Entries, Exits and the Resource Allocation:
An Analysis of the Banking Intermediation in Brazil

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Abstract

This work employs established concepts of Industrial Organization and Labor Economics in order to propose two new measures to characterize the Brazilian banking sector. The first one is called *Banking Turbulence Rate*. It shows the presence of a massive majority of municipalities with very low levels of banking intermediation. The second indicator is the *Net Absorption of Resources Rate* and it points to the dominance of deposit-raising operations in the Brazilian banking sector. Econometric models point to the local level of income and the degree of banking competition as main determinants of these banking indicators.

Keywords: industrial organization, Brazilian banking system and spatial econometrics.

JEL classification: L20; G21 and C31.

Resumo

Partindo de conceitos estabelecidos nas áreas de Organização Industrial e Economia do Trabalho, o presente trabalho propõe duas novas medidas para a caracterização do setor bancário no Brasil. O primeiro indicador, denominado *taxa de turbulência bancária*, mostra a presença de uma maioria maciça de municípios com baixíssimos níveis de intermediação bancária. A segunda medida é designada *taxa de absorção líquida de recursos* e indica que o sistema bancário no Brasil pode ser caracterizado majoritariamente pelas operações de captação, ou entrada de recursos. Os exercícios econométricos realizados permitiram associar estas medidas principalmente com a renda da localidade e com a concentração do setor bancário local.

Palavras-chave: organização industrial, sistema bancário brasileiro e econometria espacial.

Classificação JEL: L20; G21 e C31.

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1. Introduction

In general, the existence of financial intermediaries is justified by the possibility of efficiency gains in resource allocation. As an example, Diamond and Dybvig (1983) and Bryant (1980) proposed models in which, in addition to facilitating the allocation of savings and investment, the introduction of a financial market produces effective welfare gains.

The banking activity is found within this context of resource intermediation, which can be informally defined as "an institution whose current operations consist in grant loans and receiving deposits from the public*"* [Freixas and Rochet (1999): 1].

According to Freixas and Rochet (1999), the banking system fulfills its role in resource allocation by essentially lowering transaction costs. The authors argue that this objective can be reached thanks to the functions attributed to the banking system. In first place, banks offer liquidity services, allowing for the exchange of various currencies and the payment of the most diverse kinds of debts. In second place, these intermediaries allow for the transformation of assets as regards their denomination, quality and maturity. Another function of the banking system is to administer risk. Finally, banks have an important role in the monitoring of investors, mitigating the information problem inherent to the process of financial intermediation.

The definition proposed by Freixas and Rochet (1999) emphasizes two basic banking characteristics that make them crucial in resource allocation: raising and loaning financial resources. According to this concept, the banking system can be characterized by the flow of resource entry (raising resources) and exit (loaning resources). The principal objective of this work is to undertake an analysis of these basic attributes, thus creating a panorama of banking intermediation activity in Brazil. As the following chapter proposes to make clear, this characterization is similar to what already exists in other areas of the economic literature, such as Industrial Organization and Labor Economics.

In a first analysis, the gross flow of resources shall be considered, in other words, the simultaneous entry and exit of the economy's financial resources. This paper proposes a measure of *banking turbulence* that would summarize the level of intermediation in the banking system for a given locale. We then concentrate on the net flow of resources, considering the entry of savings, net of the volume of resources that have exited the economy. Thus, a measure of the *net absorption of resources* is suggested to assess the level at which the local banking sector activities are directed toward deposit-raising, as opposed to loans.

Based on these two measures and on statistics for 3,224 Brazilian municipalities, it is possible to develop a characterization of the banking system in Brazil. An econometric analysis will be undertaken with this aim and which shall explicitly consider the spatial dependence between the locales analyzed, avoiding the biases resulting from this kind of separation of figures.

In first place, the results show that the distribution of the banking turbulence in the municipalities is extremely asymmetric to the right. This evidence indicates the presence of a large number of municipalities with extremely low levels of banking turbulence and some municipalities featuring a relatively elevated level of banking turbulence. Furthermore, the econometric analysis undertaken allowed for the principal association of the banking turbulence rate with the level of income and banking competition.

The exercises also show that the banking system in Brazil can be mostly characterized by the deposit-raising operations, or entry of resources. Within the Brazilian regions, the figures seem to indicate the Southeastern region as being the main resource raising one in the country. The econometric exercises undertaken allow for the principal association of net resource raising with the locale's income and, on a smaller scale, with the concentration of the local banking sector.

This paper is composed of three other sections. Next it is presented a discussion regarding banking turbulence in Brazil. As well as presenting the proposed concept, the chapter describes the variable within the Brazilian municipalities, seeking to econometrically identify its principal determinants. The third chapter concentrates on the analysis of the net absorption of resources. Finally, the fourth chapter summarizes the main results arrived at.

2. Deposit-raising, Loans and Banking Turbulence

2.1 A definition of banking turbulence

The systematic analysis of net and gross resources flows indicators is nothing new. Several applications may be found in the areas of Industrial Organization and Labor Economics.

Within Industrial Organization, the term turbulence was introduced by Beesley and Hamilton (1984). In their paper, the authors were interested in proposing a measure of entrepreneur capacity in industry (seedbed role). According to the authors, this innovative spirit is supposedly associated to a trial and error process that translates into elevated rates of conception and, consequently, collapse of businesses. With the objective of capturing this scenario of simultaneous creation and destruction of companies, Beesley and Hamilton (1984) propose the measuring of turbulence given by the sum of the entry and exit rates of companies in a given industry. It should, however, be noted that this does not relate to a net flow of entries and exits of companies, but a gross flow that at the same time also involves the entries and exits of companies in the industry.

