)	(0.435)
Observations	400	400
Id number	25	25
R^2	0.8983	–
R^2 Adj.	0.8968	–
R^2 within	–	0.5909
R^2 between	–	0.996
R^2 overall	–	0.891

Source: Own elaboration using data from BCB and IPEADATA.
* Significant at 10%.
** Significant at 5%.
*** Significant at 1%.

The number of instruments of this model was 17 and the *p*-value for the chi^2 test was zero, showing that the null hypothesis should be rejected and that the variables contained in the model are able to explain to some extent the dependent variable *Spread*. The most significant variables were the lagged variable *Spread* and *Selic*, *Inadpf* and *Rzpib*. Variables *Inadpf* and *Rzpib* continue to present a negative coefficient.

Tests Arellano–Bond AR (1) and AR (2) have low (0.011) and high (0.36) *p*-values, respectively. This, as mentioned in the previous model, is the expected result because it shows that there was a high correlation of the residue in AR (1), but no longer in AR (2). The Hansen Test was 15.16 with a *p*-value of 0.126, a high value and that leads to accept the null hypothesis that the instruments are valid and uncorrelated with the error term of the difference equation.

Take notice of the Difference in Hansen Test result presented at the end of Table 3, which shows that the *p*-value for this test is high, which means that the instruments in level are also valid, and therefore the GMM System model adds to the GMM Difference model valid information and should be chosen as the most suitable model between the dynamic models here displayed. Thus, the best choice seems to be the GMM System model, since this best represents the dynamic nature of economic relations.

To evaluate whether the coefficients found by dynamic models are acceptable, it is possible to compare them to those found in the results of a OLS-Pooled model that considers the lagged variable – which would determine the maximum value that this parameter could achieve – and a model of Fixed Effects that considers the lagged variable – which would determine the minimum value for the parameter. Table 4 shows the results found for these models.

Thus, the parameter found for the lag variable in dynamic models must be less than 0.917 and greater than 0.655. For the GMM Difference model, the lagged variable parameter was 0.657 and for the GMM System model, the value found for the parameter of the lagged variable was 0.0661. Thus, both are in the expected range.

Considering that the best model to be used is the GMM System, some considerations can be made. The variable lagged *Spread* showed great significance, demonstrating the high stiffness to lower banking spreads, which depends significantly on the passed value of this variable. The coefficient found for *Rzpib* stands for the λ parameter of the model of Nakane (2001), which attempts to capture the average degree of market power in the banking industry. Its value is negative, in the order of 0.04, and is consistent with the results found by Nakane (2001), which means that Brazilian banks do not behave competitively, but do not represent a cartel structure. However, the increase in the value of λ indicates that there was an important change in the practices of banks in the country, as they are shunning from the more competitive market structure.

The sign of the estimated coefficient to *Rzpib* is in accordance with that shown in the model of Nakane (2001). The banking spread will be reduced when there is an increase in defaults, for the reasons stated above. Despite the recent instability in international financial markets following the subprime crisis that has increased the liquidity preference of banks, the sign of the estimated coefficient indicates that the increases in profits of major commercial banks in the Brazilian economy could to allow them to reduce their interest rates on bank loan operations, but this variable has not presents statistically significant. Moreover, competition stimulated by public banks contributed to these recent reductions in banking spread in the country.

Although the signal of the variable *Lnopcred* is in accordance to what was found by Nakane (2001), it showed no statistical significance. The basic interest rate presented a positive and significant coefficient, as expected. This last statement reinforces the argument that the interest rate acts as a floor to the level of banking spread, forcing this to rise when the interest rate increases. Summarizing, it is observed that both the macroeconomic and microeconomic factors are able to influence the level of banking spread, and more, if the macroeconomic measures to reduce spread have reached their limit, as supposed by Afanasieff et al. (2002) it is necessary to intensify the use of microeconomic measures, as recently implemented by the Brazilian government, through the encouragement of competition in the banking sector promoted by public banks, among other measures.

5. Concluding remarks

This paper aimed to present the microeconomic and macroeconomic determinants of banking spread, based on the assumption that the interest rate determines its floor, the minimum level the rate of spread can theoretically achieve, and that competition in the banking sector operates by determining its roof, or maximum level, practiced by banks. In order to do so, the theory of the banking firm was exposed and estimations were performed using panel data in order to achieve the objectives and to test the launched hypothesis.

The models developed showed different results, but it was observed that the most appropriate model for this paper is the GMM System dynamic model, since it can deal with the dynamic nature of the economy and also solves the problem of endogeneity, as it eliminates the correlation of explanatory variables with the error term and the problem originated when dealing with a finite sample that can generate bias.

The most relevant results of this model were: basic interest rate is indeed positively related to the dependent variable banking spread, and is significant at a confidence level of 95%. The variable *Rzpib* whose coefficient attempts to capture the degree of competition in the banking market by demonstrating how spread reacts to changes in the demand for credit, had a negative coefficient in all models converging with the expected by the literature. The value of its coefficient, equivalent to λ in Nakane's (2001) model, shows that the market structure in the banking sector is still undefined, since it did not remain in either one of the extremes of monopoly or perfect competition.

