ISSN 1518-3548

BANCO CENTRAL DO BRASIL

Working Paper Series 215

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October, 2010

ISSN 1518-3548
CGC 00.038.166/0001-05

Working Paper Series	Brasília	n. 215	Oct.	2010	p. 1-46

Working Paper Series

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The Effects of Loan Portfolio Concentration on Brazilian Banks' Return and Risk

Benjamin M. Tabak* Dimas M. Fazio† Daniel O. Cajueiro‡

Abstract

This paper tests whether diversification of the credit portfolio at the bank level is associated to better performance and lower risk. We employ a new high frequency (monthly) panel data constructed for the Brazilian banking system with information at the bank level for loans by economic sector. We find that loan portfolio concentration increases returns and also reduces default risk; there are significant size effects; foreign and public banks seem to be less affected by the degree of diversification. An important additional finding is that there is an increasing concentration trend after the breakout of the recent international financial crisis, specially after the failure of Lehman Brothers.

Key Words: Loan Portfolio composition, Focus, Diversification, Bank Return, Bank Risk
JEL Classification: G11; G21; C23.

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1 Introduction

This paper assesses empirically whether banks operating within the Brazilian banking system concentrate or diversify their credit portfolio and how this choice impacts their performance and risk. Both portfolio strategies can be observed in the real world. Several countries possess a set of rules limiting a bank's exposure to one single borrower, which is considered an argument in favor of the necessity of diversification [BIS, 1991, Morris, 2001]. In contrast, there are many banks that decide to specialize their loans activities to sectors in which they enjoy comparative advantage.

Traditional banking theory argues that banks should diversify their credit portfolio, given that through the expansion of their credit lines to new sectors, the bank's probability of default will be reduced [Diamond, 1984]. The idea is that due to asymmetric information, diversification reduces financial intermediation costs. Moreover, less diversified banks would be more vulnerable to economic downturns, since they are exposed to few sectors. Many banking crises in the last 25 years were caused by, among other reasons, concentration in bank's loan portfolios, which supports the view that risk is highly associated with this strategy [BIS, 1991]. This view is also empirically supported by Argentinean banks on the Argentinean financial crisis of 2001 and 2002 [Bebczuk and Galindo, 2008] and by Austrian banks over the years 1997-2003 [Rossi et al., 2009].

On the other hand, the theory of corporate finance supports the idea that firms should concentrate their activities on a specific sector or group of sectors to take benefits of expertise in how business are done in these sectors [Jensen, 1986, Denis et al., 1997, Meyer and Yeager, 2001, Stomper, 2004, Acharya et al., 2006]. Another argument against portfolio diversification is that it can also result in increasing competition with other banks, making this strategy less attractive. In particular, Winton [1999] defends that diversification only reduces the chances of bank failure in the case of moderated risks of default. When the risks are low, banks may benefit more from specialization than from diversifying, since there is a low probability of failure. Conversely, when the probabilities of insolvency are high, diversification may even worsen the situation, since the bank will be exposed to many sectors, and the downturn of one may be enough to lead this bank to bankruptcy. Therefore, the overall conclusion is that the relationship between bank's focus and return is expected to be U-shaped in risk. Furthermore, there is also empirical evidence that diversification increases the risk in the Italian banking sector [Acharya et al., 2006] and reduces the performances of the banks in the Chinese banking sector [Berger et al., 2010] and in the German banking sector [Norden and Szerencses, 2005, Hayden et al., 2007].

Independently from these two main views, Kamp et al. [2007] show that neither of the theories mentioned above are completely right for the entire German banking sector in the period from 1993 to 2003. They find that the main benefit of diversifying credit portfolios is the achievement of relative lower levels of risk compared to concentrated portfolios. The returns of concentrated portfolios, however, seem to be higher than those of diversified banks. The authors conclude that the typical risk-return tradeoff appears to be the solution of this analysis, leaving banks to choose their own strategy in order to maximize their performance.

We employ four different measures as proxies of loan portfolio concentration. Our primary goal is to identify the influence of loan concentration on Brazilian banks return. After that, we observe how risks, interacted with concentration measures, can affect the performance. We also estimate the impact of loan concentration on bank's risk, which indicate whether the banks' monitoring decisions are effective. Another interesting contribution is to explicitly show that the concentration of portfolios affect differently banks with different ownership type. Finally, this work is singular in the sense that our regressions are based on monthly data. This is specially appealing since with it we are able to take some effects not considered in yearly data into account. In particular, the update of portfolios in a shorter period of time is very useful. This allows the follow up of changes in portfolio decisions after the breakthrough of the crisis in September 2008.

It is worth mentioning that most of the studies published about this matter so far focus their attention in the banking sectors of developed countries, such as the U.S. and Germany. With the exception of Bebczuk and Galindo [2008] and Berger et al. [2010], there is a lack of evidence and discussion regarding the effects of the loan portfolio composition on banks of emerging economies. Given the uniqueness of their economic conditions, the results may be different from those observed in developed countries. This article contributes to the literature by proposing to examine the effects of loan portfolio strategies on the performance of Brazilian banks. Furthermore, we show that in the aftermath of financial crisis banks tend to concentrate their credit portfolio.

The Brazilian banking system is considered one the most developed in Latin America, both in size and performance. The solid position of the banking system was a consequence of structural changes in the economy promoted by the government in the decade of 1990, in order to stabilize the currency and improve banking regulation. In the last few years, Brazilian banks have shown a substantial increase in productivity, and they also passed through a rise in mergers and acquisitions. The maximization of bank loan portfolios performance, for this reason, have become a question of uttermost importance. Consequently, it is necessary to evaluate whether loans diversification (or concentration) is beneficial to the Brazilian financial stability.

The remainder of the paper is structured as follows. In Section 2, we describe our methodology, defining the variables of interest and the regression approaches taken. In Section 3, we present the data sources. We present the empirical results in Section 4. Final remarks are presented in Section 5.

2 Methodology

2.1 Concentration Measures

As proxies of concentration, we consider, in this paper, two traditional concentration measures and two distance measures: the Hirshmann-Herfindahl Index (HHI), the Shannon Entropy (SE), an absolute distance measure (D_a) and a relative distance measure (D_r). Each type of measure has different assumptions. For example, while the HHI considers diversification as equal exposure to every sector, the distance measures use a benchmark as an indicator of diversification.

It is important to highlight that the object of our analysis is the composition of the industrial sector in the bank's loan portfolio, i.e. the bank's relative exposures to the industries. The reason is that this sector holds greater participation than any other sector in this type of portfolio. Thus, the concentration measures will be used to estimate and verify the effect of loan concentration in one or more economic sector on banks' returns.

Before illustrating how the concentration measures are calculated, we define relative exposure (r_i) of the bank b at time t to each economic sector i as:

$$r_{bti} = \frac{Nominal\ Exposure_{bti}}{Total\ Exposure_{bt}} \tag{1}$$

The HHI, i.e. the sum of the squares of the relative exposures, has been one the most known concentration measure in Industrial Organization and in the studies about this matter, due to its relatively simplicity. The HHI of bank b at time t can be defined as:

$$HHI_{bt} = \sum_{i=1}^{n} r_{bti}^2. \tag{2}$$

Note that the inferior limit of the HHI is $\frac{1}{n}$ and represents a perfect diversified portfolio, meaning an equal share of exposure to each sector n. On the other hand, if the HHI is equal to 1, all loans are handed out to only one industry, i.e. a perfect specialization scenario. An advantage of this index is that the higher its value, the higher the concentration.