Several empirical papers make use of some measure of turbulence inspired by Beesley's and Hamilton's (1984) seminal concept. An important branch of literature that employs this concept seeks to explore the determining factors for the initial size of the installations of companies entering an industry. The argument for the importance of industrial turbulence as regards the size of the installations of entry companies is given through the consideration of sunk costs. The larger the sunk costs for a given industry, the smaller the initial size of the company entering it, as this minimizes the losses associated to an eventual closure. Among other factors, a company entering an industry is preoccupied with the size of the new market and the sunk costs associated with its entry. On the other hand, the exit of a company may have the increase in the concentration of the relevant market or the existence of low exit costs as determining factors. The simultaneous checking of elevated entry and exit rates of companies for a given industry will necessarily reflect, to a degree, the structure of its sunk costs. Therefore, if a given industry is said to be turbulent, its sunk costs will tend to be lower and the initial installation size of companies entering it will tend to be larger. This hypothesis has been tested and strong empirical support has been shown in papers by Mata and Machado (1996) for Portuguese companies and by Görg et al. (2000) for companies in Ireland.

For Brazilian data, the papers by Façanha and Resende (2004) and Resende (2005) may be cited. The first shows that the measures of turbulence used by the authors are not important discriminating factors among sectors of the manufacturing industry in Brazil. Resende (2005), in its turn, shows different evidence to that obtained by Mata and Machado (1996) and Görg et al. (2000), with the results showing little relevance for turbulence indicators as regards the initial installation size of companies entering Brazilian industry.

The Labor Economics literature constitutes another important branch that dedicates its efforts to the analysis of the entry and exit flow of workers. The interest in these flows is generally attributed to the fact that they reflect the degree of flexibility and, therefore, the capacity for the reallocation of economic resources. The flexibility of the labor market may be represented by the degree of turnover of its workers, which is, in principle, positive for the economy. There is, however, an ideal level of turnover of workers, above which the effects may begin to become undesirable. The argument generally used is that an excessive turnover rate of workers tends to induce smaller investment into training specific to the company. The result would be a lesser aggregation of human capital, culminating in a worsening of the quality in the work placements [Gonzaga (1998)].

The basic references in this regard are Davis and Haltiwanger (1992) and Haltiwanger and Vodopivec (1999), who propose measuring the net and gross flow of workers, which came to be characteristics of this literature. The rate of turnover for laborers proposed in these papers considers both the amount of jobs created and destroyed in relation to the amount of work placements for the previous period.

Gonzaga (1998) undertakes a diagnosis of the Brazilian labor market, stressing its elevated flexibility and capacity for generating new work placements. The principal problem raised by this author revolves around the low quality of the placements created, resulting in excessive labor turnover. Other papers regarding the nature and consequences of labor turnover in Brazil are those realized by Corseuil et al. (2002), Orellano and Picchetti (2005) and Menezes-Filho (2005).

For the present paper, the analogy is directly related to the industrial turbulence indicators and worker turnover rates. A banking system is characterized by the entry and exit of financial resources, such that a measure of the level of banking intermediation, that simultaneously considers resources stemming from deposit-raising and loans, can be proposed. The net flow of entry or absorption of resources is analyzed in the following section.

The total balance of deposits denotes the volume of resources raised at a given locale. This figure corresponds to the sum of private demand deposits (VP_{jt}), public demand deposits (VG_{jt}), private and public time deposits (PPG_{jt}) and savings (S_{jt}) collected at a given locale *j*:

$$DT_{jt} = VP_{jt} + VG_{jt} + PPG_{jt} + S_{jt}$$

The measure of the entry of resources into a given economy is designated the *entry of resources rate* and can be expressed by the equation below:

$$TE_{jt} = \frac{DT_{jt}}{E_{jt-1} + DT_{jt-1}}, \qquad (1)$$

where E_{jt} denotes the total balance of banking credit conceded in the locale *j* at moment *t*. What the measure above shows is the volume raised in an economy in relation to the total resources ($DT_{jt} + E_{jt}$) for the previous period.

By using an analogy, we can define the *exit of resources rate*, which denotes the volume of resources loaned in the economy in relation to the total of resources observed in the previous period:

$$TS_{jt} = \frac{E_{jt}}{E_{jt-1} + DT_{jt-1}}. \qquad (2)$$

The entry and exit of resources provide the sought after banking intermediation indicator. This measure of intermediation shall be called the *banking turbulence rate* and, according to the literature presented above, shall have the following equation:

$$TURB_{jt} = TE_{jt} \times TS_{jt}, \qquad (3)$$

where TE_{jt} and TS_{jt} are given by the equations (1) and (2), respectively.

Banking turbulence will therefore be elevated when a locale presents high resource entry and exit rates at the same time. The presence of an elevated resource entry (or exit) rate on its own does not attend the concept hereby proposed for banking intermediation. We understand that the crucial characteristic to be considered is the simultaneous occurrence of deposit-raising and bank loans. Below, we present an analysis of the banking turbulence figures for Brazil.

2.2 Banking turbulence in Brazil

The present paper uses the banking statistics report (ESTBAN) from the Brazilian Central Bank. As per the requirements of definitions (1), (2) and (3) above, the figures are in regard to the total balance of banking credit and deposits registered in December of 2002 and 2003.

The figures comprise all 5,560 municipalities registered by the IBGE (Brazilian Institute of Geography and Statistics) municipal network for 2002. Of this total, 10 municipalities that possessed bank branches in 2003, but did not in 2002, were excluded as the magnitudes defined in the previous chapter tend toward the infinite. The most significant cut, at the moment, corresponds to the 2,324 municipalities that had no bank branches in 2002 and 2003. These municipalities, with a zero balance of bank credits and deposits, are excluded due to the mathematical indetermination created in the construction of the resource entry and exit rates. Applying these observations results in a total of 3,226 municipalities that provide a portrait of banking intermediation in Brazil for the year 2003. Lastly, with the aim of focusing our analysis on real aspects that surround the banking intermediation phenomenon, the figures for 2003 were adjusted to present values using the IPCA (Consumer Price Index).

