

The Determinants of Bank Interest Spread in Brazil

Tarsila Segalla Afanasieff

Priscilla Maria Villa Lhacer

Research Department, Banco Central do Brasil

Márcio I. Nakane

Research Department, Banco Central do Brasil
Department of Economics, Universidade de São Paulo

ABSTRACT

The behavior of bank interest spreads in Brazil reveal two stylized facts. First, a remarkable fall in the average rates since early 1999 and continuing up to the present. Second, a strong and persistent dispersion of rates across banks. Such stylized facts suggest that both the time series and the cross section dimensions are important elements to understand the trend of the bank interest spread in the country.

This paper makes use of panel data techniques to uncover the main determinants of the bank interest spreads in Brazil. A question that the paper aims to address is whether macro or microeconomic factors are the most relevant ones affecting the behavior of such rates. A two-step approach due to Ho and Saunders (1981) is employed to measure the relative relevance of the micro and the macro elements.

The roles played by the inflation rate, interest rate volatility, economic activity (all macroeconomic factors) and CAMEL-type indicators (microeconomic factors) are highlighted. The results suggest that macroeconomic variables are the most relevant factors to explain the behavior of bank interest spread in Brazil.

JEL classification: G21; E43; E44.

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1. Introduction

Bank interest rates have been the focus of recent (October 1999) policy attention by the Brazilian Central Bank. In a highly publicised report [see Banco Central do Brasil (1999)], this institution showed a great concern for the high levels of the bank loan interest rates observed in the country. This report concluded that high default levels as well as high operating costs are amongst the main culprits for the high bank interest margin seen in the country. On average, loan default and operating cost accounted for 35% and 22% of bank spread, respectively, for a sample of 17 Brazilian banks.

The economic and policy relevance of such topic is beyond any questioning. However, the Central Bank report lacks a more formal approach to support their main conclusions. The decomposition of the bank interest margin among different factors is based on accounting identities rather than on a bank profit maximization model¹.

The purpose of this paper is to provide an econometric account of the main determinants of the bank interest margin in Brazil. The study makes use of the two-step regression approach advanced by Ho and Saunders (1981) to uncover the influence of bank characteristic variables as well as macroeconomic influences as the main explanatory factors of the bank spread in the country.

The paper is structured as follows: after this Introduction, section 2 reviews the relevant literature. Section 3 overviews the recent behavior of bank interest rates in Brazil. Section 4 describes the methodology to be applied in the paper. Section 5 introduces the empirical model to be estimated. Section 6 deals with the sample and data issues. Section 7 presents the main results. Section 8 summarizes the main findings and concludes the paper.

2. Literature Review

In a comprehensive study, Demirgüç-Kunt and Huizinga (1999) investigate the determinants of bank interest margins using bank-level data for 80 countries in the years 1988-1995. The set of regressors include several variables accounting for bank characteristics, macroeconomic conditions, explicit and implicit bank taxation, deposit insurance regulation, overall financial structure, and underlying legal and institutional indicators. The variables accounting for bank characteristics and macroeconomic factors are of special interest since they are close to the ones included in the regression estimated in our paper.

Demirgüç-Kunt and Huizinga report that the bank interest margin is positively influenced by the ratio of equity to lagged total assets, by the ratio of loans to total assets, by a foreign ownership dummy, by bank size as measured by total bank assets, by the ratio of overhead costs to total assets, by inflation rate, and by the short-term market interest rate in real terms. The ratio of non-interest earning assets to total assets, on the other hand, is negatively related to the bank interest margin. All the mentioned variables are highly statistically. Output growth, by contrast, does not seem to have any impact on bank spread.

¹See Barajas *et al.* (1999) for a decomposition of bank interest margins calculated from a reduced-form equation estimated on the basis of a bank profit maximization model.

Another branch of the literature is concerned with the adjustments of bank interest rates to the market interest rate². These studies show that, in the long run, one cannot reject the hypothesis that bank interest rates follow the market interest rate in a one-to-one basis, i.e. that there is full adjustment to changes in the market interest rate. In the short-run, though, the departures of bank interest rates from the market interest rate are relevant and there is some evidence that adjustments towards the long run equilibrium are asymmetric, i.e. the adjustment varies according to whether one observes positive or negative unbalances.

There is some evidence of price rigidity in local deposit markets with decreases in deposit interest rates being more likely than increases in these rates in the face of changes in the market interest rate [Hannan and Berger (1991)]. One reason for such behavior is market concentration: banks in concentrated markets were found to exacerbate the asymmetric adjustments [Neumark and Sharpe (1992)].

The same sluggishness has been observed for the loan interest rate. Cottarelli and Kourelis (1994) apply a two-step approach to investigate the reasons for the stickiness of bank lending rates for a sample of countries. In the first step, the impact multipliers of changes in the market interest rate are calculated for each country in the sample. In the second step, such impact multipliers are regressed against a large set of explanatory variables controlling for cross-country differences in the competition within the banking system, in the extent of money market development and openness of the economy, in the banking system ownership, and in the degree of development of the financial system. Of interest are the results that the impact multiplier is higher for countries where inflation is higher and where the banking systems are not dominated by public banks.

Angbazo (1997) studies the determinants of bank net interest margins for a sample of US banks using annual data for 1989-1993. The empirical model for the net interest margin is postulated to be a function of the following variables: default risk, interest rate risk, an interaction between default and interest risk, liquidity risk, leverage, implicit interest payments, opportunity cost of non-interest bearing reserves, management efficiency, and a dummy for states with branch restrictions. The results for the pooled sample suggest that the proxies for default risk (ratio of net loan charge-offs to total loans), the opportunity cost of non-interest bearing reserves, leverage (ratio of core capital to total assets), and management efficiency (ratio of earning assets to total assets) are all statistically significant and positively related to bank interest margins. The ratio of liquid assets to total liabilities, a proxy for low liquidity risk, is inversely related to the bank interest margin. The other variables were not significant in statistical terms.

Some recent contributions have made use of more structural models based on profit maximization assumptions for banks operating in imperfect markets to develop empirical equations to understand the behavior of bank interest rates³.

Barajas *et al.* (1999) documents significant effects of financial liberalization on bank interest spreads for the Colombian case. Although the overall spread has not reduced with the financial liberalization measures undertaken in the early 1990s, the relevance of the different factors behind bank spreads were affected by such measures.