The Shannon Entropy is an effective instrument to indicate variety of distributions at a given point of time, being also used as a measure of industrial concentration. This entropy is calculated as:

$$SE_{bt} = -\sum_{i=1}^{n} r_{bti} \cdot ln\left(\frac{1}{r_{bti}}\right). \quad (3)$$

If the SE is equal to 0, the loan portfolio is extremely concentrated (the loans are handed out to only one borrower). Perfect diversification is expressed by SE equal to $-ln(n)$.

In addition, we also employ distance measures to quantify the divergence between a bank (r) and the benchmark (x) loan portfolios. In this case, the industry composition of the economy's loan market portfolio is used as a benchmark for diversification. Thus, the more the value of r_i is close to x_i for every sector i, the more the bank is diversified. We calculate D_a and D_r, as follows:

$$D_a(r, x)_{bt} = \frac{1}{2}\sum_{i=1}^{n} |r_{bti} - x_{bti}| \quad (4)$$

and

$$D_r(r, x)_{bt} = \frac{1}{n}\sum_{i=1}^{n} \frac{|r_{bti} - x_{bti}|}{r_{bti} + x_{bti}}. \quad (5)$$

High values mean concentration while low values stand for diversification. Pfingsten and Rudolph [2002] have been one of the first to use these distance measures as proxies of concentration. They state that, among their advantages over the traditional measures, the differences in sizes of each sector are taken into consideration. They are also easily calculated and no additional data has to be collected. Kamp et al. [2005] estimate loan portfolio concentration of German Banks' and show that traditional and distance measures may differ significantly, which is another motivator to compare these measures in our model. On the other hand, McElligott and Stuart [2007] finds that both measures yield similar results concerning the evolution of Irish banks' loan portfolio composition.

2.2 Panel Specification

In this section, we present the model utilized to test for the influence of loan portfolio concentration on Brazilian banks' performance. First of all, we estimate the average effect of concentration on returns. Second, it is checked whether this relationship depends on the type of bank's ownership. Then, variables of risk are introduced in order to see how this relation changes as function of bank's risk. Finally, we test for the relationship between risk and concentration, that may depend on the effectiveness of bank monitoring, and also check if this effect depends on the type of bank's ownership.

In the regressions where bank's return is the dependent variable, we employ the Feasible Generalized Least Squares (FGLS) estimation. The advantages of this model are that it allows for groupwise heteroskedasticity and first order autocorrelation (AR(1)). The first consists in heteroskedasticity across groups and constant variance within groups, which is exactly the one of the assumptions of the FGLS model. We test this assumption by employing a modified Wald test with a null hypothesis of no heteroskedasticity. If the null hypothesis is rejected, we can conclude that the FGLS model is well specified[1].

On the other hand, it is worth noting that the regressions where bank's risk is the dependent variable are based on dynamic panel data model specifications. In this case we employ the procedure based on difference and system generalized method of moments (some variation of the Arellano and Bond [1991]/Blundell and Bond [1998] estimator) in order to deal with this dynamic specification. As concluded by Bond [2002], the GMM estimators consistent estimators for dynamic panels. The system GMM estimator combines the standard set of equations in first-differences with lagged levels as instruments, and an additional set of equation in levels with lagged first-differences as instruments. Then, we test if these instruments are valid, i.e. lack of serial correlation with the estimators, by using the Hansen overidentifying test. We also circumvent the problem of too many instruments [Roodman, 2009] that could arise in our study due to the large sample period by restricting the number of lagged instruments to be less than the number of cross-sectional units[2]. In addition, we use the Windmeijer [2005] finite-sample correction to the standard errors in the two-step estimations.

Next, we will describe and discuss the several different approaches, where the regressions we are going to run are specified.

[1] Regressions were also estimated using OLS fixed effects. However groupwise heteroskedasticity was verified, and thus FGLS is a more efficient estimator than fixed effects.

[2] Roodman [2006] and Roodman [2009] suggests that the number of instruments should be lower than the number of cross-sections.

2.2.1 The Relationship Between Bank Returns and Loan Portfolio Concentration

The most basic question regarding to this topic is whether loan portfolio concentration results in higher returns. It can be answered by regressing returns on a concentration measure, as in the following regression:

$$\begin{aligned} Return_{bt} &= \beta_{b0} + \beta_1 \cdot CM_{bt-1} + \gamma \cdot V_{bt-1} \\ &+ \tau_t + \epsilon_{bt}, \end{aligned} \quad (6)$$

where $Return_{bt}$ is the return of bank b at time t measured by the Return on Assets (ROA_{bt}) or also by the Return on Equity (ROE_{bt}); V_{bt-1} consists in a vector of control variables, such as the bank's size ($SIZE_{bt}$) proxied by natural logarithm, the equity ratio (EQ_{bt}), and bank-ownership dummies; CM_{bt-1} represents, separately, one of the concentration measures explained before of bank b at time t; τ_t stands for time dummies and, finally, ϵ_{bt} is the residual value.

Time dummies are introduced to capture for Brazilian macroeconomic conditions in each period of our analysis. If concentration is more advantageous than diversification, it is expected that $\beta_1 > 0$. Otherwise, $\beta_1 < 0$ means that bank returns are higher if their loan portfolio is diversified across industries. Note, however, that we do not control for risk in this regression.

In addition, we are also interested to test whether ownership control affects the results on the relationship between loan portfolio concentration and returns. Thus, we estimate equation the effect of concentration and returns from a model that includes interactions of concentration measures with two ownership dummies, as in the following equation:

$$\begin{aligned} Return_{bt} &= \beta_{b0} + \beta_1 \cdot CM_{bt-1} + \sum_{j=1,2} \alpha_j \cdot CM_{bt-1} \cdot Owner.\,Dummy_j \\ &+ \gamma \cdot V_{bt-1} + \tau_t + \epsilon_{bt}. \end{aligned} \quad (7)$$

where j refer to public, private or foreign-owned banks.

2.2.2 Concentration-return as function of bank's risk

The relation between concentration and return as function of bank risk is estimated by another equation. For this purpose, we employ the variable NPL_{bt}, which represents, in this case, the ratio of non performing loans to total loans. Its square value (NPL^2_{bt}) is utilized with the purpose of checking the veracity of Winton [1999] U-shaped relation in bank's return and loan portfolio concentration as function of risk. We consider the following quadratic equation regression:

$$\begin{aligned} Return_{bt} &= \beta_{b0} + \beta_1 \cdot CM_{bt-1} + \alpha_0 \cdot NPL_{bt-1} + \alpha_{11} \cdot CM_{bt-1} \cdot NPL_{bt-1} \\ &+ \alpha_{12} \cdot CM_{bt-1} \cdot NPL^2_{bt-1} + \gamma \cdot V_{bt-1} + \tau_t + \epsilon_{bt}. \end{aligned} \tag{8}$$

Therefore, the U-shaped behavior is distinguished in the following marginal effect of CM_{bt-1} on the dependent variable $Return_{bt}$:

$$\frac{d(return)}{d(CM_{bt-1})} = \beta_1 + \alpha_{11} \cdot NPL + \alpha_{12} \cdot NPL^2, \tag{9}$$

only if $\alpha_{11} < 0$ and $\alpha_{12} > 0$. If this effect proves to be true, it implies that returns and loan portfolio concentration may be dependent in a non-linear manner on bank's risk. Thus, better performance would be achieved by concentrating portfolio in both low and high risk scenarios.

