

Geographical diversification and cyclicity in banking activity

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Abstract

This work aims to report the recent patterns and the cyclicity standards of banking activity's geographical distribution. We use a regionalized database of account balances from Brazilian banking institutions to create geographical distribution indicators for credit and other variables. The results provide evidence that the geographic diversification of credit follows a procyclical pattern. We report heterogeneity between the types of bank ownership, suggesting that for private banks this cyclical behavior is amplified by economic fluctuations. In addition, the international financial crisis of 2008 impacted the dynamics of regional credit concentration. Finally, the estimated correlations seem to support the hypothesis of greater procyclicality in moments of higher risk.

Keywords: Banking industry; Geographical distribution of banks; Banking diversification.

JEL codes: G21; R12; L25.

Área Temática: 2. Teoria Econômica e Economia Aplicada.

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1. Introduction

The recent international financial crisis has led to important developments in macroeconomic theory. For example, articles such as those by Woodford (2010) and Gertler and Kiyotaki (2010) argue for the need to make a deeper study of the way financial intermediation services are modelled¹. When there is information failure, these models of financial intermediation and constraint suggest that the financial structure of the economy and the way financial intermediaries function can have both important short-term and long-term macroeconomic effects (Freixas and Rochet, 2008).

Thus, obtaining empirical evidence that would contribute to understanding activities in the financial sector, especially the banking sector, has become increasingly important in the literature. Such evidence has revealed that banking activity is procyclical, a fact that may potentially have an important impact on the intensification of economic cycles.

For example, Adrian and Shin (2010) and Kalemli-Ozcan, Sorensen and Yesiltas (2012) report evidence of procyclical activity in the level of banking-asset leveraging. This behaviour tends to increase the availability of banking resources in periods of economic expansion. On the other hand, the process of banking deleveraging tends to worsen economic recessions. The reported behaviour of other banking variables, such as the propensity to offer credit, to accept greater risks and to make provision for loan losses, leads to the same conclusion (Berger and Udell, 2004, Borio, Furfine and Lowe, 2002, and Bikker and Metzmakers, 2005).

In spite of these developments, there is less evidence regarding the use of geographical diversification as a banking strategy. Recent articles have analyzed the consequences of greater geographical diversification for banking performance. For example, Berger et al. (2005) pointed out that greater distance between operational units might reduce monitoring ability with adverse effects on the quality of assets. On the other hand, Goetz, Laeven and Levine (2014) provide evidence that more geographically diverse activity reduces risk for banking institutions. According to the authors, the main reason for this effect is that it allows greater opportunities for diversification and reduction of idiosyncratic risk arising from the inclusion of new locations.

This article seeks to contribute to this debate by studying the cyclicity patterns of geographical diversification in banking activity, using a sample of data from Brazil. Evidence of cyclicity in this aspect of banking activity may indicate that the macroeconomic effects of banking activity may show regional asymmetry. In other words, during periods of economic recession, the banking sector may not only cause the negative cycle to deepen but also lead to geographical concentration of resources, thus having a severer impact on more decentralized markets.

In order to carry out this study, we use a banking database that allows a regional breakdown of banking operations in Brazil. We use this database to calculate indices of geographical diversification in banking activities, which are analyzed for cyclicity patterns during the period 2001 to 2015.

The results provide evidence that the geographical distribution of credit shows procyclical behavior, that is to say, periods of expansion in banking activity are characterized by greater geographical diversification in bank lending. The econometric estimates also show that, in the case of private banks, this cyclical behavior is heightened

¹ This approach broadens the treatment given by the first generation of financial intermediation models, such as those used by Bernanke and Gertler (1989), Bernanke, Gertler and Gilchrist (1996) and Kiyotaki and Moore (1997), whose analyses were concentrated more on the credit restrictions undergone by non-financial agents.

by economic fluctuations. The estimates also support the hypothesis that the 2008 international financial crisis had an effect on the geographical distribution of credit. Lastly, the results also provide important evidence that the procyclicality resulting from geographical diversification is more intense when there is greater banking risk.

In addition to this brief introduction, the article contains three more sections. The second of these presents the banking economy literature dealing with the main factors leading to choices for greater geographical diversification in the sector. The third section provides a description of the measures developed in order to carry out geographical diversification in the Brazilian banking sector. Section 4 describes the procedures and the most important econometric results obtained regarding cyclicity in the banking sector while Section 5 concludes the study with a summary of the results. Appendix reports all the tables and figures discussed in the article.

2. Banking industry and geographical diversification

The study of geographical diversification in banking activities is an important topic in the banking economy literature. The articles dealing with this subject attempt to carry out a cost-benefit analysis of more diversified activity compared to a strategy of greater focus on local markets.

Geographical diversification involves choosing where to locate new branches and credit operations, a decision which presents important challenges for the banking sector (Acharya et al., 2006). At a more organisational level, on entering a new market a bank's performance may be adversely affected by its lack of expertise and the increase in organisational complexity demanded by more diversified activity (Deng and Elyasiani, 2008).

However, even more important than organisational diseconomies is the possibility of a rise in the cost of information management – a core feature of banking activity. When business is carried out in more decentralized locations, banks may experience a rise in the costs of monitoring their subsidiaries' activities. In addition to this, the greater distance between them and borrowers tends to increase the costs of collecting and transmitting information, especially soft information², with potentially damaging effects on the quality of their credit portfolios (Petersen and Rajan, 2002, Berger et al., 2005, Deng and Elyasiani, 2008, Agarwal and Haswald, 2010).³

On the other hand, Deng and Elyasiani (2008) argue that greater geographical diversification may be beneficial to the banking sector when associated with growth in fund raising and investment opportunities. However, the most traditional argument in favour of geographical diversification concerns the possibility of reducing investment portfolio risk. Banking risk may be spatially correlated, leading to the conclusion that greater geographical diversification of banking activity is desirable by carrying out business in various municipalities, states, and even countries (Aguirreagabiria, Clark and Wang, 2016). Therefore, in line with the basic logic of portfolio theory, when returns are imperfectly correlated with existing assets, the addition of new assets may reduce a bank's average asset risk (Boyd and Prescott, 1986, and Diamond, 1984).