The variable corresponding to the default rate of individuals in the dynamic models presented a negative coefficient, showing that an increase in default by the borrowers leads to a reduction of banking spread in the expectation that this rate reduction will ease the payment of loans. The variable profit rate also showed a negative coefficient, indicating that an increase in bank profits allows these have some leeway to reduce their spreads in order to expand its market share. The banking spread will increase when the amount of loans of each commercial bank is high, which is similar to results found by Nakane (2001) and the same will occur when there are increases in the interest rate.

This paper concludes that both macroeconomic and microeconomic factors are able to influence the level of banking spread in Brazil and that, if the assumption made by Afanasieff et al. (2002) is correct and macroeconomic measures to reduce the spread have already reached their limit, the measures taken by the Brazilian government are in a correct trajectory, in the sense of reducing banking spreads in the country by intensifying the use of microeconomic measures as encouragement to competition in the banking sector promoted by public banks.

References

Afanasieff, T.S., Lhacer, P.M., Nakane, M.I., 2002. The determinants of bank interest spread in Brazil. Working Paper Series, n. 46, Brasília, pp. 1–32.

Angbazo, L., 1997. Commercial bank net interest margins, default risk, interest-rate risk, and off-balance sheet banking. J. Bank. Financ. 21, 55–87.

Baltagi, B.H., 2001. Econometric Analysis of Panel Data, 2nd ed. Wiley, Chichester, Reino Unido.

Belaisch, A., 2003. Do Brazilian Banks Compete? IMF Working Paper, Washington.

Bikker, J.A., Haff, K., 2000, September. Measures of Competition and Concentration in the Banking Industry: A Review of the Literature. Research Series Supervision, No. 27.

Bresnahan, T.F., 1982. The oligopoly solution concept is identified. Econ. Lett. 10 (January), 87–92.

DIEESE, 2012, April. *Spread* e Juros Bancários. Nota Técnica n°109.

Ho, T.S.Y., Saunders, A., 1981, June. The determinants of bank interest margins: theory and empirical evidence. J. Financ. Quant. Anal. 16 (4), 581–600.

Klein, M.A., 1971. A theory of the banking firm. J. Money Bank. 3 (May (2)), 205–218 (Part 1).

Lau, L.J., 1982. On identifying the degree of competitiveness from industry price and output data. Econ. Lett. 10 (January), 93–99.

Marques, L.D., 2000, October. Modelos Dinâmicos com Dados em Painel: Revisão de Literatura. Cempre, Faculdade de Economia do Porto, Portugal.

Martins, B., 2012, November. Estrutura de Mercado Local e Competição Bancária: Evidências no Mercado de Financiamento de Veículos. Trabalhos para Discussão do Banco Central, n°299, Brasília, pp. 1–29.

Maudos, J., Guevara, J.F., 2004. Factors explaining the interest margin in the banking sectors of the European Union. J. Bank. Financ. 28 (9).

McShane, R.W., Sharpe, I.G., 1985. A time series/cross section analysis of the determinants of Australian trading bank loan/deposit interest margins: 1962–1981. J. Bank. Financ. 9, 115–136.

Nakane, M.I., 2001. A Test of Competition in Brazilian banking. Working Paper Series, No. 12, Brasília, pp. 1–24.

Panzar, J., Rosse, J., 1987. Testing for "Monopoly" Equilibrium. J. Ind. Econ. 35, 443–456.

Paula, L.F., 1999. Dinâmica da Firma Bancária: Uma Abordagem Não-Convencional. Rev. Brasil. Econ. 53 (July/September (3)), 323–356.

Saunders, A., Schumacher, L., 2000. The determinants of bank interest rate margins: an international study. J. Int. Money Financ. 19, 813–832.

Silva, G.J.C., Martins, H.E.P., 2012. Infraestrutura de Transportes e Desenvolvimento Regional no Brasil: Uma análise dos Impactos do Programa de Aceleração do Crescimento (PAC).

Silva, G.J.C., Oreiro, J.L.C., 2007. Taxa de Juros Convencional e Rentismo em um Modelo Pós-Keynesiano de Firma Bancária. In: Paula, L.F., Oreiro, J.L. (Eds.), Sistema Financeiro: Uma Análise do Setor Bancário Brasileiro. Elsevier, Rio de Janeiro, pp. 23–44 (Chapter 2).

Silva, G.J.C., Oreiro, J.L.C., Paula, L.F., 2007. *Spread* Bancário no Brasil: Uma Avaliação Empírica Recente. In: Paula, L.F., Oreiro, J.L. (Eds.), Sistema Financeiro: Uma Análise do Setor Bancário Brasileiro. Elsevier, Rio de Janeiro, pp. 191–220 (Chapter 9).

Silva, O.M., Cruz Jr., J.C., 2004. Dados em painel: Uma análise do modelo estático. In: Santos, M.L., Vieira, W., da, C. (Eds.), Métodos quantitativos em economia. Viçosa.

Tobin, J., 1963. Commercial banks as creators of "money". In: Banking and Monetary Studies., pp. 408–419 (cap. 22).

Wooldridge, J., 2006. Introdução à Econometria: Uma abordagem moderna. In: Cengage Learning, 1st ed.