In a single equation specification, the bank lending rate is regressed against the ratio of the deposit rate to (one minus) the reserve ratio, a scale variable represented by the volume of total loans, wages, and a measure of loan quality given by the percentage of nonperforming loans. A

² See, among others, Hannan and Berger (1991), Neumark and Sharpe (1992), Cottarelli and Kourelis (1994), Cottarelli *et al.* (1995), Scholnick (1996), and Heffernan (1997).

³ Recent contributions include Barajas *et al.* (1999) for Colombia, Catao (1998) for Argentina, and Randall (1998) for the Eastern Caribbean region.

test for market power is performed with the results showing that the banking sector in Colombia was imperfect before the liberalization but that a competitive industry describes the data well in the post-liberalization period. Another change linked with the liberalization process was an increase in the coefficient of loan quality after the liberalization. The authors notice that “this change could signal a heightened awareness on the part of bank managers regarding credit risk, and/or it could reflect an improved reporting of nonperforming loans” (p. 212). A negative sign found for the scale variable indicates that economies of scale are prevalent for both periods.

The regression results are then used to decompose the bank intermediation spread into four factors: financial taxation (reserve requirements and forced investments), operating costs, market power, and loan quality. For the pre-liberalization period, operating costs made up about 38% of bank spread while market power, financial taxation and loan quality accounted for 36%, 22% and 4% of the spread, respectively. For the post-liberalization period, the impact of market power is set equal to zero to be consistent with the regression results. Loan quality now accounts for 29% of the spread while operating costs and financial taxation were responsible for, respectively, 45% and 26% of the spread.

Unlike other Latin American countries, Argentina operates a currency board arrangement with the widespread use of foreign currency (US dollar) alongside the domestic one. Domestic banks are allowed to intermediate freely in domestic as well as in foreign currency.

Using Argentinean data, Catão (1998) studies the determinants of the intermediation spread for loan and deposits denominated both in domestic as well as in foreign currencies. Both intermediation margins are related to the average tax ratio, to the cost of reserve requirements, to operating costs, to problem loans, to the exchange rate risk, and to the market structure as measured by the Herfindahl index.

The only marked difference between the domestic and foreign currency markets is a positive and significant impact of the market structure on spread for the former markets and a non-significant impact for the latter. Catão observes that such difference reflects “the fact that most peso borrowers cannot arbitrage between domestic and foreign sources of funds, thus becoming subject to the monopoly power of local banks” (p. 21). By contrast, “interbank competition for the typical US dollar borrower is bound to be considerably fiercer and the scope for banks to exert monopoly power over the client is therefore much reduced” (p. 21).

For both markets, the intermediation spreads are mostly affected by operating costs and problem loans. The quantitative effects of both factors are nearly the same for the domestic currency market while operating costs seem to be more important than problem loans in the US dollar market. The impact of reserve requirements on spread are economically small “reflecting the fact that banks' reserves at the Central Bank are remunerated at interest rates close to that of time deposits” (p. 21).

Randall (1998) documents that for the Eastern Caribbean countries⁴, unlike the evidence gathered above, the impact of loan loss provisioning has been to reduce bank interest margin rather than to increase it once the tendency of banks to under provision in the case of government loans is accounted for. Like in other countries, operating expenses seem to have a large impact on bank spreads in the Eastern Caribbean region. Over the sample period, the ratio of operating expenses to total asset explains 23% of the estimated spread.

⁴ The Eastern Caribbean region is comprised by the following countries, in alphabetical order: Anguilla, Antigua and Barbuda, Dominica, Grenada, Montserrat, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines. These countries share a common currency and a common central bank.

Ho and Saunders (1981) advocate a two-step procedure to explain the determinants of bank interest spreads in panel data samples.⁵ In the first-step, a regression for the bank interest margin is run against a set of bank-specific variables such as non-performing loans, operating costs, the capital asset ratio, etc. plus time dummies. The time dummy coefficients of such regressions are interpreted as being a measure of the “pure” component of a country's bank spread. In the second-step, the constant terms are regressed against variables reflecting macroeconomic factors. For this second step, the inclusion of a constant term aims at capturing the influence of factors such as market structure or risk-aversion coefficient, which reflect neither bank-specific observed characteristics nor macroeconomic elements.

Brock and Rojas-Suarez (2000) apply the two-step procedure for a sample of five Latin American countries (Argentina, Bolivia, Colombia, Chile, and Peru). For each country, the first-stage regressions for the bank interest spread include variables controlling for non-performing loans, capital ratio, operating costs, a measure of liquidity (the ratio of short term assets to total deposits) and time dummies. The coefficients on the time dummies are estimates of the “pure” spread.

Their results show positive coefficients for capital ratio (statistically significant for Bolivia and Colombia), cost ratio (statistically significant for Argentina and Bolivia), and the liquidity ratio (statistically significant for Bolivia, Colombia, and Peru). As for the effects of non-performing loans, the evidence is mixed. Apart from Colombia, where the coefficient for non-performing loans is positive and statistically significant, for the other countries the coefficient is negative (statistically significant for Argentina and Peru). The authors explain these findings as “a result of inadequate provisioning for loan losses: higher non-performing loans would reduce banks’ income, thereby lowering the spread in the absence of adequate loan loss reserves” (p. 130). The result for Argentina is striking given the opposite findings reported by Catão (1998).

In the second stage, Brock and Rojas-Suarez (2000) run a regression for the measure of “pure” bank spreads on macroeconomic variables reflecting interest rate volatility, inflation rate and GDP growth rate. Their results show that interest rate volatility increases bank spread in Bolivia and Chile; the same happens with inflation in Colombia, Chile and Peru. For the other cases, the coefficients are not statistically significant.

On balance, bank spreads in Bolivia are explained by micro variables, while bank spreads in Chile and Colombia are accounted for by both macro and micro factors. As for Argentina and Peru, there is still a large fraction of the spread that cannot be explained by any of the above factors.

The evidence summarized above highlights the relevance of administrative costs and provisioning expenses for the Latin American countries. Compared to the Brazilian case [see Banco Central do Brasil (1999)] operating costs are more significant in Colombia and Argentina (for the foreign currency market) while loan quality is more important in Brazil as the main factors behind bank interest spreads. As argued by Barajas *et al.* (1999) if the shares taken by loan quality and market power are considerable, one cannot easily condemn high observed bank spreads as indicative of inefficiency since such high spreads can be being channeled into the capital base of the banking system and, therefore, aiding in strengthening the industry. This latter interpretation is consistent with the evidence that the capital ratio has increased over the years for Colombian banks.