2.2.3 The impact of Concentration on Risk

Another slope of our analysis takes into account the relationship between concentration and risk. In this specification, among other things, the bank's monitoring effectiveness is evaluated. For this purpose, we employ the natural logarithm of the the Non-Performing Loans - in absolute values. Then, the main idea is to regress this variable on CM_{bt-1}. The specification of the literature is based on a static regression. However, we propose the estimation of the following equation, which consists in using GMM estimators in order to correct for autocorrelation[3]. and to better evaluate whether there is a statistically significant influence of loan portfolio concentration on bank's risk:

$$\begin{aligned} NPL_{bt} &= \omega_0 + \omega_1 NPL_{bt-1} + \omega_2 \cdot CM_{bt-1} + \xi \cdot V_{bt-1} \\ &+ \tau_t + \epsilon_{bt}, \end{aligned} \tag{10}$$

[3] We have also estimated a FGLS static panel for this case. However results showed that the common first order autocorrelation coefficient was high for both regressions, which implies that a great deal of NPL at time t is explained by NPL in previous periods. Therefore, we specified a dynamic panel in order to control for this autocorrelation. Dynamic specifications for Eqs. (6)-(7), where *Return* is the dependent variable, were not necessary, since persistence was not verified.

in which V_{bt-1} is a vector of the already defined control variables, including also past returns (ROA_{bt-1}). An increase in focus reduces the risk only if $\omega_1 < 0$.

Acharya et al. [2006] list three reasons in order to explain why an increase in diversification might also raise the risk of banks loan portfolios. First, banks may suffer from lower monitoring efficiency, due to the lack of expertise, if they expand their loans to new sectors. Second, these sectors may be already supplied by credit of other banks. Therefore, the entrant bank might suffer from the winner's curse and face adverse selection, derived from competition. Third, diversification can increase a bank's size, subjecting it to scale inefficiencies.

As in equation (7), we also employ interaction variables of concentration measures and ownership dummies to observe whether concentration affects risks differently depending on the type of bank's ownership. The regression, therefore, becomes:

$$\begin{aligned} NPL_{bt} &= \omega_0 + \omega_1 NPL_{bt-1} + \omega_2 \cdot CM_{bt-1} \\ &+ \sum_{j=1,2} \alpha_j \cdot CM_{bt-1} \cdot Owner.\,Dummy_j + \xi \cdot V_{bt-1} + \tau_t + \epsilon_{bt}, \end{aligned} \quad (11)$$

where j refer to public, private or foreign-owned banks.

3 Data

Our sample consists of an unbalanced high frequency panel data of 96 commercial banks in 74 month periods from January 2003 to February 2009, totalizing 5175 observations. This high frequency panel data is an innovation over previous studies, since we are able to better study differences in the loan portfolio composition in shorter periods of time. The individual bank-level data was provided by the Central Bank of Brazil. Table 1 presents the summary statistics of the variables that are used in our specifications. The mean of bank's size is approximately R$ 20 billion, or about US$ 12 billion. In percentage, the non-performing loans are considered low (1.9%), meaning that Brazilian banks enjoy a reduced probability of default. Finally, and most important to our study, by analyzing the mean and the standard deviation of all the concentration measures, we conclude that Brazilian banks' loan portfolios seem to be moderately concentrated.

Place Tables 1 and 2 About Here

If we compare the Brazilian banks' loan portfolio composition with the findings of the literature, we can see that in general it is more concentrated than Italians', in which average HHI is 0.237 (Acharya et al. [2006]), Irish's (see McElligott and Stuart [2007]), and German's with an average HHI equals to 0.291 (Hayden et al. [2007]). The loan portfolios of Brazilian banks are only found to be more diversified than the ones from Argentina, in which the average HHI is 0.55 (Bebczuk and Galindo [2008]).

Table 2 shows the cross correlations of the explanatory variables. The results from this table evidence a high correlation within the traditional measures, and within the distance measures. However, correlation between these two categories of measures is less pronounced, suggesting that the effects of both on bank risk-return performance may be at least slightly different.

Place Table 3 About Here

The Brazilian economic sectors to which banks can lend are equal to 21, and they are illustrated in Table 3. Our data includes the relative exposures of Brazilian banks to all these sectors, which will make the results more accurate in comparison to other studies about this topic. As we have already stated, it is widely accepted that loan concentration means high exposure to one or few of these sectors, while diversification means a more equal loan portfolio distribution across them. However, according to Pfingsten and Rudolph [2002], concentration means a high divergence from the economy's mean exposure to these sectors, while diversification stands for being close to this benchmark.

Place Table 4 About Here

In Table 4, we show the summary statistics of the loan portfolio concentration measures by the type of bank ownership. There are clear signs that foreign banks' loan portfolio are more concentrated in relation to the private domestic banks. Foreign banks may be less familiar with the Brazilian economic and financial conditions, which makes them more caution in expanding their lending activities. On the other hand, Brazilian national banks may be inclined to diversify their credit portfolios, and thus reaching a wider range of sectors with its services.

Place figures 1, 2, 3 and 4 About Here

We have also calculated the monthly average concentration measures with the purpose of observing its tendency and sudden changes in its behavior. As can be seen in Figures 1, 2, 3 and 4, we find a very interesting result related to the recent financial crisis. It is easy to verify there is a decreasing tendency of the loan portfolio concentration in the second semester of 2007 and the first of 2008. However, after the Lehman Brothers bankruptcy, in September 2008, Brazilian banks started to increase their loan portfolio concentration, reversing that diversification tendency. The Lehman Brothers breakdown was followed by a drastic fall in the credit worldwide, increasing the risk of default of several financial institutions. Thus, banks became more selective, lending only to those economic sectors that were not as affected by this crisis. In other words, banks were willing to substitute their simultaneous exposure to several sectors with the exposure to only few sectors, reflecting their risk aversion behavior in this uncertain period. In this same line of thought, their monitoring effectiveness should have increased, as well. In the next section, we will see if our empirical model supports this analysis.

4 Results

The results of our models are presented in this section. In the first subsection, we analyze the effect of loan portfolio concentration on bank return. Then, we evaluate whether this effect is non-linear in risk. In section 4.3, the effects of concentration on risk are presented. In the last subsection, robustness tests using two other models to estimate our dynamic specification are shown. A problem that could arise with our estimation is the presence of unit root. We test if this is the case for $SIZE_b$ and $Eq.\,Ratio_b$. Unit root is rejected in both cases.

4.1 The Relationship Between Bank Returns and Loan Portfolio Concentration

The results of the FGLS estimation of Equation (6) are presented in Table 5. Here, we try to evaluate the effect of loan portfolio concentration on ROA and on ROE, while controlling by the bank's size, the equity ratio and two bank ownership dummies (in this case, Private and Public). Four different concentration measures are used in order to achieve this goal. In each column of Table 5, we show the results of the estimations of ROA and ROE by using one of these measures. All the regressions reject the null hypothesis for the test of groupwise heteroskedasticity, which implies the FGLS model well specified.

Place Table 5 About Here

Regarding the estimated coefficients of the four concentration measures we can see that all of them are positive and the majority are strongly significant as well. The coefficients of the SE and the D_r are significant at 10%, 5% and 1% levels, respectively, in both ROA and ROE equations. The coefficients of D_a and HHI are only significant (10%) when ROE and ROA are the dependent variable, respectively. These results give us strong evidence that concentration influences positively banks' return, suggesting that focusing loan portfolios to few sectors is more profitable than diversifying.