² Soft information is the type of information about bank clients that cannot be adequately expressed in numbers and is therefore difficult to formulate and communicate (Petersen and Rajan, 2002). Agarwal and Haswald (2010) demonstrate that the principal effect of bank-borrower proximity is to make it easy to obtain soft information in the credit market and that this has an influence on the lending conditions for those clients with the greatest proximity.

³ Petersen and Rajan (2002) and Berger et al. (2005) have produced evidence that a greater distance between bank and client tends to make the relationship more impersonal and based on verifiable numerical information (hard information).

In general, the empirical literature supports the hypothesis that geographical diversification allows better management of banking risk. For example, Deng and Elyasiani (2008) argue that the variables of diversification and distance between head office and branches become difficult to distinguish when banks expand geographically. It would therefore be important to analyse these two dimensions separately. While it seems that the distance between headquarters and local branches has damaging effects on the quality of assets, greater geographical diversification tends to increase the market value of banks and reduce average portfolio risk (Deng and Elyasiani, 2008).

Goetz, Laeven and Levine (2014) study the relation between geographical diversification and risk and emphasize the potential for endogeneity in the choice of regional activity. In order to deal with this problem, these authors employ an identification strategy based on the changes introduced in 1994 by the Riegle-Neal Interstate Banking and Branching Act, which flexibilized the restrictions on regional banking in the United States. The results indicate that geographical diversification may reduce banking risk through lower exposure to idiosyncratic local risks.

In the same way, Meslier et al. (2016) study the operations of a set of 10,681 US banks between 1994 and 2006 with the aim of analyzing the effects of the Riegle-Neal Act. In the same way as Goetz, Laeven and Levine (2014), they use the regional distribution of newly raised deposits as a proxy for the geographical diversification of the banks. In general, they find evidence that, in the case of the banks analyzed, geographical diversification improves the relation between risk and return. In addition, the effects of diversification appear to be non-linear, so that continuing the process of expansion may have negative effects when certain limits are exceeded.⁴

Similar results are obtained by Aguirregabiria, Clark and Wang (2016), who reports evidence that the Riegle-Neal Act had increased the prospects for geographical diversification of banking risk, especially for small-sized banks located in economically homogenous states. In spite of this, the authors notice that the majority of these banks had not taken advantage of these changes in the law and had opted instead for intra-state expansion strategies. In order to explain this choice, Aguirregabiria, Clark and Wang (2016) use a structural competition model to identify the banks preferences for geographical diversification of risk separately from other factors related to the decision to expand geographically and show that the benefits from greater diversification may have been compensated for by other factors such as the lack of economic density in the new markets.

The above-mentioned articles show that the possibilities for risk reduction can be an important motivating factor in choosing a strategy of greater regional diversification in banking activity. This article investigates whether this increase in regional diversification follows a particular pattern of cyclicity in the way confirmed in the literature dealing with the propensity to make loans and accept risk in the banking sector (Adrian and Shin, 2010, Kalemli-Ozcan, Sorensen and Yesiltas, 2012, Berger and Udell, 2004, Borio, Furfine and Lowe, 2002, and Bikker and Metzmakers, 2005). If any procyclicality in geographical diversification were discovered, it would be a sign that banking activity had the potential not only to intensify economic cycles but to cause differentiated regional impacts during the cycle.

⁴ Similar results are found in Acharya et al. (2006). These authors produce evidence that greater geographical diversification does not necessarily improve the relation between banking risk and return. Specifically, the study demonstrates that diversification does not guarantee less risk, especially in the case of banks that are more at risk.

3. Institutional background and dataset

Just as in other productive activities, Brazilian banking system operations are highly concentrated in certain regions. Data from the Brazilian Central Bank (BCB) show that, in December 2015, 52% of bank branches were located in the South-East Region, whereas the North and Centre-West Regions had only 5% and 8% respectively. As can be seen in Table 1, the disparity is even greater when it comes to the regional distribution of credit and deposit account balances, since the South-East Region accounted for 69% and 60% respectively of the amounts recorded for these two variables at the end of 2015.

These regional specificities in Brazilian banking activities along with their potential impact on local economic development, have been examined by a series of articles, such as Fonseca (2005), Corrêa (2006), Crocco et al. (2006), Rocha and Nakane (2008), Crocco, Santos and Amaral (2010) and Rodrigues (2013). Our aim in this article is to make a contribution to this literature by introducing a new metric for geographical diversification in banking activity and to study the cyclical patterns for this variable.

Table 1: Geographical distribution of banking activity, December/2015

Region	Branches	%	Loans (\$ millions)	%	Deposits (\$ millions)*	%
Centre-West	1,828	8%	277,195	9%	130,487	8%
North	1,149	5%	65,477	2%	44,300	3%
North-East	3,620	16%	231,844	8%	186,516	12%
South	4,291	19%	371,840	12%	254,019	16%
South-East	11,903	52%	2,136,575	69%	940,550	60%
Total	22,791	100%	3,082,930	100%	1,555,873	100%

Source: Central Bank of Brazil.

Note: *The total balance of deposits corresponds to the sum of total demand deposits, total time deposits and savings.

The main source of information for this study is the Banking Statistics by Municipality (Estatística Bancária por Município – ESTBAN) database, provided by the Brazilian Central Bank.⁵ This database provides the monthly balance of the main categories from the balance sheets of commercial and universal banks holding a commercial bank portfolio in each Brazilian municipality.

A novel feature recently introduced by the BCB is the disaggregation of accounts according to the banking institution operating in each locality. Thus, we have information, for example, about the volume of credit in municipality j , at moment t , discriminated according to the banking institutions operating in that location. To put this another way, this information allows us to observe the total amount of credit supplied by institution i at moment t , disaggregated by the municipalities served by this bank.