Before presenting the description of banking turbulence and its component rates for Brazil, it remains to highlight an important preliminary methodological aspect. The resource entry and exit rates are extremely sensitive to the volume of operations that make up the banking sector in the locale considered. As a result, municipalities with modest banking sectors may present elevated resource entry and exit rates, when in truth, what is being observed is the effect of reduced balances of credits and deposits offered by their banks.

The solution found for this problem follows Lemos et al. (2003), where a similar issue in the calculation of the importance of the tertiary sector in Brazilian micro-regions. Following the authors, we applied a corrective factor to the entry and exit rates that takes into account the size of the local banking sector in relation to a reference banking sector. The, almost obvious, procedure adopted for the case of banking intermediation was to compare the total amount of bank credits and deposits for each locale *j* to the volume of these resources for the municipality of São Paulo (indicated by *SP*), the country's largest financial center. The corrective factor to be applied in a multiplicative manner is:

$$F_{jt} = 1 - exp[ln(0.05) \times (\frac{E_{jt-1} + D_{jt-1}}{E_{SPt-1} + D_{SPt-1}})] \qquad (4)$$

The above equation makes it clear that the correction multiplies the values of the reference locale by a factor of 0.95. The factor presents decreasing values in the measure in which the total bank credit and deposit volume of a given locale becomes smaller in relation to that for the municipality of São Paulo (SP).

Thus, we have new expressions for the resource entry and exit rates, adjusted by the total credits and deposits accounted for in the locale:

$$TEA_{jt} = F_{jt} \times TE_{jt} \qquad (5)$$

$$TSA_{jt} = F_{jt} \times TS_{jt} \qquad (6)$$

where F_{jt} is defined by equation (4).

Table 1 presents some descriptive statistics of the banking resource entry and exit rates. The entry and exit rates are shown without the application of the corrective factor, which implies significant changes. In first place, as could be reasonably expected, the corrective factor provokes a reduction in the variable distribution scale, which results in smaller values for all the statistics regarding the corrected variables. It is also worth emphasizing that values larger than the unit, common in the case of non-adjusted entry and exit rates, are eliminated after the application of correction (4). In relation to the statistics obtained, it should be mentioned that the Brazilian banking system is characterized by behavior in which deposit-raising stands out more than loans, judging by the higher entry rate observed in the sample.

Table 1 - Descriptive statistics: entry and exit rates, 2003

	Entry rate	Adjusted entry rate	Exit rate	Adjusted exit rate
Minimum	0.0822371	0.0000010	0.0117367	0.0000002
Maximum	3.4768992	0.4035106	3.7509501	0.4821699
Average	0.6052001	0.0009662	0.4299029	0.0008602
Median	0.5951265	0.0000807	0.3966893	0.0000768
Standard Dev.	0.2240835	0.0107660	0.2507314	0.0110405

Table 3 shows the ranking of Brazilian municipalities possessing the highest resource entry rates (adjusted). Yet again, the difference caused by the application of the corrective factor should be noted. Without it, the municipality of Nova Alvorada do Sul (MS) presents the highest resource entry rate (3.48), followed by other small scale municipalities. The explanation for this result seems to be a case of the direct influence of reduced amounts collected in deposits and credits. For 2002, Nova Alvorada do Sul (MS) possessed only 0.002% of the volume of bank deposits and credits registered for the municipality of São Paulo (SP), the country's largest financial center, which only appears in 2,587th place in the ranking. Thus, the suitability of considering the relative importance of each municipality, as intended by factor (4), becomes clear. The ranking obtained for the adjusted entry rate presents the municipalities of São Paulo (SP), Rio de Janeiro (RJ), Brasília (DF) and Belo Horizonte (MG) as the largest resource raising ones, in that order.

The ranking obtained for the resource exit rate can also be seen in Table 3. Without considering the adjustment through the relative importance of the municipality we would, once again, see the predominance by small cities with São Paulo (SP) appearing in a modest 1,028th position. After correction, the ranking shows São Paulo (SP), Osasco (SP), Rio de Janeiro (RJ) and Brasília (DF) at the top of the banking resource exit rates ranking. According to the previous discussion, we can define the rate of banking turbulence by the equation below:

$$TURBA_{jt} = F_{jt} \times TURB_{jt} \, . \qquad (7)$$

Table 2 presents a description of the adjusted and non-adjusted banking turbulence rate, included simply for the purposes of comparison. It is possible to, once more, note that the correction fully reduces the turbulence distribution, furthermore limiting its values to the 0 to 1 interval. However, what springs to attention in Table 2 is the evident asymmetry to the right existing in the banking turbulence variable distribution. This fact may be verified by the value for the median, which is ten times smaller than that for the average, which is a non-robust measure of central tendency in the presence of extreme values, which appears to be the case. Figure 1 illustrates this fact.

Table 2 - Descriptive statistics: banking turbulence rate, 2003

	Turbulence rate	Adjusted turbulence rate
Minimum	0.002053090	0.000000039
Maximum	12.764086297	0.204800698
Average	0.226286442	0.000407987
Median	0.221760049	0.000037472
Standard Dev.	0.273528979	0.004852409

Thus, we can highlight a noticeable characteristic of banking intermediation in Brazil. In general terms, there is a low pattern of banking turbulence for the majority of Brazilian locales, which contrasts with the existence of a few large centers demonstrating greater banking activity. Table 3 shows a ranking that lists the large banking intermediation centers of Brazil. Of note are, once again, the municipalities of São Paulo (SP), Rio de Janeiro (RJ), Brasília (DF) and Belo Horizonte (MG).