There is evidence of a positive relationship between bank's size and return, which is, however, only significant when ROE is the dependent variable for all concentration measures and also in the ROA estimation for D_r. This suggests that bigger banks tend to have higher returns than smaller banks, which is in accordance to the literature. The coefficients of equity ratio are significantly positive in ROA estimations and significantly negative in ROE equations. This means that an increase in the proportion of equity used to finance banks assets has a positive effect in the bank management of its assets, but a negative effect in the management of its equity. Private and public dummies are positively significant, meaning that national banks have higher performance compared to foreign banks.

Place Table 6 About Here

Additionally, we are interested to observe whether the return-concentration relationship depends on the bank's ownership category. In order to achieve this conclusion, we estimate equation (7), in which interaction variables between private/foreign dummies and concentration measures are introduced. The results are demonstrated in Table 6.

These findings suggest that the effects of concentration on returns are more significant for private banks. All their coefficients are positive, indicating that private banks are the ones that have greater profitability from portfolio concentration than foreign and public banks. This finding can explain why private banks in Brazil are often trying to expand their business. Foreign and public banks, on the other hand, appear to be less affected by a variation in the loan portfolio composition. In fact, public banks' profitability may even be negatively affected by loan portfolio concentration when HHI and D_a are employed. The estimated coefficients of the control variables are similar to those demonstrated in the table 5.

4.2 Concentration-return correlation as function of risk

The results of the FGLS estimation of Equation (8) are presented in Table 7. In this specification, we check if the relationship between concentration of loan portfolio and returns has a non-linear relation on risk, as Winton [1999] and Acharya et al. [2006] defend. For this purpose, we employ interactions of NPL and NPL^2 with concentration measures. In addition, all the regressions strongly reject the null hypothesis for the test of groupwise heteroskedasticity, which suggests that the model is well specified.

Place Table 7 About Here

The result suggest that the concentration-return relationship is U-shaped on risk when the Shannon entropy is used as the portfolio concentration measure and ROA is the dependent variable. Alternatively, we find an $\bigcap$-shaped relationship when HHI is employed and ROE is the dependent variable. Again, the results of the other explanatory variables are similar with those found in section 4.1.

4.3 The effects of Concentration on Risk

The results of the Arellano and Bond [1991] estimation of Equation (10) and Equation (11) are presented in Tables 8 and 9 respectively. Our objective with these regressions is to evaluate the effects of loan portfolio concentration on bank's risk, proxied by NPL. The independent variables employed are the lagged values of NPL, so as to control for autocorrelation, of the natural logarithm of total assets, which represents a bank's size, of the equity ratio, and of ROA. In each pair of columns of Table 8 show the results for one concentration measure. All the regressions have significant first order autocorrelation, and the null hypothesis of overidentified restrictions are not rejected by the Hansen J test. In addition, we use lagged values of the NPL at time $t-1$ as instruments in order to assess for endogeneity of this variable.

Place Table 8 About Here

First, we present the results of the estimation of the equation (10) in Table 8, in which we add a lagged value of NPL as an explanatory variable. As expected the coefficient of NPL at time $t-1$ is highly significant and positive, meaning that current risks are directly proportional to risks from a previous period of time. The coefficients of Equity Ratio are positive and significant, meaning that higher equity in relation to assets results to higher risks faced by banks. Another interesting finding is that larger banks also face more risks. Finally, ROA has the expected negative sign, meaning that higher performance leads to lower risks.

Regarding the portfolio concentration indices, the HHI and the SE are both significantly negatively related to bank's risk. The coefficients of the distance measures are all insignificant in this case. The results show strong evidence that loan portfolio concentration implies in lower risks, which contradicts the ideas of Diamond [1984]. There are a lot of reasons why concentrated loan portfolios might make banks less susceptible to risks. One is that diversification seems to have a downward effect on monitoring efficiency, increasing the non performing loans. On the other hand, loan portfolio concentration seems to raise monitoring efficiency, since it is easier for the bank to catch up problem loans before problems deteriorate too far. This may be due to the fact that they develop an expertise on the few sectors they cover.

Chang et al. [2006] found that, in Brazil, concentrated banking sectors, in terms of industrial organization, have lower risks. An hypothesis raised by the authors was that concentrated banks could better diversify their loan portfolio across the economic sectors, due to its high market power. However, our results show that the diversification of the loan portfolio diversification increases the cost of monitoring, due to a problem of information asymmetry. Thus, the exposure to several sectors seems to in fact increase the risk of insolvency, which can cause problems for the financial stability of the banking sector as a whole.

Place Table 9 About Here

Table 9 presents the results from the estimation of the equation (11), in which we evaluate whether this relationship varies for each type of bank ownership. Again, as expected the coefficient of NPL at time $t-1$ is very significant, meaning that the bank's risk at time t is positively influenced by the bank's risk at time $t-1$, meaning the presence of a strong autocorrelation.

In all cases, loan portfolio concentration seems to reduce risk from public banks. Note that, in column (3), we interact the concentration measure with public and foreign dummies in instead of private and foreign dummies. When D_a is employed, the coefficient between this measure and the foreign dummy is significant and negative, which indicates that for foreign banks, the reduce in risks due to an increase in concentration is also valid. The control variables have similar results than those presented in table 8.

5 Concluding Remarks

The question of whether it is preferable for banks to concentrate or diversify their loan portfolio across economic sectors has become of uttermost importance for the study of financial stability. The relationship between loan portfolio sectoral distribution and bank performance, however, has not been widely analyzed for banking sectors of emerging economies. In this paper, we proposed to evaluate in which way the concentration (or diversification) of the loan portfolio affects the return and the risk of 96 Brazilian banks using monthly periods from 2003 to 2009. Several regressions were estimated using both statical (with the FGLS estimator) and dynamical specifications (with the system GMM estimator) of panel data models and employing both traditional concentration measures (HHI and SE) and distance measures (D_a and D_r), as proxies for loan portfolio concentration.

Brazilian banks' loan portfolios are found to be, on average, moderately concentrated. The measures of concentration show that these portfolios are more concentrated than those of developed countries like Germany, Italy and the US. Moreover, there is also evidence that foreign owned banks are more specialized than national banks, both private and public. We raise an hypothesis that foreign owned banks have lower familiarity of Brazilian's economic and financial conditions, and therefore they prefer to restrict their lending activities to few sectors, in order to benefit from reduced monitoring costs.

Our overall conclusion is that loan portfolio concentration seems to improve the performance of Brazilian banks in both return and risk of default. The concentration indices were found to be positively related to returns and negatively related to risks. The reason may be that loan portfolio concentration increases monitoring efficiency, since banks may have expertise in the sectors they lend, as affirmed by Winton [1999]. Diversification on the other hand, reduces this efficiency, since it is more difficult for banks to monitor their credit clients and they may also face adverse selection, derived from competition with other banks.

When the different types of bank ownership are taken into account, we conclude that, for private banks, the higher the credit portfolio specialization the higher the returns. Foreign banks may face lower risks due to loan portfolio concentration, meaning that they should be cautions in high exposure to some sectors. On the other hand, the allocation of loans to only few economic sectors seems to reduce public banks' risk. For these two last types os ownership the impact of concentration on return is inconclusive. In other words, the profitability of these banks appear to be, on average, less affected by loan concentration.