Geographical diversification of banking activity will be analyzed mainly in terms of the regional distribution of credit volumes, which is taken to be the principal banking product. This choice is supported by the traditional intermediation approach to banking institutions proposed by Sealey and Lindley (1977), according to which banks use capital, labour, office supplies and funds in order to produce loans and other revenue-earning assets.

⁵ Banking data obtained from Code 4500 Document, which can be found at <http://www4.bcb.gov.br/fis/cosif/estban.asp>.

In this section, in addition to data about credit, we will present information relating to the geographical distribution of branches and total deposits raised by banks⁶, since these variables allow a more comprehensive description of the patterns of banking diversification.

The measurement of geographical distribution used in this paper is the same as that used by Goetz, Laeven and Levine (2014):

$$ID_{y,i,t} = 1 - \sum_{j=1}^J \left(\frac{y_{j,i,t}}{\sum_{i=1}^I y_{j,i,t}} \right)^2, \quad (1)$$

Where $ID_{y,i,t}$ is the Index of Diversification (ID) of the banking variable y for the banking institution i , with $i=1..I$, at moment t . In addition, $j=1,..,J$ identifies the municipality.

The indicator ID varies from 0 to 1 and higher values denote greater geographical diversification of the banking variable under consideration. As we can see, the second term in the above equation is equivalent to the standard Herfindahl-Hirschman Index (HHI). Therefore, in the extreme case of banking being completely concentrated in one single municipality, the HHI will tend to 1 and the ID to 0. At the other end of the scale, complete dispersion of banking operations will cause the HHI to tend to 0 and the ID to 1.

The database was created by excluding information concerning banking institutions whose operations were concentrated in one single branch or which had no records of credit operations or deposits. Once these adjustments had been made, the database contained a total of 978 annual observations for 117 banks during the period 2001-2015.

Table 2 shows some descriptive statistics for the Index of Diversification of the number of bank branches, the total amount of credit and the deposit balances for each municipality. As explained above, the ID for each of these variables was calculated for each bank on a yearly basis.

These descriptive statistics show that there is not a uniform pattern of geographical diversification and that it changes according to the variables studied. The average ID of bank branches is 0.765; well above the figure of 0.339 recorded for the volume of loans and 0.249 for deposits raised. These figures seem to indicate that a simple analysis of the national distribution of branches may overestimate the real level of the geographical diversification of banking services offered by banking institutions.

The table also shows the basic statistics disaggregated by type of ownership. The sample consists of 65 private banks, giving a total of 549 observations for the period under investigation. State-owned banks were represented by 19 institutions with 180 observations and, last of all, there were 33 foreign banks counting for 258 observations for the period.

It is worth noting that the greater geographical diversification of branches in relation to credit and deposit operations was found for all three categories of bank. On the other hand, the data seem to indicate heterogeneity of diversification patterns between types of ownership. In all cases, the indices of average diversification in state-owned banks are greater than the observed in the total banking sector. As regards distribution of credit and deposits, the average index for state-owned banks is actually a little higher than double that for the average of the banking sector (0.684 for credit and 0.600 for deposits against, respectively, 0.339 and 0.249). This picture may be the result of a deliberate policy of geographical expansion in banking services on the part of state-owned banks

⁶ Total deposits are measured by adding the demand deposits (from the private and public sector) to the time deposits and savings.

with the aim of serving regions and areas where the offer of these products is more restricted.

Table 2: Descriptive statistics

Banking branches						
Variables	Obs	Average	Median	Standard Dev.	Min	Max
Total Banking System	987	0.765	0.833	0.199	0.00	0.99
Private banks	549	0.743	0.805	0.200	0.00	0.99
State-owned banks	180	0.945	0.976	0.063	0.74	0.99
Foreign banks	258	0.687	0.666	0.185	0.00	0.98
Banking loans						
Variables	Obs	Average	Median	Standard Dev.	Min	Max
Total Banking System	987	0.339	0.325	0.323	0.00	0.99
Private banks	549	0.262	0.058	0.298	0.00	0.89
State-owned banks	180	0.684	0.745	0.231	0.03	0.98
Foreign banks	258	0.261	0.213	0.269	0.00	0.86
Banking deposits						
Variables	Obs	Average	Median	Standard Dev.	Min	Max
Total Banking System	987	0.249	0.039	0.320	0.00	0.97
Private banks	549	0.159	0.005	0.273	0.00	0.93
State-owned banks	180	0.600	0.583	0.248	0.03	0.97
Foreign banks	258	0.192	0.001	0.292	0.00	0.92

Source: Central Bank of Brazil

The figures shown below present the changes in the average indices of banking diversification over time and show the behaviour of both the average for the banking system and for different types of ownership.

In Figure 1, we have the dynamics of diversification in the number of banking agencies between 2001 and 2015. It can be seen from the sector average that there is evidence that the geographical diversification has grown in recent years. This evidence seems to be repeated in a general way in the three categories of bank mentioned in the figure. This may be the result of a general effort to expand the network of banks in Brazilian municipalities.