In addition to the studies concerning Latin American countries, Saunders and Schumacher (2000) apply Ho and Saunders two step method to a sample of banks of seven OECD countries (namely Germany, Spain, France, Great Britain, Italy, United States and Switzerland). The

⁵ Section 4 discusses this approach in more detail.

purpose of the authors is to decompose the determinants of bank net interest margins into regulatory, market structure and risk premium components.

Among the three control variables used in the first step, the one with the major impact is the implicit interest rate, a fee proxy. That is, for almost all countries, banks have to increase margins to finance implicit interest payments. Besides that, the coefficients for the opportunity cost of reserves were positive and significant in most countries and years. At last, bank capital ratios were also in general significant and positive.

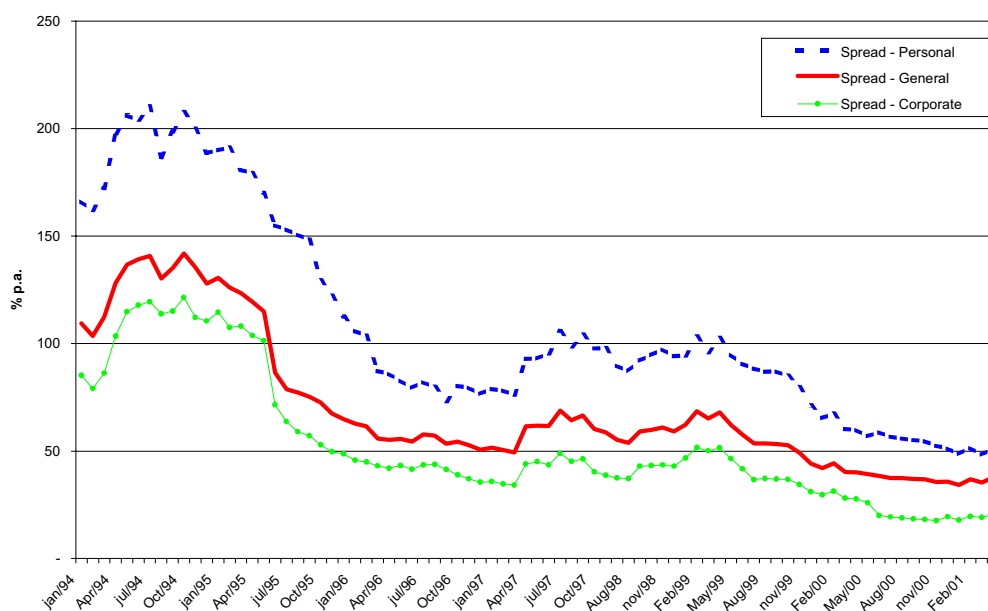
The intercepts of these first step regressions can be understood as the common pure spread across all banks in a single country at the same time. The authors then ran a cross-country second step regression, in which the dependent variable was the estimated pure spreads from the first step. This second stage is supposed to measure the sensitivity of the margins with respect to market structure and interest rate volatility. The results showed that, first, the more segmented and restricted the system is, the higher the spreads are, probably due to the monopoly power, and, second, that the volatility of interest rate has also a significant impact on the margins. These findings suggest that the pure spreads are sensitive to both, market structure and volatility effects, and also that the effects are quite heterogeneous across countries.

3. Recent Evolution of Bank Interest Rates in Brazil

The Brazilian banking system has traditionally been characterized by high lending rates and low levels of credit as a proportion of GDP. Recently, with inflation under control and a stable macroeconomic environment there has been a notable trend towards a more balanced credit market, with a vigorous fall in bank interest margins and an increase in credit.

Figure 1 illustrates the behavior of the bank interest spread in Brazil for both the corporate and the personal sectors. Since 1995, interest spreads in Brazil have been in a downward trend. The overall interest spread has fallen from a rate of 135% p.a. at the beginning of 1995 to 35% p.a. in early 2001. The main reasons behind such trend are related to both a stable macroeconomic environment as well as to official measures aiming at reducing loan interest rates in the country.

Figure 1: Bank Interest Spread in Brazil



The stabilization plan (Plano Real) launched in July 1994 succeeded in controlling inflation rates and creating a more stable macroeconomic environment. As a result, the basic interest rate reduced (with the exception of periods of external shock; see Figure x) and output growth resumed. These favorable macroeconomic conditions were conducive to reductions in bank interest.

In 1999, the Brazilian government adopted some measures with the explicit purpose of reducing banks' spread, namely a gradual reduction of reserve requirements – from 75% to 45% for demand deposits and from 20% to zero for time deposits – and cuts in financial market taxation – from 6% to 1.5%.

Figure 2 illustrates that the drop in the spread rates was simultaneous to an expansion of freely allocated credit in the economy. Total freely allocated loans in the banking system increased 127% in the two-year period from April 1999 to April 2001, rising from R\$ 44,000 million to R\$ 100,000 million. It is important to emphasize though that overall credit in the economy has increased in a more moderate term. Directed credit in the economy (including housing and rural credit) has declined, allowing overall credit to stay stable at 31 percent of GDP, notwithstanding the strong growth in free credit observed in Figure 2.

Figure 2: Bank Interest Spread and Total Freely Allocated Loans

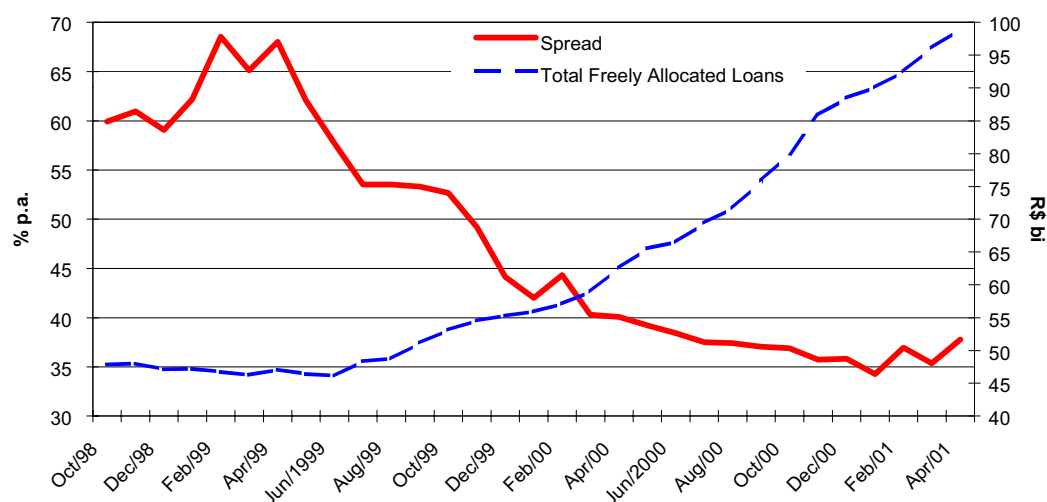


Table 1 compares the simple correlation coefficients of the bank spread with the loan and deposit rates for Brazil, Argentina, Chile and Mexico. Different from other Latin American countries, the variation of the interest spread in Brazil is strongly correlated with both the loan and deposit rates. For the other Latin American countries, the loan rates impact more significantly the spread, probably due to the fact that the deposit interest rate in these countries are set in accordance to the behavior of international interest rates.