Table 3 - Municipality rankings: entry, exits and turbulence rates, 2003

Ranking	Adjusted entry rate		Adjusted exit rate		Adjusted turbulence	
	Name	Rate	Name	Rate	Name	Rate
1	São Paulo	0.4035106	São Paulo	0.4821699	São Paulo	0.2048007
2	Rio de Janeiro	0.3000193	Osasco	0.2265753	Rio de Janeiro	0.1080470
3	Brasília	0.2184611	Rio de Janeiro	0.1977390	Brasília	0.0935334
4	Belo Horizonte	0.1473627	Brasília	0.1571678	Belo Horizonte	0.0638348
5	Curitiba	0.1227670	Curitiba	0.1042315	Curitiba	0.0569644
6	Porto Alegre	0.1145846	Belo Horizonte	0.0986134	Porto Alegre	0.0493288
7	Fortaleza	0.0799107	Porto Alegre	0.0920737	Campinas	0.0222192
8	Salvador	0.0578869	Barueri	0.0606197	Fortaleza	0.0217437
9	Recife	0.0506143	Campinas	0.0588150	Salvador	0.0209582
10	Campinas	0.0425785	Salvador	0.0442076	Osasco	0.0186329

Finally, to finish this first descriptive approach, we have Table 4 and some statistics for the banking turbulence rate for the Brazilian regions. One of the first aspects to note is that the asymmetry of the distribution repeats itself for the Brazilian regions, seeing as the median is, in all cases, approximately ten times smaller than the average, indicating a minority of municipalities with elevated banking turbulence. Also of note is the higher banking intermediation noted for the Southeastern, Southern and Central Western regions, with an average banking turbulence rate almost twice as large as that seen for the North and Northeastern regions.

Table 4 - Descriptive statistics: banking turbulence by Brazilian regions

	Northern	Northeastern	Southeastern	Southern	Center Western
Minimum	0.000000247	0.000000275	0.000000039	0.000000133	0.000000073
Maximum	0.008531900	0.021743700	0.204800700	0.056964400	0.093533400
Average	0.000230200	0.000189100	0.000585400	0.000312500	0.000549200
Median	0.000040300	0.000022400	0.000042000	0.000051300	0.000055500
Standard Dev.	0.000885900	0.001387600	0.006878500	0.002686400	0.005667600
Number of Obs.	145	727	1,259	816	279

Having presented the initial characterization of the problem, we now go on to discuss the variables that have a relevant role in the explanation of the banking turbulence rate in Brazil.

2.3 The determinants of banking turbulence in Brazil

The Brazilian banking system has been the object of extensive analysis over the last years, with a variety of papers having dealt with the subject.

Nakane (2002) and Fonseca (2005) are part of the literature that seeks to analyze the structure of the prevailing market in Brazil. Nakane (2002) finds evidence of a situation of imperfect competition in the Brazilian market, although the hypothesis of a cartel can be rejected.

Fonseca (2005), in turn, empirically supports his hypothesis that the heterogeneity of the demanding agents for banking services allow for a larger segmentation of services, thus increasing the market power of the banks.

The hypothesis raised herein is that the banking turbulence rate can be influenced by aspects related to the banks' supply, especially the structure of the prevailing market. In this regard, some indicators of banking competition and heterogeneity of the demanding agents, such as those proposed by Fonseca (2005), will have their influence tested in the models presented below.

Issues more directly associated with the demand for banking services shall also be included in the econometric models. The objective shall basically be to assess the influence of the large scale or density of the market on the level of banking intermediation.

Bearing these hypotheses in mind, the following section briefly presents the econometric methodology used. It is a class of models able to incorporate the question of spatial dependence, a phenomenon frequently present in municipal figures, such as those analyzed here.

2.3.1 Methodology

The database used for this paper constitutes the realizations of stochastic processes in space. This kind of data, common in problems applied of regional and urban economics, has as its principal characteristic the presence of dependency and spatial heterogeneity[1]. Dismissing these characteristics, the econometric analysis can create inefficient inferences or even inconsistent ones. An autonomous research field, given the generic name, spatial econometrics[3], arose from dealing with these problems.

This statistical problem may have a variety of diverse origins. According to that reported by Anselin (1988), spatial dependence may be the consequence of measuring errors caused by arbitrary definition of geographical units, problems in the grouping of variables and the presence of external factors and spatial spillovers. Furthermore, the author emphasizes that the most relevant aspect is related to the spatial structure inherent to the problem, which could give rise to complex interactions between the component units analyzed [Anselin (1988): 8]. As a consequence, a linear regression model that does not incorporate these aspects can present spatially dependent errors and, as in the case of autocorrelation in time series, would invalidate all the inference.

The analogy to the time series literature is direct. In this case, we have regression errors correlated at different points in time. The spatial autocorrelation, in turn, relates to correlation of errors at different points in space. What makes the analogy difficult is the notion of proximity, which for spatial problems may assume less obvious contours.

Normally, the notion of proximity and, therefore, the quantification of the spatial dependence are carried out with the use of a matrix of spatial weights, *W*. There are many ways suggested in the literature for the construction of the matrix, *W*. The general condition required is that its elements obey the definition of a function of distance:

(i) $w(i,j) > 0, \ \forall\, i \neq j.$

(ii) $w(i,i) = 0.$

(iii) $w(i,j) = w(j,i).$

(iv) $w(i,j) \leq w(i,h) + w(h,j), \ \forall\, i,j$ *and* h.