The behavior of Brazilian banks after the Lehman Brothers bankruptcy, which deepened the effects of the financial crisis throughout the world, is a confirmation of our empirical results. These banks increased the concentration of their loan portfolios in order to reduce the risk of default, at the same time that maintaining their profitability during this uncertain period. We suggest further analysis and research about the characteristics of the the sectoral distribution of loans during this crisis for both developing and developed countries.

6 Acknowledgements

The authors are grateful to financial support from CNPQ foundation. The opinions expressed in this paper are those of the authors and do not necessarily reflect those of the Banco Central do Brasil or its members.

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7 Tables and Figures

Table 1: Summary Statistics

Variables	Mean	SD	Min	Max
ROA	0.002	0.013	-0.527	0.204
ROE	0.011	0.101	-4.528	1.276
Assets*	19,581.207	52,274.33	15.418	500,000
Equity*	2,000.4	5,131.9	-1.996	50,722.85
Eq. Ratio	0.188	0.128	-0.127	0.884
HHI	0.316	0.168	0.109	1.0000
SE	-1.6044	0.477	-2.445	0.0000
D_r	0.595	0.203	0.142	0.9996
D_a	0.376	0.22	0.0376	0.996
NPL	0.019	0.026	0.0000	0.348
NPL*	123.690	359.854	0	4,836.725

*In millions of Brazilian Reais (R$)

Table 2: Cross-correlation table

Variables	HHI	SE	D_r	D_a	NPL	Assets	EQ
HHI	1.000						
SE	0.962	1.000					
D_r	0.641	0.753	1.000				
D_a	0.615	0.646	0.824	1.000			
NPL	0.062	0.106	0.196	0.219	1.000		
Assets	-0.319	-0.397	-0.708	-0.543	-0.133	1.000	
EQ	0.157	0.234	0.398	0.354	0.151	-0.6	1.000

Table 3: Brazilian Economic Activities

	Section	Denomination
1.	Agriculture, livestock, forestry, fishing and aquaculture	Agriculture
2.	Extractive Industries	Extractive Ind.
3.	Transformation Industries	Transformation Ind.
4.	Electricity and Gas	Energy
5.	Water, sewage, waste management activities and decontamination	Utilities
6.	Construction	Construction
7.	Trade; repair of motor vehicles and motorcycles	Trade
8.	Transport, storage and mail	Transport
9.	Housing and Food	Food
10.	Information and communication	Communication
11.	Financial, insurance, and related services activities	Finances
12.	Real estate activities	Real Estate
13.	Professional, scientific and technical activities	Professional
14.	Administrative and complementary services activities	Administrative
15.	Public administration, defense and social security	Public Sector
16.	Education	Education
17.	Human health and social services	Health
18.	Arts, culture, sports and recreation	Culture
19.	Others service activities	Other Services
20.	Domestic Services	Services
21.	International organisms and other extraterritorial institutions	International

Source: CNAE research.

Table 4: Concentration Measures by Bank Ownership

	Foreign Banks				Private Banks				Public Banks			
Variable	**Mean**	**SD**	**Min.**	**Max.**	**Mean**	**SD**	**Min.**	**Max.**	**Mean**	**SD**	**Min.**	**Max.**
HHI	0.342	0.154	0.157	1	0.308	0.154	0.13	1	0.31	0.223	0.11	1
SE	-1.484	0.477	-2.204	0	-1.63	0.435	-2.317	0	-1.66	0.586	-2.445	0
D_r	0.61	0.235	0.191	0.997	0.602	0.192	0.142	0.995	0.551	0.197	0.225	1
D_a	0.32	0.2	0.051	0.96	0.3836	0.022	0.037	0.95	0.41	0.24	0.11	0.996
Obs.	1078				3202				895			

Table 5: Relationship between Return and Concentration - FGLS estimation

VARIABLES	(1) roa	(2) roa	(3) roa	(4) roa	(5) roe	(6) roe	(7) roe	(8) roe
Eq. Ratio$_{t-1}$	0.00660***	0.00650***	0.00688***	0.00675***	-0.0194***	-0.0201***	-0.0202***	-0.0197***
	(0.000846)	(0.000853)	(0.000887)	(0.000873)	(0.00399)	(0.00400)	(0.00412)	(0.00413)
SIZE$_{t-1}$	3.18e-05	3.93e-05	2.84e-05	0.000101**	0.000681***	0.000768***	0.000720***	0.00130***
	(2.91e-05)	(3.00e-05)	(3.28e-05)	(3.94e-05)	(0.000226)	(0.000233)	(0.000250)	(0.000303)
HHI$_{t-1}$	0.000717*				0.00366			
	(0.000398)				(0.00248)			
SE$_{t-1}$		0.000344**				0.00202**		
		(0.000136)				(0.000884)		
D$_{a,t-1}$			0.00381				0.0418*	
			(0.00361)				(0.0227)	
D$_{r,t-1}$				0.00139***				0.0104***
				(0.000380)				(0.00271)
Public	0.000798***	0.000814***	0.000717***	0.000805***	0.00984***	0.00982***	0.00871***	0.00919***
	(0.000139)	(0.000141)	(0.000149)	(0.000148)	(0.00115)	(0.00115)	(0.00120)	(0.00116)
Foreign	0.000905***	0.000933***	0.000823***	0.000954***	0.00704***	0.00721***	0.00675***	0.00768***
	(0.000125)	(0.000128)	(0.000127)	(0.000136)	(0.000918)	(0.000925)	(0.000932)	(0.000963)
Constant	-0.000430	0.000302	-0.000263	-0.00155***	0.00274	0.00653***	0.00290	-0.00691
	(0.000383)	(0.000365)	(0.000410)	(0.000560)	(0.00293)	(0.00247)	(0.00307)	(0.00428)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5079	5079	5079	5079	5079	5079	5079	5079
N. of Banks	96	96	96	96	96	96	96	96
Wald test	429.2***	431.0***	398.0***	412.2***	393.6***	393.7***	366.9***	380.6***
Modified Wald	$6.4 \cdot 10^6$***	$6.5 \cdot 10^6$***	$6.4 \cdot 10^6$***	$6.2 \cdot 10^6$***	$7.2 \cdot 10^6$***	$7.6 \cdot 10^6$***	$7.0 \cdot 10^6$***	$7.6 \cdot 10^6$***
Common AR(1)	0.2537	0.2555	0.2699	0.2670	0.2186	0.2182	0.2272	0.2240

NOTE - This table presents the results for the FGLS estimation of the relation between return, measured by ROA or ROE, and focus, proxied by HHI, SE, D_a and D_r. We test for groupwise heteroscedasticity by employing a modified Wald test (H_0 = no heteroscedasticity). First order autocorrelation (AR1) coefficients are also shown in the table. We do not present the coefficients of time dummies for the sake of brevity. Standard errors in parentheses.
*** p<0.01, **p<0.05,* p<0.1

Table 6: Relationship between Return and Concentration - Ownership control effects - FGLS estimation