Table 1: Correlation of spread with loan and deposit rates for selected Latin American countries

Country	Loan Rate	Deposit Rate
Brazil	0.97	0.87
Argentina	0.89	0.05
Chile	0.75	0.22
Mexico	0.42	-0.33

Source: Brazil – our calculation
Other Countries – Brock and Rojas-Suarez (2000)

In addition to the high observed temporal variation of the bank interest rates in Brazil it is also worth highlighting the important cross-sectional dispersion of such rates. Table 2 computes the coefficients of variation for the loan, deposit and spread rates both over time and across banks.⁶

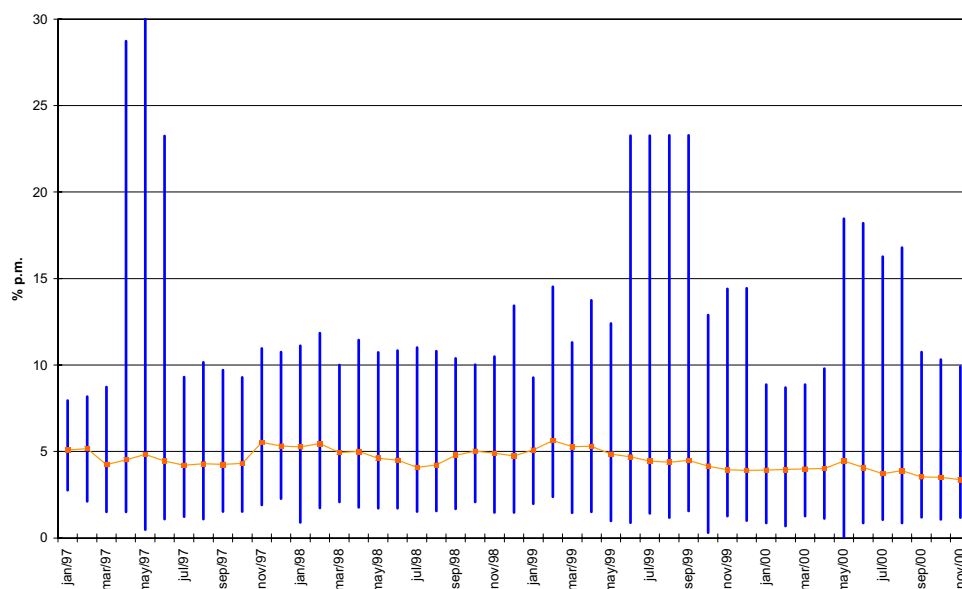
Table 2: Coefficients of variation for the loan, deposit and spread rates

	Loan Rate		Deposit Rate		Spread	
	Over Time	Across Banks	Over Time	Across Banks	Over Time	Across Banks
1997	0.0931	0.4436	0.2634	0.5413	0.0491	0.5435
1998	0.0771	0.4038	0.1839	0.4877	0.0607	0.5221
1999	0.1451	0.4222	0.3467	0.5679	0.0843	0.5459
2000	0.0820	0.5402	0.0524	0.6758	0.1363	0.5479
1997-2000	0.1701	0.4656	0.3111	0.5266	0.1427	0.4870

The results of Table 2 show that the cross-section dispersion of the interest rates is even more pronounced than the temporal variation. Such across banks dispersion is observed for all the three bank rates. Table 2 also shows that the cross-section dispersion of interest rates has not significantly changed over the years.

The same evidence can be gathered by the observation of Figure 3. This figure shows, for each month, the minimum and maximum lending rates observed in the market. One can see that the dispersion is not only quite significant but also very persistent over time.

Figure 3: Mean, Maximum and Minimum Loan Rate



⁶ The coefficient of variation is the ratio of the standard-error to the mean of the corresponding series. The column “Over Time” shows the coefficients of variation when the individual observations that make the series up are the average rates (for all the banks) for each month. In contrast, the column “Across Banks” shows the coefficients of variation when the observations that make the series up are the average rates (for every month) for each bank.

The temporal variation of the interest spreads observed in Brazil, the still high levels of such rates, the dispersion of rates charged across banks, and the persistence of such dispersion justify our use of panel data techniques to analyze the behavior of the interest margins in the country. Specifically, our aim is to decompose the main determinants of the interest spread into microeconomic (inefficiencies or lack of competition of the sector, for example) and macroeconomic (volatility of the basic interest rate, inflation and economic growth) variables.

4. Methodology

The methodology to be applied to the data borrows from the two-step approach advanced by Ho and Saunders (1981). Their applied methodology is based on an adaptation of a model of bid-ask prices of security dealers [see, e.g. Ho and Stoll (1980)] to the determination of the bank interest margin.

The representative bank is modeled as a risk-averse agent that acts as a dealer in a market for the immediate provision of deposits and loans. It holds illiquid assets and it therefore runs the risk of an unbalanced portfolio with either excessive demand for loans or insufficient supply of deposits. The bank sets both the deposit and the loan rates with the aim of maximizing a mean-variance objective function in end-of-period wealth.

Depositors and borrowers are supposed to arrive randomly according to Poisson processes. Ho and Saunders assume linear symmetric specifications for the Poisson arrival rates of loans and deposits:

$$\lambda_L = \alpha - \beta b, \quad \lambda_D = \alpha + \beta a \quad (1)$$

where a and b are the fees charged on deposits and loans.