Having defined a notion of proximity, a linear regression model that presents its errors spatially dependent, would present problems with the inference on its estimated parameters. A first attempt to circumvent this problem is to explicitly model the dependence existing in the error term for the sectional units. The Spatial Error Model (SEM) considers the case of first order autocorrelation of regression errors:

$$\begin{aligned} Y &= X\beta + u \\ u &= \lambda W u + \varepsilon, \ \varepsilon \sim N(0, \sigma^2 I_n) \end{aligned} \qquad (8)$$

Where Y is a vector containing the elements of the dependent variable, X is a matrix $(n+1)\times k$ of explicative variables and a constant, with β as a vector $(k+1)\times 1$, containing the parameters associated with X, W is the matrix $n\times n$ of spatial weights and λ is the spatial dependence parameter.

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[1] Although, as mentioned above, the spatial heterogeneity is one of the fundamental issues of spatial econometrics, the analysis carried out only emphasizes spatial dependency.

[3] A good reference in this regard and one that is extensively cited throughout this paper, is Anselin (1988). Another reference with a more applied focus is LeSage (1999).

The model (8) is only a first effort to incorporate the question of spatial dependence into the regression model. Instead of concentrating on the specific modeling of regression errors, we could propose other econometric models based on a general view of the problem. Taking this approach, the spatial dependence should be incorporated as a principal element of the modeling that, when not considered, creates the error autocorrelation problem. Therefore, we would go from the general to the specific.

In this sense, we could present the Spatial Auto-Regressive (SAR) model:

$$\begin{aligned} Y &= X\beta + u \\ u &= \rho WY + \varepsilon,\ \varepsilon \sim N(0,\sigma^2 I_n) \end{aligned} \qquad (9)$$

The model (9) includes as an explicative variable the spatial lag of the dependent variable, *WY*, with ρ as the coefficient of spatial dependency in this case. Another model, called the Spatial Durbin Model (SDM), generalizes (9) by incorporating a spatial lag for the explicative variables, *WX*:

$$\begin{aligned} Y &= X\beta + u \\ u &= \rho WY + \alpha WX + \varepsilon,\ \varepsilon \sim N(0,\sigma^2 I_n) \end{aligned} \qquad (10)$$

Where α is the vector of coefficients $k \times 1$ associated to the neighboring variables.

Should the real data generating process be (9) or (10), the estimate by Ordinary Least Squares (OLS) that does not consider *WY* and *WX* would gain biased and inconsistent estimators. The parameters for (8), (9) and (10) can be estimated by Maximum Likelihood, according to that presented by Anselin (1988).

As the last methodological step, it remains to describe the tests to be realized to detect the presence of spatial autocorrelation in the errors of the classical linear regression model. This model, which serves as a null hypothesis and a base for the following tests, is constituted by (8) for the particular case where spatial autocorrelation is not considered, in other words, λ=0.

The most common test for checking the null hypothesis of spatial non-autocorrelation of errors, to be implemented, is the Moran *I* test:

$$I = \frac{e'We}{e'e} \sim N(E(I), Var(I)) \qquad (11)$$

Where *e* is the series of residuals estimated for the OLS regression in the base model without considering spatial autocorrelation[4]. The Moran I test is, without doubt, that most used in empirical literature. However, there is another class of tests that is also widely used for checking spatial autocorrelation. These are the combination of asymptotic Wald, Lagrange Multipliers (LM) and the Likelihood Ratio (LR) tests, which can be constructed based on the Log-Likelihood of the models above. Whilst the Moran test does not postulate a specific alternative hypothesis – it only accepts or rejects the null hypothesis – these asymptotic tests consider the Spatial Error Model as the alternative[5].

2.3.2 Estimation strategy

The next step in our methodological construction is the definition of a strategy for the linking of the econometric models and spatial dependency tests just presented.

In first place, the OLS model, equivalent to (8) under the restriction $\lambda = 0$, shall be estimated. This model will function as a basis of reference for the analysis of explicative variables, in terms of direction and the magnitude of the effects indicated by the coefficients obtained. Then, the Moran I test, defined in (11), is carried out on the residuals of the OLS model for the evaluation of the null hypothesis of non-existence of spatial autocorrelation. If the null hypothesis cannot be rejected, there shall be no support for the model's specification error, postulated in the form of the alternatives presented in (8), (9) and (10) and the OLS results may be considered robust to the biases resulting from spatial autocorrelation.

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[4] The derivation of the Normal distribution parameters can be seen in Anselin (1988).

[5] Further discussion can be found in Anselin (1988).

In the case of the rejection of the null hypothesis of the inexistence of spatial correlation, two procedures, inspired in the treatment of the problem corresponding to time series, are used to try to model the spatial dependency[6]. The first attempt stems from the idea that the autocorrelation existing in the OLS regression residuals is the result of a more general problem, associated to a poor model specification. In this sense, we started with the general, elaborating a parametric correction for the model in order to eliminate a specific problem of spatial correlation.

The less obvious issue is defining which correction should be implemented. In this sense, an alternative is the use of the SAR model, defined in (9), assuming that the spatial lag dependent variable omitted from the OLS regression is able to solve the spatial correlation problem. From the economic point of view, the rationale behind this correction could be associated with a regional performance strategy of the banking system [see, for example, Sanches, Rocha and Silva (2009)], making the consideration of banking transactions in neighboring municipalities relevant to the analysis of a given locale.

Following this procedure, the next step is the verification of the efficiency of the correction undertaken to eliminate spatial autocorrelation. Thus, the SAR model regression residuals are tested for the occurrence of first order autocorrelation:

$$Y = X\beta + u$$
$$u = \rho W_1 Y + \lambda W_2 u + \varepsilon,\ \varepsilon \sim N(0, \sigma^2 I_n) \quad (12)$$

This model, used as an alternative equation to SAR, is known as the Spatial Autocorrelation Model (SAC). As can be seen, it combines the properties of spatial dependence from the SAR and SEM models.