VARIABLES	(1) roa	(2) roa	(3) roa	(4) roa	(5) roe	(6) roe	(7) roe	(8) roe
Eq. Ratio$_{t-1}$	0.00605***	0.00573***	0.00675***	0.00597***	-0.0201***	-0.0213***	-0.0209***	-0.0211***
	(0.000861)	(0.000870)	(0.000880)	(0.000856)	(0.00406)	(0.00409)	(0.00414)	(0.00417)
SIZE$_{t-1}$	3.69e-05	5.12e-05*	5.02e-05	0.000146***	0.000728***	0.000814***	0.000745***	0.00145***
	(2.90e-05)	(2.93e-05)	(3.22e-05)	(3.80e-05)	(0.000221)	(0.000226)	(0.000247)	(0.000304)
HHI$_{t-1}$	0.00191***				0.00635**			
	(0.000571)				(0.00315)			
HHI$_{t-1}$·Foreign	-0.000947				0.00818			
	(0.00104)				(0.00724)			
HHI$_{t-1}$·Public	-0.00223***				-0.0104*			
	(0.000842)				(0.00597)			
SE$_{t-1}$		0.000890***				0.00335***		
		(0.000186)				(0.00110)		
SE$_{t-1}$·Foreign		-0.000743**				-0.00100		
		(0.000303)				(0.00220)		
SE$_{t-1}$·Public		-0.000880***				-0.00416**		
		(0.000291)				(0.00205)		
D$_{a,t-1}$			0.0143***				0.0765***	
			(0.00496)				(0.0284)	
D$_{a,t-1}$·Foreign			-0.0149*				-0.0743	
			(0.00811)				(0.0531)	
D$_{a,t-1}$·Public			-0.0212***				-0.132***	
			(0.00696)				(0.0485)	
D$_{r,t-1}$·				0.00289***				0.0157***
				(0.000480)				(0.00335)
D$_{r,t-1}$·Foreign				-0.00253***				-0.0125***
				(0.000556)				(0.00416)
D$_{a,t-1}$·Public				-0.000999				-0.00945**
				(0.000710)				(0.00475)
Foreign	-0.000623**	-0.00221***	-0.000461**	0.000261	-0.00918***	-0.00863**	-0.00466***	-0.00107
	(0.000311)	(0.000542)	(0.000209)	(0.000278)	(0.00232)	(0.00380)	(0.00167)	(0.00235)
Public	0.000452*	-0.00173***	0.000519**	0.000258	0.00566***	-0.00446	0.00677***	0.00657**
	(0.000251)	(0.000541)	(0.000237)	(0.000363)	(0.00202)	(0.00355)	(0.00204)	(0.00288)
Constant	-0.000308	0.00151**	-0.000579	-0.00360***	-0.00153	0.00432	-0.00206	-0.0233***
	(0.000773)	(0.000741)	(0.000839)	(0.00104)	(0.00566)	(0.00504)	(0.00621)	(0.00824)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5079	5079	5079	5079	5079	5079	5079	5079
Number of Banks	96	96	96	96	96	96	96	96
Wald test	444.4***	471.1***	414.5***	476.9***	406.9***	409.5***	386.6***	403.2***
Modified Wald	$6.2 \cdot 10^6$***	$6.2 \cdot 10^6$***	$6.5 \cdot 10^6$***	$5.9 \cdot 10^6$***	$7.4 \cdot 10^6$***	$8.0 \cdot 10^6$***	$6.9 \cdot 10^6$***	$9.9 \cdot 10^6$***
Common AR(1)	0.2412	0.2397	0.2535	0.2430	0.2154	0.2143	0.2281	0.2180

NOTE - This table presents the results for the FGLS estimation of the relation between return, measured by ROA or ROE, and focus, proxied by HHI, SE, D_a and D_r. We also employ interactions of each concentration measure with private and foreign dummies, in order to observe how the concentration-return relationship depends on the bank's ownership category. We test for groupwise heteroscedasticity by employing a modified Wald test (H_0 = no heteroscedasticity). First order autocorrelation (AR1) coefficients are also shown in the table. We do not present the coefficients of time dummies for the sake of brevity. Standard errors in parentheses.
*** p<0.01, **p<0.05,* p<0.1

Table 7: Nonlinearity of the relationship between Return and Concentration on Bank Risk - FGLS estimation

VARIABLES	(1) roa	(2) roa	(3) roa	(4) roa	(5) roe	(6) roe	(7) roe	(8) roe
Eq. Ratio$_{t-1}$	0.00707*** (0.000852)	0.00678*** (0.000857)	0.00709*** (0.000890)	0.00731*** (0.000892)	-0.0181*** (0.00402)	-0.0193*** (0.00408)	-0.0191*** (0.00418)	-0.0185*** (0.00421)
SIZE$_{t-1}$	3.58e-05 (2.93e-05)	4.21e-05 (3.00e-05)	4.31e-05 (3.29e-05)	0.000131*** (4.01e-05)	0.000645*** (0.000228)	0.000736*** (0.000236)	0.000752*** (0.000254)	0.00139*** (0.000309)
NPL$_{t-1}$	0.00346 (0.00717)	-0.00782 (0.00984)	0.0155** (0.00780)	0.0224* (0.0125)	-0.0425 (0.0433)	0.0276 (0.0582)	0.0550 (0.0513)	0.123 (0.0925)
HHI$_{t-1}$	0.000386 (0.000456)				-0.000545 (0.00279)			
HHI$_{t-1}$·NPL$_{t-1}$	0.0121 (0.0226)				0.209* (0.115)			
HHI$_{t-1}$·NPL$^2_{t-1}$	-0.161** (0.0808)				-0.856** (0.410)			
SE$_{t-1}$		0.000461*** (0.000157)				0.00157 (0.00104)		
SE$_{t-1}$·NPL$_{t-1}$		-0.0103* (0.00579)				0.00110 (0.0389)		
SE$_{t-1}$·NPL$^2_{t-1}$		0.0509* (0.0271)				0.297 (0.188)		
D$_{a,t-1}$			0.0111** (0.00476)				0.0667** (0.0284)	
D$_{a,t-1}$·NPL$_{t-1}$			-0.440** (0.217)				-1.503 (1.163)	
D$_{a,t-1}$·NPL$^2_{t-1}$			0.204 (0.643)				-0.0199 (3.213)	
D$_{r,t-1}$				0.00203*** (0.000481)				0.0137*** (0.00338)
D$_{r,t-1}$·NPL$_{t-1}$				-0.0357* (0.0211)				-0.190 (0.138)
D$_{r,t-1}$·NPL$^2_{t-1}$				-0.00872 (0.0467)				-0.0371 (0.251)
Public	0.000741*** (0.000144)	0.000730*** (0.000144)	0.000673*** (0.000155)	0.000750*** (0.000156)	0.00986*** (0.00118)	0.00975*** (0.00119)	0.00829*** (0.00123)	0.00863*** (0.00122)
Private	0.000838*** (0.000125)	0.000886*** (0.000127)	0.000845*** (0.000127)	0.000979*** (0.000136)	0.00680*** (0.000931)	0.00711*** (0.000943)	0.00658*** (0.000945)	0.00753*** (0.000973)
Constant	-0.000464 (0.000403)	0.000383 (0.000372)	-0.000662 (0.000430)	-0.00229*** (0.000607)	0.00412 (0.00302)	0.00593** (0.00257)	0.00196 (0.00320)	-0.00958** (0.00455)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5079	5079	5079	5079	5079	5079	5079	5079
Number of Banks	96	96	96	96	96	96	96	96
Wald test	423.7***	437.0***	407.1***	424.5***	387.6***	384.7***	360.1***	380.6***
Modified Wald	$6.6 \cdot 10^6$***	$6.3 \cdot 10^6$***	$6.0 \cdot 10^6$***	$5.8 \cdot 10^6$***	$6.7 \cdot 10^6$***	$7.2 \cdot 10^6$***	$6.8 \cdot 10^6$***	$8.2 \cdot 10^6$***
Common AR(1)	0.2622	0.2577	0.2755	0.2759	0.2231	0.2246	0.2305	0.2278