The equilibrium bank interest margin has then the following simple specification:

$$s = a + b = \frac{\alpha}{\beta} + \frac{1}{2} R \sigma_i^2 Q \quad (2)$$

The bank interest spread is thus the sum of two terms. The first term (α/β) is a measure of the “risk neutral spread” in the sense that it is the bank spread that would be chosen by a risk neutral bank. The risk neutral spread is the ratio of the intercept (α) to the slope (β) of the symmetric deposit and loan arrival probability functions. Ho and Saunders interpret this first term as a measure of market power, since if a bank faces relatively inelastic demand and supply functions in the two markets, it exercises market power by charging a greater spread.

The second term is a measure of risk premium and it reflects the composition of three elements, namely the coefficient of absolute risk aversion (R), the variance of the interest rate on net credit inventories (σ_i^2), and the size of the deposit/loan transaction (Q).

The basic model was extended by, among others, Allen (1988), McShane and Sharpe (1985), and Angbazo (1997) to consider more than one type of loans, other sources of interest rate uncertainty, and asymmetric arrival probability functions.

Ho and Saunders develop a two-step methodology to empirically evaluate the main determinants of the bank interest spread. The first step makes use of a panel of banks to relate the bank-level interest spread to a vector of bank observable characteristics plus a set of time dummies. The time dummy coefficients are interpreted as a measure of the pure bank spread.

The time dummy coefficients are then used as the dependent variable in the second step regression. The set of regressors in the second step includes a measure of interest rate volatility plus other macroeconomic variables.

This two-step approach has been applied to bank data by Ho and Saunders (1981) and Angbazo (1997) for US banks, by McShane and Sharpe (1985) for Australian banks, by Brock and Rojas-Suarez (2000) for Latin American banks (Argentina, Bolivia, Chile, Colombia, Mexico, Peru, and Uruguay), and by Saunders and Schumacher (2000) for a bank sample for US and six European countries (Germany, Spain, France, Great Britain, Italy, and Switzerland).

5. Empirical Model

The empirical model to be estimated in this paper makes use of a panel data set for Brazilian banks to implement the two-step approach described in the previous section. The following equation is used for the first step:

$$s_{it} = \delta + D\boldsymbol{\gamma} + \mathbf{X}_{it}\boldsymbol{\beta} + \varepsilon_{it} \quad (3)$$

where s_{it} is the interest spread for bank i in period t ($i = 1, \dots, N$; $t = 1, \dots, T$) measured as the difference between the loan and the deposit rates, D is a set of T time dummy variables taking the value one for period t , \mathbf{X}_{it} is a vector of bank characteristics, ε_{it} is the statistical disturbance, and δ , $\boldsymbol{\gamma}$, and $\boldsymbol{\beta}$ are parameters to be estimated.

The vector of bank characteristics includes the following variables: a) number of employees; b) the ratio of non-interest bearing deposits to total operational assets; c) the ratio of interest-bearing funds to total earning assets; d) operating costs; e) bank liquidity; f) the ratio of service revenues to total operational revenues; g) the bank net worth; and h) bank leverage. Details on the calculation of each variable are given in section 6.

The measure of the pure bank spread is the estimate of $(\delta + \gamma_t)$, where γ_t is the t^{th} element in the $\boldsymbol{\gamma}$ vector. Let ps_t denote the estimate of the pure spread. In the second-step of the procedure, the following equation is estimated:

$$ps_t = \phi + \mathbf{Z}_t\boldsymbol{\lambda} + u_t \quad (4)$$

where \mathbf{Z}_t is a vector of macroeconomic variables, u_t is the statistical disturbance, and ϕ and $\boldsymbol{\lambda}$ are parameters to be estimated.

The vector of macroeconomic variables contains the estimated volatility of the market interest rate, the inflation rate, and the output growth rate.

6. Sample and Data

Monthly data for all the commercial banks operating in Brazil during the period from February 1997 to November 2000 is used in the study.

Bank observations that were missing, misreported or that constituted clear outliers were excluded from the sample. Banks with less than twelve months of observations were also excluded from the sample. The final sample is an unbalanced panel data with 142 commercial

banks. The total number of observations is 5,578. The average number of observations per period is 121.3.

The deposit interest rate is the rate paid on 30-day certificates of deposits. The loan interest rate is the average rate charged on fixed-rate free-allocated operations. In other terms, both floating-rate operations as well as credit directly channeled through legal requirements (mainly credit to the housing and rural sectors) are excluded from the computation of the loan rate.

Both interest rates are posted rates. By contrast, most of the literature makes use of reported interest income and interest expenses when computing bank interest margins. The advantage of our measure is that the posted rates are more likely to be influenced and to respond to changes in the economic environment than interest income and expense. One possible drawback of posted rates is that they can be far from the effective rates paid to depositors and charged from borrowers due to the exclusion of factors such as payment of fees, commissions, idle resource requirements, etc. in their calculation. Moreover, being an *ex ante* measure, posted rates do not account for loan losses of any nature.

Balance sheet and income statement data come from *COSIF*, a monthly report that all financial institutions in Brazil are required to submit to the Central Bank.

The bank characteristic variables included in the first-step regression aim at controlling for different individual factors that are due to affect the bank interest spread. The main factors considered in the paper include the bank size, its operational policies, and its exposure to risks of different kinds. Our proxies for these factors include the number of bank employees, the ratio of non-interest bearing deposits to total operational assets, the ratio of interest-bearing funds to total earning assets, operating costs, bank liquidity, the ratio of service revenues to total operational revenues, bank net worth, and the leverage ratio.

The number of full-time bank employees (n) is our measure of bank size. The expected sign for this variable is not clear *a priori*. On one side, bigger banks can have more market power, which is conducive to higher interest spreads. On the other hand, economies of scale can lead bigger banks to operate with lower average costs, which works to reduce bank spreads.

Non-interest bearing deposits are mainly demand deposits. Banks are forbidden by law to pay any interest on demand deposits. Total operational assets are total bank assets minus fixed assets. The ratio of non-interest bearing deposits to total operational assets ($nibd$) measures the channeling of non-interest-bearing resources to fund bank activities on the asset side. Non-interest bearing deposits are less costly than interest-bearing resources. Thus, one can expect that banks with higher values for $nibd$ are associated with lower values for the interest spread. However, one can also argue that this variable is actually capturing the effect of the opportunity cost of non-interest bearing reserves, in which case one would expect a positive sign for it in the interest spread equation.

Moreover, although non-interest bearing deposits may imply less interest costs for the bank, it is not clear that banks that rely heavily on non-interest bearing deposits have overall lower costs. Due to the distortions created by a long period of high inflation, many Brazilian banks developed a large and costly branch network with the aim of attracting non-interest bearing deposits subject to inflationary corrosion.