Figure 1 – Geographical diversification: banking branches

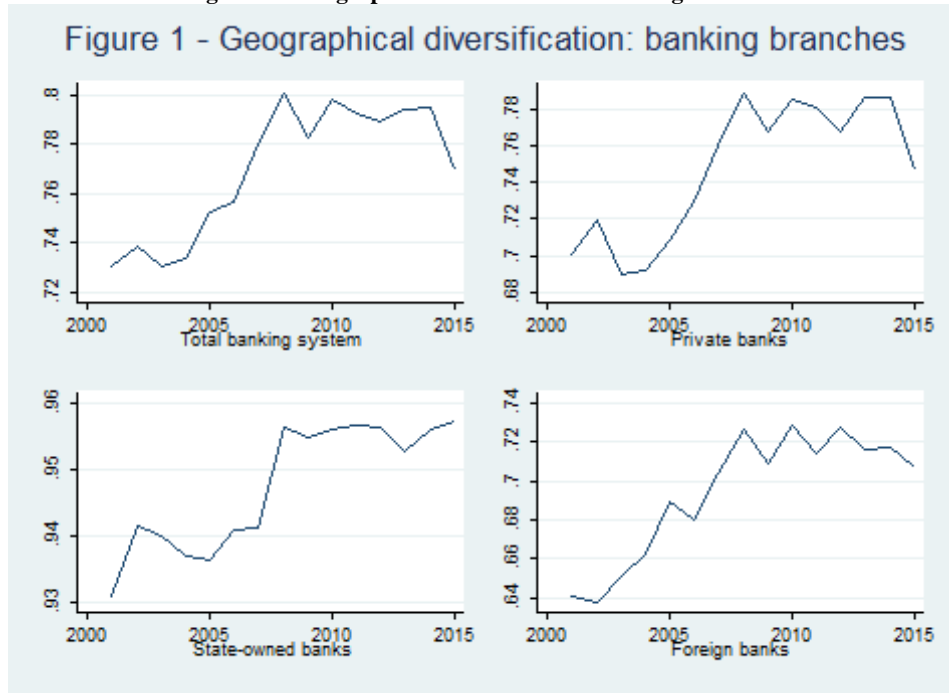
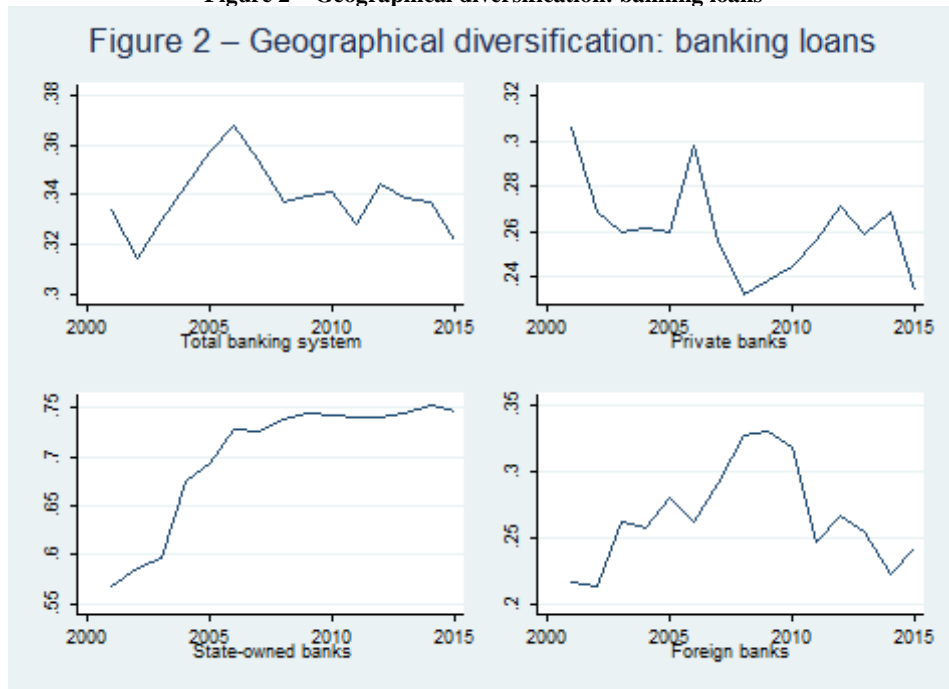


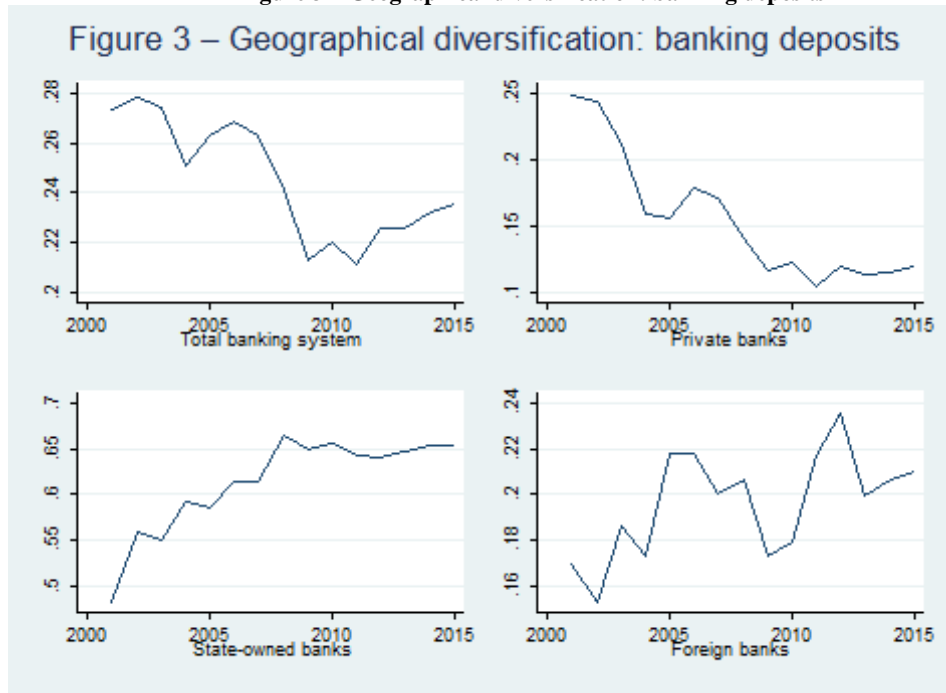
Figure 2 shows the changes over time of the geographical diversification indices for bank credit during the period under analysis. With the exception of state-owned banks, there has been no marked trend in the behaviour shown by this variable during the last few years. Although not in great evidence, there are signs of a decline in credit diversification in the final part of the sample of private and foreign banks. Such a development may be a reaction to the international financial crisis, which affected the Brazilian economy more strongly from 2008 onwards. In the same way as bank branches, we find that geographical diversification of credit balances was higher for state-owned banks in the last years of the sample.