NOTE - This table presents the results for the FGLS estimation to test whether the relation between return, measured by ROA or ROE, and focus, proxied by HHI, SE, D_a and D_r, is U-shaped on risk. We test for groupwise heteroscedasticity by employing a modified Wald test (H_0 = no heteroscedasticity). First order autocorrelation (AR1) coefficients are also shown in the table. We do not present the coefficients of time dummies for the sake of brevity. Standard errors in parentheses.
*** p<0.01, **p<0.05,* p<0.1

Table 8: The effects of Concentration on Risk - Arellano-Bond dynamic panel estimation

VARIABLES	(1) lnNPL	(2) lnNPL	(3) lnNPL	(4) lnNPL
lnNPL_{t-1}	0.556***	0.557***	0.560***	0.560***
	(0.0574)	(0.0572)	(0.0565)	(0.0564)
Eq. Ratio_{t-1}	0.905**	0.945**	0.927**	0.899**
	(0.399)	(0.400)	(0.412)	(0.397)
SIZE_{t-1}	0.499***	0.491***	0.517***	0.479***
	(0.0680)	(0.0678)	(0.0682)	(0.0741)
HHI_{t-1}	-0.641*			
	(0.385)			
SE_{t-1}		-0.260*		
		(0.146)		
$\text{D}_{a,t-1}$			0.467	
			(3.059)	
$\text{D}_{r,t-1}$				-0.468
				(0.464)
ROA_{t-1}	-7.553***	-7.536***	-7.732***	-7.582***
	(1.817)	(1.838)	(1.811)	(1.838)
Public	-0.105	-0.0992	-0.144	-0.101
	(0.120)	(0.118)	(0.133)	(0.127)
Foreign	-0.183	-0.155	-0.231	-0.181
	(0.190)	(0.189)	(0.189)	(0.184)
Constant	-3.503***	-3.993***	-4.175***	-3.071**
	(0.833)	(0.848)	(0.958)	(1.275)
Time Dummies	Yes	Yes	Yes	Yes
Observations	5079	5079	5079	5079
Number of Banks	96	96	96	96
Hansen J Statistic	5.248	5.350	5.042	5.407
Hansen p-value	0.386	0.375	0.411	0.368
AR1	-3.512***	-3.514***	-3.523***	-3.525***
AR2	-1.352	-1.352	-1.350	-1.347

NOTE - This table presents the results for the Arelano-Bond GMM estimation to test the impact of bank's risk, measured by the natural logarithm of NPL, and the four measures of focus we employ in this study. We have used the Windmeijer [2005] correction, which reduces the bias from our two-step estimation. First and second order autocorrelation (AR1 and AR2) coefficients are also shown in the table. The Hansen J statistic tests whether the model is overidenfied. Time dummies coefficients are not presented for the sake of brevity. Standard errors in parentheses.
*** p<0.01, **p<0.05,* p<0.1

Table 9: The effects of Concentration on Risk - Ownership control effects - Arellano-Bond dynamic panel estimation

VARIABLES	(1) lnNPL	(2) lnNPL	(3) lnNPL	(4) lnNPL
lnNPL_{t-1}	0.558***	0.558***	0.559***	0.563***
	(0.0575)	(0.0574)	(0.0580)	(0.0567)
Eq. Ratio_{t-1}	0.930**	0.971**	0.872**	0.855**
	(0.412)	(0.416)	(0.429)	(0.407)
SIZE_{t-1}	0.497***	0.490***	0.516***	0.477***
	(0.0683)	(0.0680)	(0.0685)	(0.0759)
HHI_{t-1}	-0.389**			
	(0.185)			
HHI_{t-1}·Private	-0.418			
	(0.536)			
HHI_{t-1}·Foreign	-0.167			
	(1.170)			
SE_{t-1}		-0.203**		
		(0.0899)		
SE_{t-1}·Private		-0.0917		
		(0.205)		
SE_{t-1}·Foreign		-0.0462		
		(0.403)		
$\text{D}_{a,t-1}$			4.508	
			(3.583)	
$\text{D}_{a,t-1}$·Public			-8.094**	
			(3.897)	
$\text{D}_{a,t-1}$·Foreign			-14.96**	
			(6.809)	
$\text{D}_{r,t-1}$				-0.777**
				(0.393)
$\text{D}_{a,t-1}$·Private				0.534
				(0.478)
$\text{D}_{r,t-1}$·Foreign				0.114
				(0.660)
ROA_{t-1}	-7.561***	-7.545***	-7.838***	-7.587***
	(1.813)	(1.831)	(1.825)	(1.837)
Private	0.230	-0.0565		-0.199
	(0.182)	(0.392)		(0.247)
Foreign	-0.0346	-0.138	0.248	-0.131
	(0.373)	(0.686)	(0.195)	(0.324)
Public			0.167	
			(0.173)	
Constant	-3.677***	-3.993***	-4.267***	-3.020**
	(0.840)	(0.825)	(0.941)	(1.282)
Time Dummies	Yes	Yes	Yes	Yes
Observations	5079	5079	5079	5079
Number of Banks	96	96	96	96
Hansen J Statistic	5.212	5.328	5.143	5.336
Hansen p-value	0.391	0.377	0.399	0.376
AR1	-3.512***	-3.511***	-3.510***	-3.510***
AR2	-1.357	-1.355	-1.359	-1.364

NOTE - This table presents the results for the Arelano-Bond GMM estimation to test the impact of bank's risk, measured by the natural logarithm of NPL, and the four measures of focus we employ in this study. Interactions of each concentration measure with ownership dummies are also employed in order to observe how the concentration-risk relationship depends on the bank's ownership category. We have used the Windmeijer [2005] correction, which reduces the bias from our two-step estimation. First and second order autocorrelation (AR1 and AR2) coefficients are also shown in the table. The Hansen J statistic tests whether the model is overidenfied. Time dummies coefficients are not presented for the sake of brevity. Standard errors in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

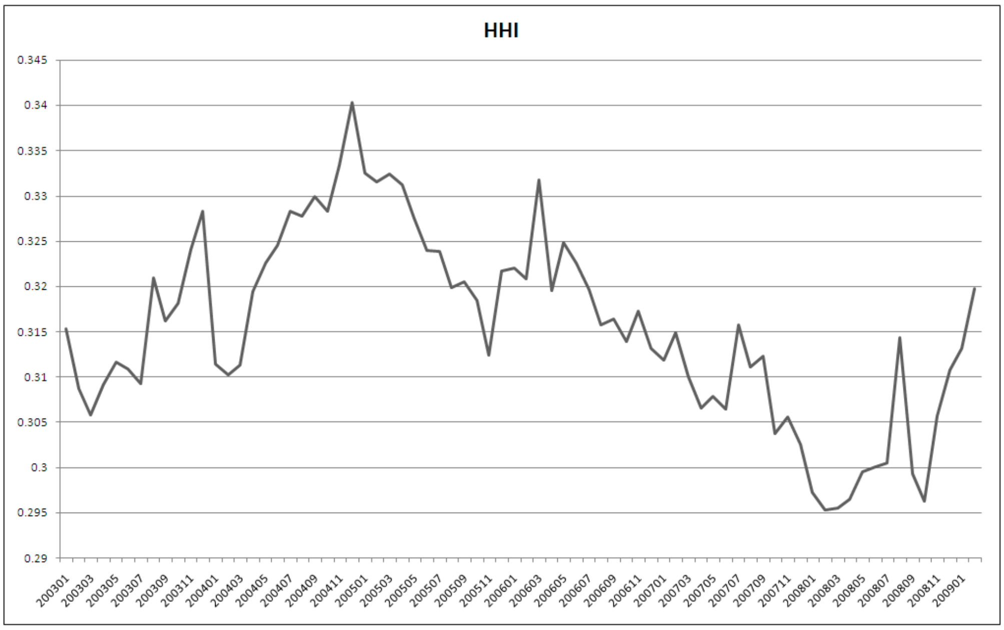

Figure 1: This figure presents the evolution of the monthly-averaged value of the Herfindahl-Hirschman Index (HHI) for the banks in our sample from January 2003 to February 2009.