It is therefore unclear what the expected sign for $nibd$ should be.

Interest-bearing funds include interest-bearing deposits (mainly passbook savings and time deposits) plus purchased funds. Total earning assets are defined as total operational assets less the sum of foreign-denominated resources, demand deposits, and public sector resources.

The ratio of interest-bearing funds to earning assets (*ibf*) tries to capture the importance of costly resources to fund the bank asset activities. The expected sign for this variable is not *a priori* certain due to the same reasons given for the *nibd* variable.

Operating cost (*opc*) is the ratio of administrative costs to total assets. Banks with higher operating costs are expected to have higher interest spreads.

Bank liquidity (*liquid*) is defined as the ratio of total operational assets to total bank liabilities. This variable is expected to be negatively related to interest spread. An increase in liquidity reduces the bank liquidity risk, which reduces the interest spread due to a lower liquidity premium charged on loans.

Service revenues include mainly revenues from fee collection. Operational revenues include service plus interest revenues. The ratio of service revenues to operational revenues (*servr*) proxies for the importance of bank's off-balance sheet activities. Angbazo (1997) argues that off-balance sheet activities have two opposing effects on banks. On one hand, off-balance sheet activities "should increase profitability since they permit banks to expand in investments that would be passed up if restricted to equity- or deposit-financing" (p. 76). But, on the other hand, since these activities are subject to lower capital requirements, there is a moral hazard effect that may lead banks to "increase off-balance sheet activities in a manner that increases asset risk and enhances the subsidy value of deposit insurance if the premium does not reflect the marginal risk associated with new investment opportunities" (p. 76).

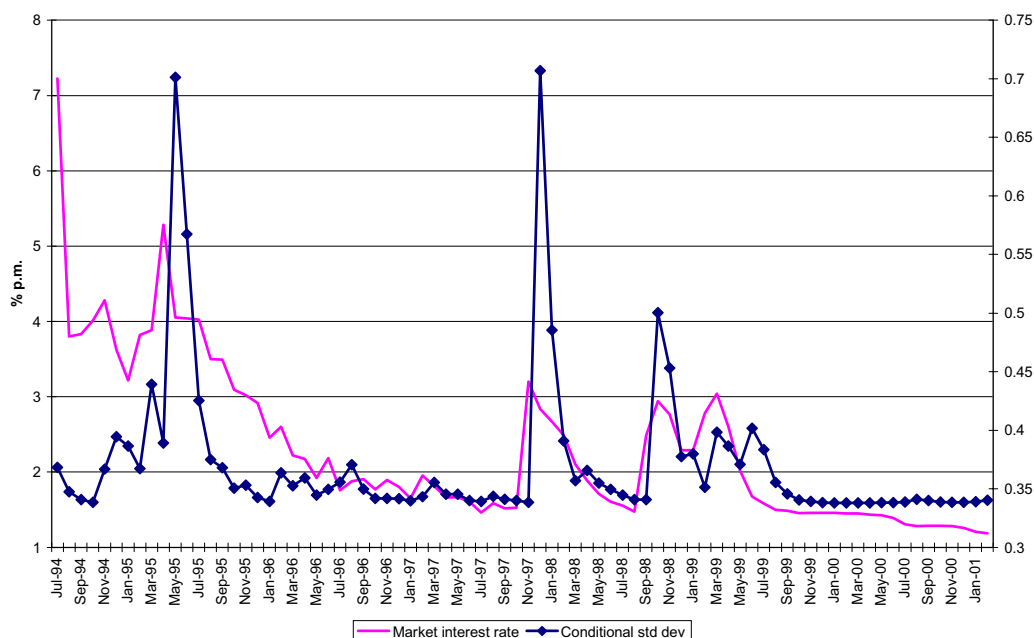
The bank net worth (*netw*) is a summary measure of its earnings performance. The effect of the net worth on interest spread is expected to be negative. Large net worth provides a cushion for banks to better face different risks involved in its activities, which reduces the interest spread.

The leverage ratio (*lever*) is defined as the ratio of total liabilities plus net worth to bank net worth. An increase in the leverage ratio is interpreted as an increase in the bank solvency risk, which is conducive to higher interest spread.

In the second-step regression, the estimate of the pure spread is related to a set of macroeconomic variables, which include the market interest rate, the volatility of the market interest rate, inflation rate, and output growth.

The market interest rate is the overnight *Selic* rate. A GARCH model is adjusted to obtain an estimate of the interest rate volatility. The chosen model is a AR(2) for the mean equation and a GARCH(1,1) for the conditional variance equation. Monthly data for July 1994 to February 2001 is used to estimate the model.

Figure 4 shows the behavior of both the *Selic* interest rate as well as the estimated conditional standard deviation. The impact of the external shocks in both series is quite evident. Interest rate volatility increased sharply during the Mexican crisis of early 1995, the Asian crisis of October 1997, and (to a lesser extent) during the Russian crisis of November 1998.

Figure 4: Market Interest Rate and Its Conditional Variance

The inflation rate is measured as the monthly rate of change of the general price index (IGP-DI) as calculated by Fundação Getúlio Vargas. Output growth is measured by the first difference of the logarithm of the seasonally-adjusted industrial production series as calculated by IBGE.

One expects that the bank interest spread increases when the basic interest rate (*irate*) or its volatility (*ivol*) increase. The same is expected to happen when inflation rate (*infl*) increases. As for the effect of output growth (*ygr*) on interest spread, it can be either positive or negative. On one hand, higher output growth signals a greater demand for bank loans, leading banks to charge more on their loans. On the other hand, to the extent that economic growth is indicative of increased competition and macroeconomic stability, one can expect that lower spread is associated with stronger growth.