The evaluation of spatial autocorrelation in the residuals of (9), in the manner postulated in (12), is given through a specific LM test proposed by Anselin (1988).

$$LM = \left(\frac{e' W_2 e}{s_0^{\,2}}\right)^2 . \{T_{22} - (T_{21A})^2 . var(\rho)\}^{-1} \sim \chi^2(1) \quad (13)$$

Where $T_{22} = tr\{W_2.W_2 + W_2'.W_2\}$, $T_{21A} = tr\{W_2.W_1.A^{-1} + W_2'.W_1.A^{-1}\}$ and $A = I - \rho W_1$. Furthermore, $var(\rho)$ and s_0^2 are the estimated variances of ρ and of the SAR regression, as well as the residuals of the SAR regression, whilst W_1 and W_2 are matrices of spatial weights established for the SAC model, defined in (12).

If the LM test does not indicate the rejection of the null hypothesis of the absence of spatial autocorrelation, the correction introduced with the SAR model is sufficient to treat the spatial dependency not caught by the OLS model. If the opposite holds true, the modeling is expanded to other spatial controls. The option attempted is constituted by the SDM model, presented in (10), which introduces the explicative variables spatially lagged as additional controls. Along the course of the work, the SDM model regression residuals will have the presence of spatial autocorrelation tested using the Moran I test statistic, presented in (11).

The second alternative for the resolution of spatial autocorrelation captured in the OLS model residuals is the direct modeling of these components using the SEM model, given in (8). This strategy differs from the one previously laid out as it concentrates on the specific modeling of the residuals, without worrying about a more general characterization of the problem, such as the specification of the model or the functional form used.

Therefore, the estimation process to be followed in this paper can be summarized by the five steps presented below:

1. OLS model estimation;

2. Testing of the regression residuals;

[6] For a discussion regarding the treatment of autocorrelation in temporal series, see Davidson and McKinnon (1996).

3.a. If the null hypothesis of the absence of spatial autocorrelation in (2) is rejected, an estimation of the SAR model follows;

(i) Testing of the regression residuals;

(ii) If the null hypothesis of the absence of spatial autocorrelation in (i) is rejected, an estimation of the SDM model follows;

3.b. If the null hypothesis of the absence of spatial autocorrelation in (2) is rejected, an estimation of the SEM model follows;

Once the econometric line to be followed is established, the next section describes the variables used in the regressions, as well as the main results obtained.

2.3.3 Description of the variables and results

In accordance with that previously discussed, the demand is represented here by the element of market size and quality and influences the banking intermediation process in the measure that it can allow different business opportunities for the sector. For this purpose, the GDP will be used as the principal indicator of market potential.

The supply side of the banking sector shall be represented, in its turn, by the attributes that would be capable of influencing the level of banking competition. According to the discussion found in Fonseca (2005), the heterogeneity of demand for banking services shall be the determining factor and three dimensions for this differentiation shall be used. In first place, the differentiation of the local economic structure is considered, represented by the sum of the squares of the share of the sectors in the composition of the aggregate value in the economy. The *Diversification* variable is calculated using the following equation:

$$Diversification_{jt} = \frac{VAP_{jt}^2 + VAS_{jt}^2 + VAT_{jt}^2}{VT_{jt}^{\ 2}},$$

where VAP_{jt}, VAS_{jt} and VAT_{jt} represent the added value in the primary, secondary and tertiary sectors, respectively, whilst VT_{jt} is the total added value for the municipality *j* for the period *t*.

Another dimension considered for the differentiation of the demand for banking services refers to the heterogeneity in the income distribution of individuals. Thus, the indicator of inequality of income *Gini* is included in the regressions below. Finally, the banking density per municipality is considered, through the ratio between the number of branches and the municipality's total area (*Branches/Area*).

Some control variables are added to the regressions. The *Agriculture* variable is constructed through the importance of the agricultural sector to the municipality, relative to the importance of this sector to Brazil as a whole: $Agriculture_{jt} = \frac{VAP_{jt}}{VT_{ij}} / \frac{VAP_{Brazilt}}{VT_{Brazilt}}$, where $VAP_{Brazilt}$ and $VT_{Brazilt}$ represent the added value in agriculture and for the entire Brazilian economy for period *t*. This variable is included to capture the impact of governmental transfers of credits aimed at this sector. The regressions also include the Human Development Indicator (HDI), a dummy variable indicating whether the municipality is the capital of the state (*Capital*) and five other dummies for the Brazilian regions. To minimize eventual endogeneity problems all the explicative variables were constructed for the year 2002[7]. The necessary hypothesis of identification, hence, is that the explicative variables in 2002 are not influenced by the turbulence rate identified for 2003.

[7] The Gini index and HDI are available for 2000. Furthermore, we used the number of branches in 2003, under the hypothesis that this magnitude is given for the determination of banking turbulence.

The source of data for the construction of the sample is the IBGE[8]. With the exception of the dummy variables, all the variables involved in the models are transformed by the natural logarithm[9]. The aim of this operation is to eliminate the asymmetry of the dependent variable, as well as obtain an interpretation of the elasticity for the estimated coefficients.