Figure 2 – Geographical diversification: banking loans



Lastly, Figure 3 shows the changes over time in the geographical diversification of bank deposits in Brazilian municipalities. We note that the sources from which banks raised funds were more geographically concentrated in the more recent period. This behaviour is, basically, the result of the same factors operating in in the domestic private sector. In state-owned banks, on the other hand, following the trend found in other indicators, there was a rise in the more recent levels of geographical diversification in the bank deposits in Brazilian municipalities.

Figure 3 – Geographical diversification: banking deposits



4. Cyclicality of geographical diversification in banking activity

In this section, we continue with an analysis of the cyclicality patterns in the geographical diversification of banking activity by using an econometric model for the credit data from Brazilian banks between 2001 and 2015.

The variable that interests us most here is the total amount of bank assets (“*Total Assets*”) because it is the correlation of this amount with the diversification indicator that will indicate the nature of the cyclical behaviour of bank diversification strategy. This variable is deflated by the Broad National Consumer Price Index (CPI) and integrated into the model in logarithmic form.

In addition to this variable, the model also considers some controls for banking characteristics and macroeconomic performance. First of all, in order to take the effects of greater regional penetration and the availability of a larger physical structure into account, we include the number of bank branches (“*Branches*”) belonging to each banking institution for each year of the sample.

From the point of view of macroeconomic controls, the econometric model takes three more variables into consideration. The first of these is the average real interest rate for the year (“*Interest rate*”) calculated based on the deflation of the Selic base rate by the inflation rate, as measured by the CPI. We intend to use this variable in order to integrate the actual conditions of the money market in any given year into the econometric models.

The second macroeconomic variable inserted into the model reflects the situation regarding diversification of the GDP in Brazilian municipalities (“*GDP Diversification*”). Our intention here is to integrate the effects of change in diversification of the real national product for each Brazilian municipality. In order to calculate this variable, we use the municipal GDP indices produced by the Brazilian Geographical and Statistical Institute (IBGE), which are available up to 2013, applying the same formula as equation (1) above.

Lastly, the variable “*Economic Growth*” provides the real Brazilian GDP growth rate during the years under analysis. This variable is integrated into the model with the aim of controlling the effects of economic fluctuations, thus revealing, in the same way as variations in bank assets, an important dimension of the cyclical behaviour of banking activity.

The models also include dummy variables indicating whether the institution is a public, domestic private or foreign private bank. The data produce an unbalanced panel providing information on banking institutions between 2001 and 2013. The econometric models are estimated with fixed effects, controlling for the specific individual characteristics of the banking institutions analyzed in the period.⁷ The following tables report the results of the regressions calculated for the geographical diversification of banking credit in Brazil.

Table 3: Determinants of Banking Geographical Diversification

Explicative variable	(1)	(2)	(3)	(4)
Total assets	0.00669 (0.00445)	0.00671 (0.00445)	0.0134** (0.00492)	0.00726 (0.00534)
Branches			-2.14e-05 (1.53e-05)	-2.26e-05 (1.53e-05)
Interest rate			0.00140 (0.00110)	0.00139 (0.00109)
GDP diversification			4.729* (1.833)	4.737** (1.824)
Economic growth			-0.000473 (0.00168)	-0.0439** (0.0152)
Asset x Growth				0.00185** (0.000642)
Constant	0.181+ (0.105)	0.176 (0.108)	-4.577* (1.785)	-4.439* (1.777)
Control for ownership type	No	Yes	Yes	Yes
Observations	987	987	880	880
R2	0.003	0.003	0.022	0.033
Number of institutions	116	116	114	114

Note: Standard deviation between parentheses. ** p<0.01, * p<0.05, + p<0.1.

Table 3 presents four econometric specifications that vary according to the variables included in the models. In equation (3) we have the specification that

⁷ Taking specification (3), shown in Table 3, as reference, the Hauman test rejected the null hypothesis for the absence of significant differences between the coefficients calculated for fixed and random effects. The test statistic, $\chi^2(5) = 38.88$, is associated with a p-value of 0.00.

incorporates all the previously described variables. The results show that there is a significant positive correlation between the index for bank credit diversification and bank assets. The point estimate shows that the 1% increase in bank assets is, on average, related to a rise in geographical diversification of around 1.34 p.p. This procyclical behaviour may have important consequences from a regional point of view, since periods of banking expansion are characterized by greater regional distribution of credit. On the other hand, a reversal in the process of credit expansion is accompanied by greater regional concentration of loans by banking institutions.

This result suggests that the credit cycles are not homogenous in terms of the regional distribution of funds. In order to understand this process more clearly, models (1) and (4) were repeated for the dependent variable “diversification of bank deposits (Table 7). As can be seen, the pattern of cyclicity is reversed with a rise in diversification of sources from which funds can be raised when banking activity contracts. In other words, a cyclical contraction in banking activity is marked by greater regional concentration in lending combined with diversification in sources of finance.

Table 4: Determinants of Banking Geographical Diversification – Ownership structure

Explicative variable	Private banks		State-owned banks		Foreign banks	
	(5)	(6)	(7)	(8)	(9)	(10)
Total assets	0.00744 (0.00783)	-0.00361 (0.00853)	0.0262** (0.00994)	0.0270** (0.0101)	0.0219* (0.00893)	0.0191+ (0.00990)
Branches	-2.19e-05 (2.52e-05)	-2.45e-05 (2.49e-05)	-1.98e-05 (1.66e-05)	-1.93e-05 (1.66e-05)	-4.22e-05 (3.31e-05)	-4.18e-05 (3.31e-05)
Interest rate	-0.000287 (0.00161)	-0.000276 (0.00159)	0.00205 (0.00135)	0.00207 (0.00136)	0.00392+ (0.00225)	0.00391+ (0.00225)
GDP diversification	6.017* (2.810)	6.205* (2.782)	8.400** (2.217)	8.377** (2.224)	0.748 (3.622)	0.733 (3.628)
Economic growth	-0.00122 (0.00240)	-0.0710** (0.0226)	0.00236 (0.00218)	0.0139 (0.0230)	-0.000689 (0.00349)	-0.0188 (0.0282)
Asset x Growth		0.00300** (0.000965)		-0.000472 (0.000936)		0.000772 (0.00120)
Constant	-5.786* (2.713)	-5.713* (2.685)	-8.189** (2.182)	-8.188** (2.188)	-1.002 (3.560)	-0.923 (3.567)
Observations	491	491	162	162	227	227
R2	0.020	0.042	0.160	0.162	0.049	0.051
Number of institutions	65	65	19	19	33	33

Note: Standard deviation between parentheses. ** p<0.01, * p<0.05, + p<0.1.