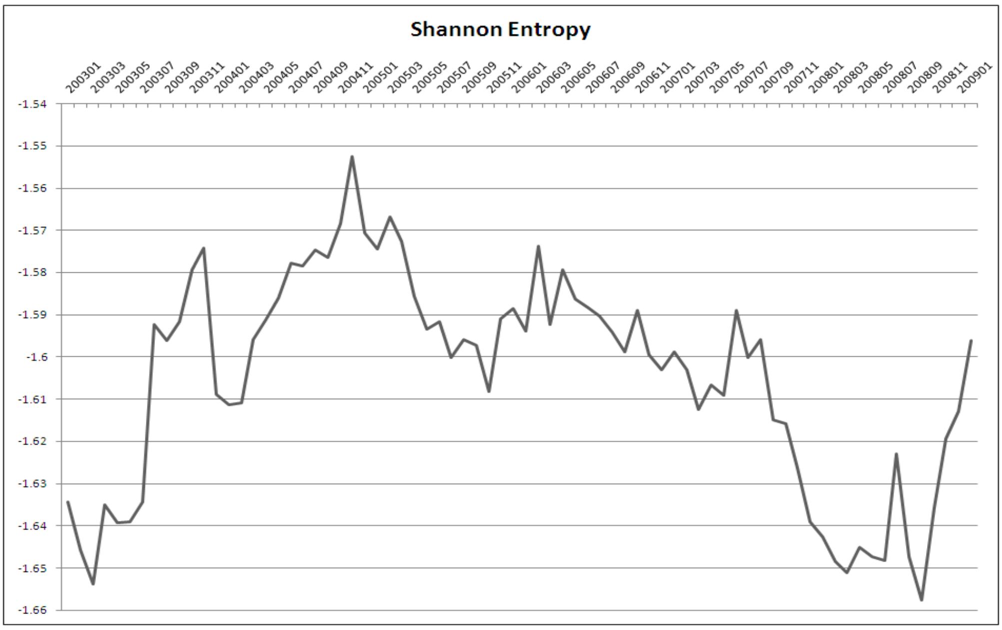

Figure 2: This figure presents the evolution of the monthly-averaged value of the Shannon Entropy (SE) for the banks in our sample from January 2003 to February 2009.

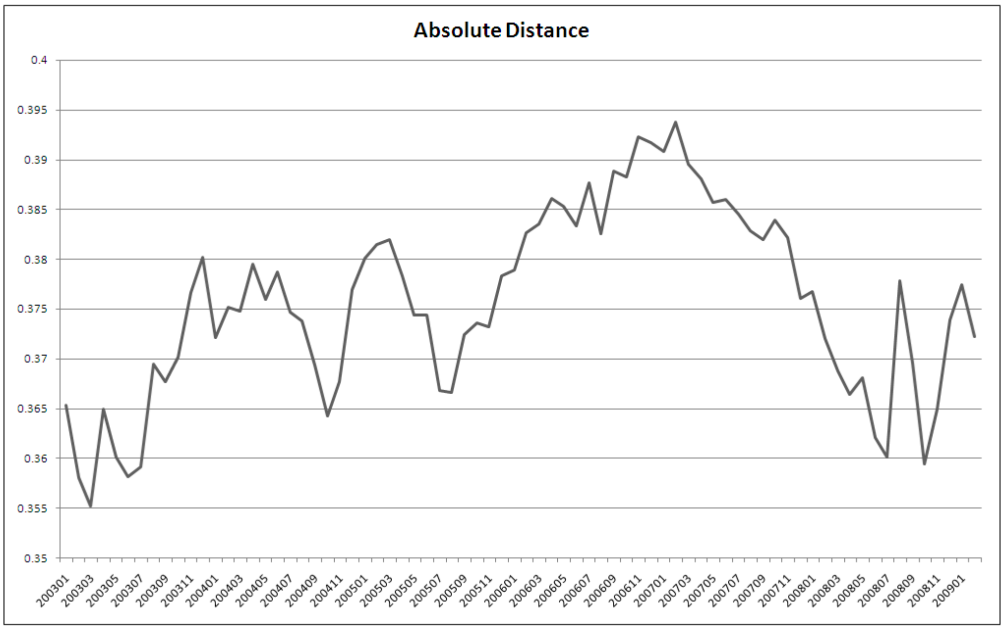

Figure 3: This figure presents the evolution of the monthly-averaged value of the Absolute Distance measure for the banks in our sample from January 2003 to February 2009.

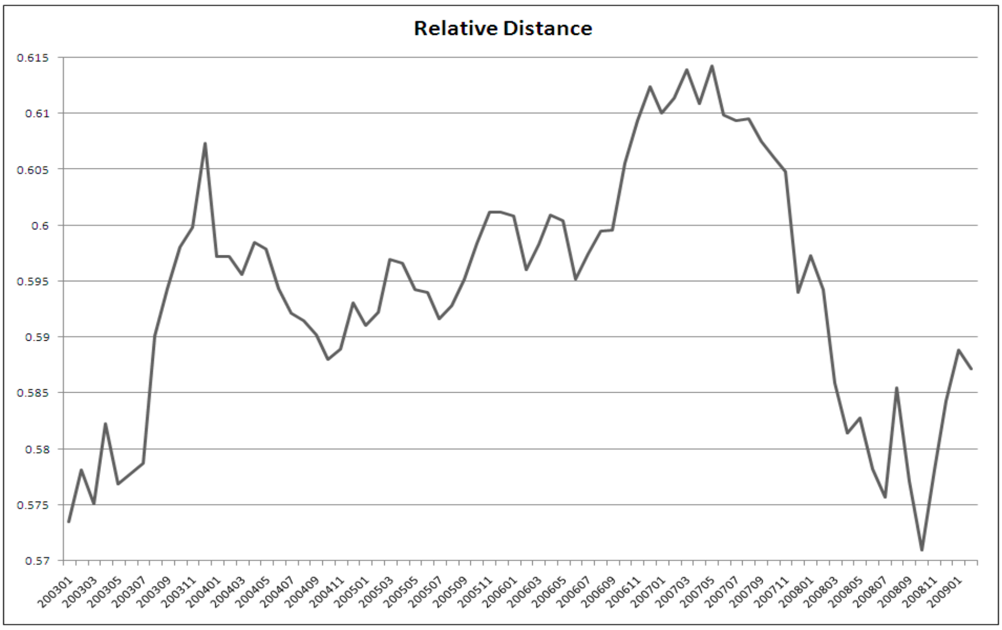

Figure 4: This figure presents the evolution of the monthly-averaged value of the Relative Distance measure for the banks in our sample from January 2003 to February 2009.

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