Finally, it is necessary to present the definition of the matrix, *W*, of spatial weights, used. This paper makes use of a normalization of the matrix of the inverse of the distances between the Brazilian municipalities' centroids. The distances, in their turn, were constructed using the Euclidean distance calculated from the longitude and latitude coordinates for each locale:

$$\begin{cases} w(i,j) = \dfrac{d_{ij}}{\sum_j d_{ij}}, \forall i \neq j \\ w(i,j) = 0, \text{otherwise.} \end{cases}, \text{ where: } d_{ij} = \frac{1}{\sqrt{(latitude_i - latitude_j)^2 + (longitude_i - longitude_j)^2}}$$

For the realization of the spatial autocorrelation tests in the SAR model, where it was necessary to specify a second matrix of spatial weights for the spatial autocorrelation prevalent in the regression residuals, an alternative definition is used for the construction of the matrix, W_2:

$$\begin{cases} w(i,j) = \dfrac{d_{ij}}{\sum_j d_{ij}}, \forall i \neq j \\ w(i,j) = 0, \text{otherwise.} \end{cases}, \text{ where: } \begin{cases} d_{ij} = 1, \text{if the distance between the municipalities (i, j)} \leq 100 \text{ Km.} \\ d_{ij} = 0, \text{otherwise.} \end{cases}$$

In the presentation of the results, we will start with the description of the models used in the estimations, followed by a discussion of the estimates obtained using the econometric models.

Table 5 presents the results of the OLS regressions. As defined in the estimation strategy recently presented, the Moran test shows the rejection of the null hypothesis of the absence of spatial autocorrelation.

These results necessitate the incorporation of the issue of the dependency that exists among the Brazilian municipalities into the analysis. This should be done to avoid the problems related to the efficiency and even the consistency of the desired estimators. Initially, this is undertaken in the SAR regression, also presented in Table 5, together with the SAR LM test that evaluates the existence of spatial autocorrelation in the model's residuals. Yet again, the null hypothesis is rejected, indicating the insufficiency of the inclusion of the lag dependent variable to eliminate the spatial autocorrelation not considered in the OLS model.

Thus, following the spatial autocorrelation modeling strategy, Table 5 shows the regressions with the Durbin model (SDM), aiming to broaden the spatial controls, and the Spatial Error Model (SEM), which constitutes a second alternative for treating the problem.

This table, as previously explained, presents the Moran I test for the autocorrelation of the SDM residuals. As can be seen, even with the additional controls inserted in the model, the hypothesis of spatial non-dependence can be rejected, thereby making the possibility of using the alternative presented by the SEM model a useful option.

In this regard, Table 5 shows that the three asymptotic tests undertaken (Wald, LM and LR) present exact levels for the non-rejection of the null hypothesis (P-value) at virtually zero. As discussed in section 2.3.1, these tests consist of the verification of the null hypothesis of spatial non-autocorrelation, using as an alternative model the SEM. Therefore, this result emphasizes the suitability of the unrestricted SEM

[8] All the information used in the paper could be obtained from the Institute's municipal database. For more information, please access www.ibge.gov.br.

[9] For the variable, *Agriculture*, 19 municipalities received values equal to zero as they had no GDP for 2002. Furthermore, two municipalities were eliminated from the sample as they lacked HDI and Gini index values.

model for the modeling of spatial autocorrelation in relation to the restricted model represented by the OLS regression.

Table 5 - Determinants of banking turbulence, 2003

Explicative variables[2]	Model used[1] OLS	SAR	SDM	SEM
ρ		0.102 (0.000)	0.982 (0.000)	
λ				0.988 (0.000)
GDP	1.184 (0.000)	1.179 (0.000)	1.228 (0.000)	1.197 (0.000)
Diversification	-1.089 (0.000)	-1.092 (0.000)	-1.220 (0.000)	-1.140 (0.000)
Gini	2.826 (0.000)	2.865 (0.000)	2.699 (0.000)	2.872 (0.00)
Branches/Area	0.198 (0.000)	0.196 (0.000)	0.309 (0.000)	0.226 (0.000)
Agriculture	0.081 (0.000)	0.080 (0.000)	0.054 (0.038)	0.078 (0.000)
HDI	2.806 (0.000)	2.740 (0.000)	2.207 (0.000)	2.591 (0.000)
Capital	-0.128 (0.461)	-0.101 (0.671)	-0.670 (0.004)	-0.169 (0.467)
Dummy Region	Yes	Yes	Yes	Yes
Neighboring Locales				
GDP			-1.502 (0.000)	
Diversification			6.968 (0.000)	
Gini			-12.281 (0.000)	
Branches/Area			-1.748 (0.000)	
Agriculture			-0.040 (0.832)	
HDI			6.762 (0.169)	
Capital			-32.911 (0.000)	
Dummy Region			Yes	
Moran I Test	27.776 (0.000)		9.132 (0.000)	
SAR LM Test		378.29 (0.000)		
Wald Test				25.881 (0.000)
LM Test				467.693 (0.000)
LR Test				116.547 (0.000)
Number of Observations	3,224	3,224	3,224	3,224
Adjusted R^2	0.698	0.696	0.625	0.709
Log-Likelihood	-3,877.700	-3,877.304	-3,752.601	-3,819.689
Restrictions test (χ^2): **H_0: non-significant explicative variables**	14,325 (0.000)	13,627 (0.000)	13,908 (0.000)	10,487 (0.000)

Note: P-value between parentheses. [1] All the models were estimated with a constant not reported in the above table. [2] Dependent and explicative variables transformed by the natural logarithm, with the exception of the dummies variables for capital and region.

Concentrating on the estimated results, it should be noted that these seem to be consistent between the different specifications, generally maintaining both the direction as well as the significance of the analyzed relationships. In the general scope of the models used, three main results deserve to be highlighted.

In first place, it should be emphasized that, even after the inclusion of the control variables, there is an elevated spatial dependence as attested by positive and significant parameters estimated for λ and ρ. In other words, banking turbulence is an economic attribute that cannot be taken in isolation for a given locale. It is necessary to consider the degree of banking intermediation in the neighboring locales, but not only for the strong spatial persistence of these municipalities' economic characteristics, seeing as the SDM model's spatial coefficient is statistically significant. In this way, banking turbulence's spatial dependency also results in an issue associated to the performance of the banks. An explanation for this phenomenon could be the existence of economies of scale in the provision of banking services. In this case, it could be economical, from the point of view of operating costs, to extend the services to a network of neighboring municipalities, where the performance could be facilitated by the sharing of common activities, such as all the administrative management.