The indicator for productive diversification is the only control in the model that is found to be significant. In this case, there is intuitive evidence that periods of regional decentralization in GDP are associated with greater diversification of bank credit. The economic growth variable shows a negative but not significant correlation with geographical diversification of bank credit. Equation (4) adds an interaction between the bank asset and the rate of economic growth (“*Asset x Growth*”). The coefficient associated with this variable has a positive sign, indicating that the procyclicality of the geographical diversification of bank lending is intensified by the economic cycle.

Table 4 reports the equivalent of specifications (3) and (4), but disaggregates the sample by type of ownership. In equations (5) and (6) we have the results for the sample with domestic private banks, while models (7-8) and (9-10) deal with state-owned banks

and foreign banks, respectively. In general, the results are similar to those discussed above. One important factor that should be highlighted refers to the “*Asset x Groth*” interaction, which appears only to be significant in the case of private domestic banks, i.e., domestic private banks have their own pattern of geographical diversification procyclicality, which is intensified by economic fluctuations. In the other segments, there is evidence that geographical diversification increases when there are periods of expansion of bank assets but not because of economic cycles.

In the previous section, we reported the time series of geographical diversification indicators for selected banking variables. In the case of credit operations, in the final years of the sample, it is possible to identify a certain level of stability in the behaviour of state-owned banks and even a slight fall in the case of private domestic and foreign banks. These changes may be connected to the international financial crisis, which impacted the Brazilian economy more strongly after the last trimester of 2008.

In order to analyse this possibility, the models reported in Table 5 use a dummy variable to identify the years after 2008. Three possibilities were tested in the model: (i) *Crisis 1*: the dummy variable has a unitary value for all the years after 2008 and attempts to record any longer-lasting effects of the financial crisis; (ii) *Crisis 2*: the dummy variable has a unitary value in 2009 and 2010 and attempts to record the effects of the most pronounced period of the crisis; (iii) *Crisis 3*: the dummy variable has a unitary value in 2009, 2010 and 2011, constituting a variation of *Crisis 2*.

The models reported in Table 5 also present interactions between the variables that represent the 2008 financial crisis and the total amount of banking assets in an attempt to register changes in the cyclicity patterns of geographical diversification over time. The results show that the variables *Crisis 1* and *Crisis 2* do not present statistically significant coefficients. In the same way, these variables do not seem to indicate any significant alteration in the patterns of cyclicity in the geographical diversification of post-crisis bank credit.

Table 5: Determinants of Banking Geographical Diversification – 2008 Financial Crisis

Explicative variable	(11)	(12)	(13)	(14)	(15)	(16)
Total assets	0.0133** (0.00494)	0.0118* (0.00514)	0.0134** (0.00493)	0.0122* (0.00498)	0.0134** (0.00493)	0.0116* (0.00501)
Branches	-2.18e-05 (1.54e-05)	-3.01e-05+ (1.75e-05)	-2.17e-05 (1.54e-05)	-2.50e-05 (1.55e-05)	-2.15e-05 (1.54e-05)	-2.85e-05+ (1.58e-05)
Interest rate	0.00181 (0.00156)	0.00182 (0.00156)	0.00157 (0.00114)	0.00152 (0.00114)	0.00147 (0.00115)	0.00140 (0.00115)
GDP diversification	4.291+ (2.191)	4.321* (2.191)	4.792** (1.838)	4.907** (1.838)	4.714* (1.836)	4.874** (1.834)
Economic growth	-7.18e-05 (0.00201)	-5.97e-05 (0.00201)	-0.000451 (0.00168)	-0.000598 (0.00168)	-0.000461 (0.00168)	-0.000610 (0.00168)
Crisis 1	0.00511 (0.0140)	-0.0789 (0.0845)				
Asset x Crisis 1		0.00360 (0.00357)				
Crisis 2			0.00522 (0.0102)	-0.134 (0.0929)		
Asset x Crisis 2				0.00594 (0.00393)		
Crisis 3					0.00164 (0.00897)	-0.155+ (0.0821)
Asset x Crisis 3						0.00668+ (0.00347)
Constant	-4.151+ (2.134)	-4.148+ (2.134)	-4.641** (1.790)	-4.722** (1.789)	-4.563* (1.788)	-4.675** (1.786)
Control for ownership type	Yes	Yes	Yes	Yes	Yes	Yes
Observations	880	880	880	880	880	880
R2	0.022	0.023	0.022	0.025	0.022	0.027
Number of institutions	114	114	114	114	114	114

Note: Standard deviation between parentheses. ** p<0.01, * p<0.05, + p<0.1.

On the other hand, in equation (16) there is evidence of the importance of the international financial crisis, in line with the definition provided by the *Crisis 3* variable. The results appear to indicate a fall in the average values of the indicator for geographical diversification of credit in the years immediately after the crisis. In addition to this, the positive significant value of the coefficient of the variable “*Asset x Crisis 3*” demonstrates that the 2008 financial crisis caused the geographical diversification of bank credit to be even more procyclical.