7. Results

The first-step equation was estimated by means of a within-group estimator where the observations for each bank constitute a group. This estimation procedure amounts to estimate equation (3) by ordinary least squares with the inclusion of time dummy variables for each month in the sample. Dynamic adjustments of the bank spread to changes in the regressors are allowed through the inclusion of lagged terms in the equation. Six lags of each variable were included in the unrestricted model. Non-significant terms are then excluded. The statistic of the Wald test on the validity of the imposed restrictions is equal to 24.42 for a Chi-squared (25) distribution [*p-value* equal to 0.495]. Equation (5) reports the implied long-run results of the first-step regression:⁷

⁷ The long run shows the sum of the coefficients of each variable and its significant lags. In order to spare space, the coefficients on the time dummy variables are not reported. The estimated standard deviations for each coefficient are based on the robust Huber-White sandwich estimators. The t-values are reported in parentheses.

$$\begin{aligned} \hat{s}_{it} = & 2.876 + 1.04 \times 10^{-5} n_{it} + 0.063 nibd_{it} - 3.13 \times 10^{-3} ibf_{it} + 0.030 opc_{it} \\ & + 4.39 \times 10^{-4} liquid_{it} + 0.032 servr_{it} - 2.11 \times 10^{-4} netw_{it} + 1.01 \times 10^{-3} lever_{it} + D_i \hat{\gamma} \end{aligned} \quad (5)$$

$$R^2 = 15.91\% \quad \hat{\sigma} = 1.838 \quad \text{Joint Significance: } \chi^2(30) = 303.8 \quad \text{Time dummy Significance: } \chi^2(39) = 267.4$$

The results of the first-step regressions suggest that large banks charge higher interest spreads. This result can be interpreted as evidence of either exercise of market power by larger banks or else as existence of diseconomies of scale. The coefficient is not precisely estimated though.

The ratio of non-interest bearing deposits to total operational assets (*nibd*) affects positively the interest spread. One reason for this positive link is related to the fact that the opportunity cost of non-interest bearing reserves increases when *nibd* is high, leading banks to charge higher spreads.

The same reason can explain why the ratio of interest-bearing funds to earning assets (*ibf*) is negative in equation (5).

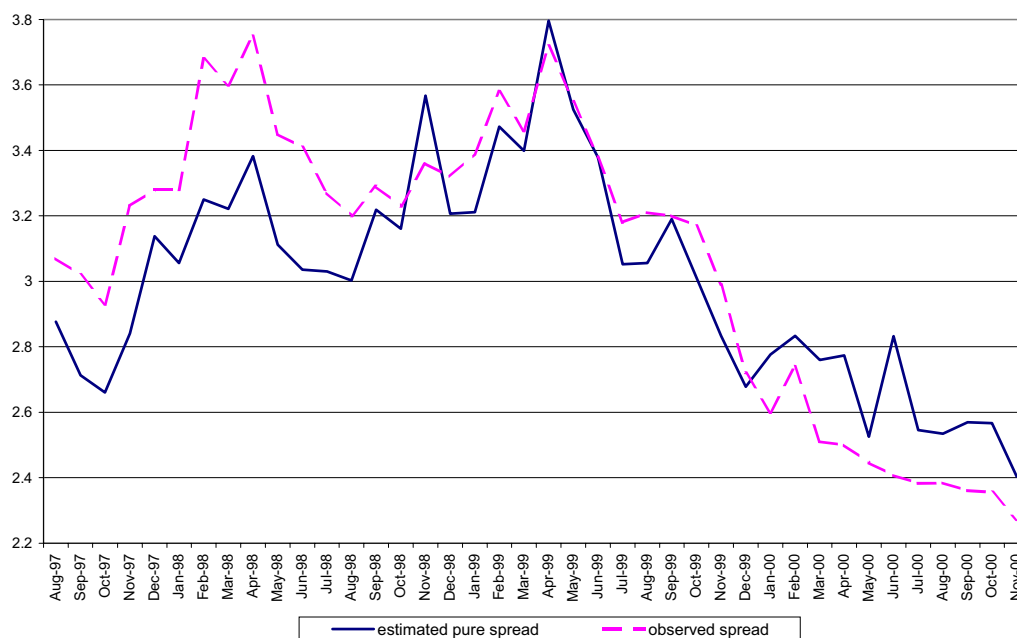
As expected, operating costs (*opc*) act to increase the bank interest margin. The expected negative sign for liquidity (*liquid*), however, is not confirmed.

The ratio of service revenues to operational revenues (*servr*) is found to have a positive impact on the interest spread. To the extent that this variable proxies for the relevance of off balance sheet activities, our results may be capturing some moral hazard behavior due to the regulatory treatment of such activities leading to higher asset risk and, as a result, to higher bank spread as well.

The coefficient on bank net worth (*netw*) is negative, as expected. Such coefficient is not, however, tightly estimated.

An increase in bank leverage (*lever*) is associated with higher interest margins due, probably, to higher solvency risk. The estimated coefficient for this variable is not statistically significant though.

The estimated values for the constant term plus the coefficients on the time dummy variables are our measure of the bank pure spread. Figure 5 contrasts the estimate for the pure spread with the average bank spread. The average bank spread is calculated for the whole banking system rather than for the banks present in our sample.

Figure 5: Bank Interest Spread and Pure Spread

Both series track each other fairly closely. In the first part of the sample the actual bank spread was larger than the estimated pure spread whereas the opposite seems to be true towards the end of the period.

These results suggest that microeconomic factors (in the form of individual differences amongst banks) do not seem to be a major determinant of interest spreads in Brazil. The lack of influence of microeconomic factors on the interest spread is even more pronounced after October 1999 when the Brazilian Central Bank launched a series of measures with the aim of reducing the interest spreads (see Section 3).

It remains to be presented the possible relevance of the macroeconomic factors as determinants of the interest margin in the country.

The second step regression makes use of a general to particular specification search. First, an unrestricted model is estimated. The unrestricted model is a distributed lag one with five lags of the explanatory variables included. Second, a reduction process is implemented through the elimination of the non-significant variables. The final model is the restricted version of the two-step equation. Third and last, the long-run implied equation is computed from the restricted model.

The estimated restricted equation is shown below:⁸

$$\begin{aligned}
 ps_t = & 1.759 + 0.152irate_t + 0.321irate_{t-1} + 0.291irate_{t-5} - 0.653ivol_t \\
 & (11.65) \quad (2.75) \quad (4.86) \quad (8.02) \quad (1.50) \\
 & + 0.120infl_t - 0.145infl_{t-1} + 0.076infl_{t-3} - 0.013ygr_{t-3} \\
 & (3.43) \quad (3.99) \quad (2.86) \quad (1.85)
 \end{aligned} \tag{6}$$

⁸ The t-statistics are shown in parentheses. Some diagnostic tests are also reported: *AR1-3* is a Wald test for the presence of serial auto-correlation up to order three; *ARCH3* is a Wald test for the presence of ARCH residuals up to order three; *Normality* is Jarque-Bera test for normal residuals; X_i^2 is a Wald test for functional form mis-specification; and *RESET* is Ramsey regression specification test for functional form mis-specification. See Doornik and Hendry (1996) for further details.

$$R^2 = 90.37\% \quad \hat{\sigma} = 0.1144 \quad F(8,31) = 36.37 \quad AR1-3 F(3,28) = 0.891 \quad ARCH3 F(3,25) = 0.335$$

$$Normality \chi^2(2) = 1.297 \quad X_i^2 F(16,14) = 1.837 \quad RESET F(1,30) = 0.279$$

The restricted equation shows no sign of mis-specification. Moreover, the imposed restrictions are not rejected by the data. The Wald statistic on the restriction is equal to 0.357, with a $F(16,15)$ distribution [p -value is equal to 0.9754].