At this stage, it would be natural to attempt to understand the reasons that lead banks to increase their level of geographical diversification during periods of asset expansion. Goetz, Laeven and Levine (2014) argue that one of the advantages of geographical diversification is the possibility of reducing the level of risk in banking activity. In order to investigate the possibility of a connection between diversification and risk, the regressions used in Table 6 incorporate variables that seek to determine the level of risk in the banking portfolios analysed.⁸

⁸ Banking institutions authorized to operate in Brazil are obliged to classify their credit operations according to 9 categories in order of increasing risk: AA, A, B, C, D, E, F, G, and H, which must obey the minimum

The variable “% *Low risk*” refers to the percentage of the portfolio classified according to the risk categories AA, A, B and C⁹ and provides a measure of the relative importance of low risk credit. In turn, the variable “% *Risk 1*” provides an initial approximation to the relative importance of riskier credit present in the bank’s portfolio, while showing the percentage of credit operations classified as D, E, F and G. Lastly, the variable “% *Risk 2*” refers to the proportion of lowest quality credit (category H) in relation to the total value of the bank’s portfolio.

Table 6: Determinants of Banking Geographical Diversification – Level of risk

Explicative variable	(17)	(18)	(19)	(20)	(21)	(22)	(23)
Total assets	0.0134** (0.00492)	0.0107+ (0.00561)	0.0348 (0.0221)	0.00501 (0.00560)	- (0.00598)	0.00730 (0.00553)	0.00537 (0.00563)
Branches	-2.14e-05 (1.53e-05)	-2.36e-05+ (1.42e-05)	-2.21e-05 (1.43e-05)	-1.75e-05 (1.44e-05)	-1.28e-05 (1.45e-05)	-2.02e-05 (1.49e-05)	-2.06e-05 (1.48e-05)
Interest rate	0.00140 (0.00110)	0.000651 (0.00115)	0.000711 (0.00115)	0.00135 (0.00118)	0.00150 (0.00118)	0.000697 (0.00114)	0.000801 (0.00114)
GDP diversification	4.729* -1.833	5.015* -1.941	5.348** -1.963	5.201* -2.013	6.059** -2.036	4.982* -1.940	5.340** -1.948
Economic growth	-0.000473 (0.00168)	0.000273 (0.00172)	0.000327 (0.00172)	0.000532 (0.00173)	0.000441 (0.00172)	0.000527 (0.00170)	0.000467 (0.00170)
% Low risk		-0.00266 (0.0457)	0.619 (0.554)				
Asset x Low risk			-0.0268 (0.0238)				
% Risk 1				-0.0446 (0.0706)	-1.598* (0.651)		
Asset x Risk 1					0.0679* (0.0283)		
% Risk 2						-0.114 (0.0697)	-1.332+ (0.701)
Asset x Risk 2							0.0556+ (0.0318)
Constant	-4.577* -1.785	-4.731* -1.891	-5.615** -2.047	-4.740* -1.953	-5.463** -1.968	-4.602* -1.884	-4.909** -1.889
Control for ownership type	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	880	674	674	686	686	776	776
R2	0.022	0.023	0.026	0.024	0.033	0.025	0.030
Number of institutions	114	95	95	92	92	105	105

Note: Standard deviation between parentheses. ** p<0.01, * p<0.05, + p<0.1.

criteria established by the Brazilian Central Bank (Resolution 2,682, 1999). The information required for developing these variables was obtained from the document entitled “Banking Institutions Capital Balance Sheets” (Document Code 4010) at the website of the Brazilian Central Bank.

In columns (18) and (19) the variable “% *Low risk*” was inserted separately and in interaction with the measure used for bank assets (“*Asset x Low risk*”). As can be seen, the coefficients associated with normal risk loans are not statistically significant. On the other hand, there is evidence that accepting greater risks is relevant to the process of bank diversification. In equations (21) and (23) we can see that, in the first place, that the greater level of credit risk is associated with lower geographical diversification. Furthermore, the interactions between these measures of risk and bank assets suggest that the higher level of risk increases the procyclicality of geographical diversification. In other words, the attempt to increase geographical diversification when bank assets are expanding increases when there are moments of higher risk. If geographical diversification allows better allocation of funds (Goetz, Laeven and Levine, 2014), then these correlations indicate the important defensive nature of procyclicality in the diversification of these activities.

5. Final considerations

In the last few years, the economics literature has provided evidence that banking activity is important for macroeconomic dynamics and that, in addition to these aggregate effects, banking activity may not be neutral from a regional perspective.

This article seeks to contribute to this debate by presenting the cyclicity patterns in the geographical distribution of banking activity. In order to do this, we based our analysis on a regionalized database of Brazilian banking activity, which allowed us to analyze the patterns of the geographical distribution of credit and other indicators in relation to each individual bank.

We provide evidence that the geographical distribution of credit follows a procyclical pattern. In other words, periods of expansion in banking activity are characterized by greater geographical diversification of bank lending.

The econometric estimates also demonstrate the heterogeneity of the different types of bank ownership, which suggests that, in the case of private banks, economic fluctuations intensify this cyclical behaviour. Lastly, the estimates support the hypothesis that the 2008 international financial crisis affected the dynamics of credit concentration. There is also evidence that geographical diversification diminished and became more procyclical in the years immediately after 2008.

The results are important in that they demonstrate that the cyclicity patterns in geographical diversification are affected by the level of risk. In particular, the estimated correlations seem to support the hypothesis of greater procyclicality in moments of higher risk. This behaviour may be related to the possibility of risk reduction resulting from greater geographical diversification in banking activity (Goetz, Laeven and Levine, 2014).

These results are consistent with previous results in the literature, which confirms the importance of banking activity for regional development. In particular, the cyclicity patterns presented above imply that episodes of credit contraction would be accompanied by greater regional concentration and potentially lower availability of bank funds in more isolated locations.

References

Acharya, V.; Hasan, I. & Saunders, A. (2006). Should banks be diversified? Evidence from individual bank portfolios. *The Journal of Business*, 79(3), 1355-1412.