The restricted equation aims at capturing the short-run dynamics in the data. We are more interested in the long-term determinants of the bank spread. The long-run solution associated to equation (6) is the following (t-values are shown in parentheses):

$$ps_t = 1.759 + 0.764 irate_t - 0.654 ivol_t + 0.051 infl_t - 0.013 ygr_t \quad (6)$$

(11.65) (14.47) (150) (1.52) (1.85)

The results suggest that the pure spread increases with rises in either the basic interest rate or in the inflation rate, as expected. By contrast, the impact of the output growth is to reduce the bank spread. The interpretation suggested in the previous section is that output growth may be related to increased competition in the banking industry or else with macroeconomic stability, both factors leading to lower bank spread. Contrary to expectations, however, interest rate volatility affects negatively the pure spread.

The high coefficient of determination of equation (5) suggests that macroeconomic factors are important determinants of the bank interest spread in Brazil.

The constant term in equation (6) shows what one would expect for the estimated spread once the macroeconomic factors have been accounted for. Ho and Saunders (1981) interpret this coefficient as measuring the impact of market power on the bank interest margin. The significance for this term suggests that other factors apart from those controlled for in the regressions may be relevant to explain the movements of the pure spread. Market power can be one of such factor although the results obtained by Nakane (2001), showing that the banking industry in Brazil is fairly competitive, do not support this conjecture. Regulatory restrictions in the form of compulsory credit at subsidized rates for rural and real estate loans is another contender.

It is interesting to compute the temporal behavior of the intercept in equation (6) in view of the fact that official measures were undertaken in October 1999 with the aim of reducing bank interest spreads. Figure 5 showed that both the actual spread as well as the pure spread showed a decreasing trend since early 1999. Figure 6 shows the estimated value for the intercept in equation (6) computed through recursive least squares (as well as plus/minus two standard errors).

Figure 6: Recursive Estimation of the Intercept in Equation (6)

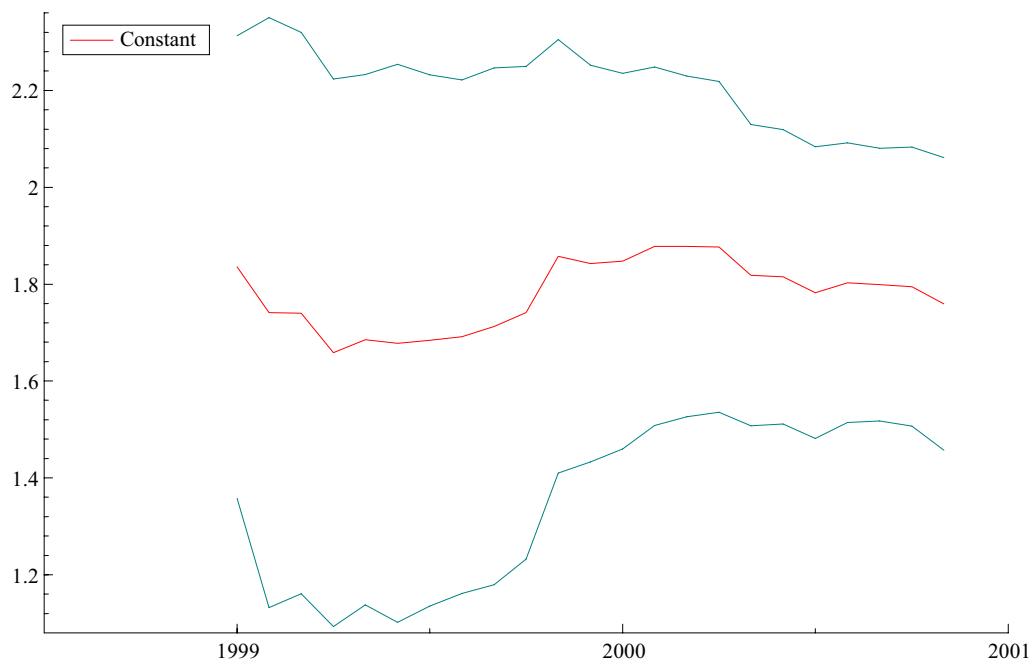


Figure 6 shows that, unlike the other measures of the bank spread, the component due to market power and other unaccounted factors does not show a decreasing trend over the recent period. Such behavior reinforces the interpretation that this component measures some more structural factor affecting the bank interest spread.

8. Conclusions

Bank interest spread in Brazil has shown an impressive downward trend in the recent period. A stable macroeconomic environment as well as the official priority given to the reduction of the interest margins are the main factors behind this behavior.

Another important feature of bank interest spreads in Brazil is its high and persistent cross-sectional dispersion. These elements disclose a market where productive inefficiencies and regulatory burden allow that some banks keep operating even charging rates much higher than their rivals.

These stylized facts are consistent with the findings of our econometric results. Using a panel data of 142 Brazilian banks for the February 1997-November 2000 period, the two-step approach due to Ho and Saunders (1981) is implemented. The results show the relevance of the macroeconomic conditions over bank's observable characteristics as the main determinants of bank interest spreads in Brazil. However, some yet unidentified factors still account for a large portion of the spread behavior in the country.

Despite all the recent developments, bank interest margins in Brazil have remained stubbornly high by international standards. It is not clear if further reductions can still be expected from the development of the macroeconomic conditions. Given the nature of the cross-section dispersion of the interest spread, we foresee that the possible trend is now for such rates to be more and more affected by changes in the microeconomic environment that shakes the industry structure

and modifies the behavior of the different banks towards reducing slack and improving managerial practices.

As far as the Central Bank is concerned, we envision a world with the primacy of the prudential regulation and supervision tools over the traditional short-term monetary policy instruments as the most effective ways to ensure a convergence of the best-practices in the local banking industry towards the international benchmarks.

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