- Adrian, T. & Shin, H.S. (2010). Liquidity and Leverage. *Journal of Financial Intermediation*, 19(3), 418-437.
- Agarwal, S. & Hauswald, R. (2010). Distance and private information in lending. *The Review of Financial Studies*, 23(7), 2757-2788.
- Aguirregabiria, V.; Clark, R. & Wang, H. (2016). Diversification of geographical risk and retail bank networks: Evidence from bank expansion after the Riegle-Neal Act. *RAND Journal of Economics*, 47(3), 529-572.
- Berger, A. & Udell, G. (2005). The institutional memory hypothesis and procyclicality of banking lending behavior. *Journal of Financial Intermediation*, 13(4), 458-495.
- Berger, A.; Miller, N.; Petersen, M.; Rajan, R. & Stein, J. (2005). Does function follow organizational form? Evidence from the lending practices of large and small banks. *Journal of Financial Economics*, 76(2), 237-269.
- Bernanke, B. & Gertler, M. (1989). Agency costs, net worth and business fluctuations. *American Economic Review*, 79(1), 14-31.
- Bernanke, B., Gertler, M. & Gilchrist, S. (1996). The financial accelerator and the flight to quality. *The Review of Economics and Statistics*, 78(1), 1-15.
- Bikker, J. & Metzmakers, P.A.J. (2005). Bank provisioning behaviour and procyclicality. *Journal of International Financial Markets, Institutions and Money*, 15(2), 141-157.
- Borio, C.; Furfine, C. & Lowe, P. (2001). Procyclicality of the financial system and financial stability: issues and policy options. *BIS Papers*. Bank for International Settlement (BIS), 1, 1-57.
- Boyd, J. & Prescott, E. (1984). Financial intermediary-coalitions. *Journal of Economic Theory*, 38(2), 211-232.
- Corrêa, V.P. (2006). Distribuição de agências bancárias e concentração financeira nas praças de maior dinamismo econômico – um estudo dos anos 1980 e 1990. In: Crocco, M. and Jayme Jr., F. (2006). *Moeda e Território: Uma Interpretação da Dinâmica Regional Brasileira*. Belo Horizonte: Editora Autêntica. pp: 169-210.
- Crocco, M.; Cavalcante, A.; Barra, C. & Val, V. (2006). Polarização regional e sistema financeiro. In: Crocco, M. and Jayme Jr., F. (2006). *Moeda e Território: Uma Interpretação da Dinâmica Regional Brasileira*. Belo Horizonte: Editora Autêntica. pp: 231-269.
- Crocco, M.; Santos, F. & Amaral, P.V. (2010). The spatial structure of financial development in Brazil. *Spatial Economic Analysis*, 5(2), 181-203.
- Deng, SE. & Elyasiani, E. (2008). Geographic diversification, bank holding company value, and risk. *Journal of Money, Credit and Banking*, 40(6), 1217-1238.
- Diamond, D. (1984). Financial intermediation and delegated monitoring. *Review of Economic Studies*, 51(3), 393-414.
- Fonseca, C.F. (2005). *Structure, Competition and Performance in Banking Sector with Heterogeneous Market* (in Portuguese) PhD Thesis. IPE/FEA/USP, São Paulo.
- Freixas, X. & Rochet, J-C. (2008). *Microeconomics of Banking*. Cambridge: The MIT Press.
- Gertler, M. & Kiyotaki, N. (2010). Financial intermediation and credit policy in business cycle analysis. In: Friedman, B. and Woodford, M. (2010). *Handbook of Monetary Economics*. Chapter 11. pp: 547-599.
- Goetz, M.; Laeven, L. & Levine, R. (2014). Does the geographic diversification of banks reduce risk?. *NBER Working Paper*. No. 20758.
- Kalemli-Ozcan, S.; Sorensen, B. & Yesiltas, S. (2012). Leverage across firms, banks and countries. *Journal of International Economics*, 88(2), 284-298.

- Kiyotaki, N. & Moore, J. (1997). Credit cycles. *Journal of Political Economy*, 105(2), 211-248.
- Meslier, C.; Morgan, D.; Samolyk, K. & Tarazi, A. (2016). The benefits and costs of geographical diversification in banking. *Journal of International Money and Finance*, 69, 287-317.
- Petersen, M. & Rajan, R. (2002). Does distance still matter? The information revolution in small business lending. *The Journal of Finance*, 57(6), 2533-2570.
- Rocha, B.P. & Nakane, M.I. (2008). Entries, exits and resource allocation: An analysis of the banking intermediation in Brazil. *Anais. Latin American and Caribbean Economic Association 13th Annual Meeting*. The Latin American and Caribbean Economic Association, LACEA. Rio de Janeiro.
- Rodrigues, T.A.P. (2013). *Assimetria de informação e conhecimento bancário local: Uma análise para os municípios brasileiros*. Master Degree Dissertation. CEDEPLAR/UFMG, Belo Horizonte.
- Sealey, C. & Lindley, J. (1977). Inputs, outputs and a theory of production and cost of depository financial institutions. *Journal of Finance*, 32(4), 1251-1266.
- Woodford, M. (2010). Financial intermediation and macroeconomics analysis. *Journal of Economic Perspectives*, 24(4), 21-44.

Appendix

Table 7: Determinants of Banking Geographical Diversification – Banking Deposits

Explicative variable	(1A)	(2A)	(3A)	(4A)
Total assets	-0.0148** (0.0036)	-0.0149** (0.0036)	-0.0197** (0.0042)	-0.0189** (0.0046)
Branches			9.28e-06 (0.0000)	9.44e-06 (0.0000)
Interest rate			0.00036 (0.0009)	0.00036 (0.0009)
GDP diversification			-0.1520 (1.5545)	-0.1530 (1.5553)
Economic growth			0.0004 (0.0014)	0.0061 (0.0129)
Asset x Growth				-0.0002 (0.0005)
Constant	0.598** (0.086)	0.629** (0.088)	0.8966 (1.5138)	0.8785 (1.5151)
Control for ownership type	No	Yes	Yes	Yes
Observations	987	987	880	880
R2	0.0187	0.0214	0.0351	0.0354
Number of institutions	116	116	114	114

Note: Standard deviation between parentheses. ** p<0.01, * p<0.05, + p<0.1.