In second place and as regards the variable *GDP*, we have a sign that is positive and significant to 1%, showing that increases in the scale and the quality of the demand for banking services tend to be followed by an increase in intermediation. As regards the other controls included, it could be said that the municipalities with elevated shares relative to the agricultural sector and HDI present greater turbulence. Furthermore, the dummy variable for *capital* was shown to be statistically significant only in the SDM model, presenting an unexpected negative coefficient.

Another important result is that the negative coefficient for the variable, *Diversification*, seems to indicate that a diversified economic structure and one which has more possibility of banking segmentation is associated to lower levels of banking turbulence. The same happens for the variable *Gini index* where the positive sign obtained shows that an elevation in the distribution of income and, therefore, the possibility of market segmentation, is followed by a fall in banking turbulence. Finally, the variable, *Branches/Area*, presents a positive coefficient, indicating that an increase in the density of bank branches in a given locale causes more banking turbulence. Hence if we take these variables as indicators of the possibility of banks exercising market power, these results support the hypothesis that an increase in competition in the banking sector tends to create an increase in the turbulence rate.

Also worthy to be noted is the evidence obtained in the specific context of the SDM model. As pointed out in the previous section, this model considers as additional explicative variables a weighting of the observed variables in the collection of a locale's neighbors. With the exception of the variables *Capital*, discussed below, and *HDI*, which is statistically insignificant, all the signs for the coefficients described above present contrary signs when regards the locale's neighbors. This result seems to show an interesting aspect of banking strategy: the effect of the increase in demand and competition is mitigated if the municipality is located next to other municipalities where similar increases have also been tried. In other words, an increase in the income and competition of a determined locale does not just increase its own banking intermediation, but also reduces, *ceteris paribus*, the intermediation of its surrounding neighborhood.

Another important result regarding neighboring banking behavior is obtained by the negative and significant coefficient associated with the variable *Capital*. As can be seen, the level of banking turbulence is lower if a given municipality neighbors a state capital. This result emphasizes the importance of the state capitals as providers of banking services to their neighboring municipalities.

3. Deposit-raising, Loans and Net Absorption of Resources

3.1 A definition of net absorption of resources

Whilst the previous chapter sought to analyze the gross entry and exit flow of banking resources, this one concentrates on the net entry of resources. This is given, similarly to that previously proposed, by the ratio between the economy's resource entry and exit rates:

$$TLA_{jt} = \frac{TE_{jt}}{TS_{jt}}. \quad (14)$$

This measure is called the *net absorption of resources rate*, indicating the capacity for raising resources for a given locale, *vis-à-vis* the bank loans realized within it. Using the definitions given in (1) and (2), we can describe the net absorption of resources as:

$$TLA_{jt} = \frac{DT_{jt}}{E_{jt}}, \quad (15)$$

which is simply the ratio between the total deposits and the bank loans realized in locale *j*.

If this ratio is larger than one, we have an indication that the locale in question absorbs net resources, in other words, presents a resource entry flow greater than its exit flow. The opposite happens when the net absorption of resources rate is lower than one.

3.2 Net absorption of resources in Brazil

This section uses the same set of figures described in the empirical analysis of the banking turbulence rate. Here, the advantage is that, given the nature of indicator (14), we can obtain the net absorption rate for both years of the sample: 2002 and 2003.

Table 6 presents the principal descriptive statistics for the net absorption of resources in Brazil and within its constituent macro-regions. As can be seen, for 2002, the average net absorption is 3.43 for Brazil, indicating an absorbing position in which the raising of resources is predominant. This evidence, together with the prevalence of the resource entry rate shown in the previous section, highlights the previously alluded to resource raising character of the Brazilian banking system.

This predominance of resource raising operations is also observed in the Brazilian regions, which present an average net absorption greater than one. This measure, however, is not robust for aberrant values and this seems to be the case, as can be seen by the elevated maximum values presented by the resource absorption measure. The municipality of Cipotânea, in the state of Minas Gerais, for example, presents a volume of bank deposits 184 times higher than bank credits. The analysis of the median, suitable for these cases, indicates the same tendency for the absorption of resources, although the lower values highlight the previously emphasized asymmetrical distribution to right. The exception is the Central Western region, which appears to behave more as a net loaner of resources.

The same pattern of results is observed for the year 2003, with the exception of a small fall in the average values of the net absorption of resources. As can be seen, this fall is basically due to a reduction in the extreme values of the net absorption of resources.

Table 6 - Descriptive statistics: net absorption of resources, 2002 and 2003

	Minimum	Maximum	Average	Median	Standard Dev.	Number of Obs.
Year: 2002						
Northern	0.3133	78.4003	5.0080	1.5873	10.9775	141
Northeastern	0.1501	130.0131	4.2583	1.7080	9.1862	723
Southeastern	0.0763	184.8378	4.0248	2.1697	7.5109	1,246
Southern	0.1452	26.5252	2.3178	1.4326	2.5111	816
Central Western	0.0954	8.0957	1.0896	0.5961	1.2287	279
Brazil	**0.0763**	**184.8378**	**3.4306**	**1.7080**	**7.0094**	**3,205**
Year: 2003						
	Minimum	**Maximum**	**Average**	**Median**	**Standard Dev.**	**Number of Obs.**
Northern	0.2141	33.6654	3.0412	1.2143	5.3289	141
Northeastern	0.1385	62.3680	3.5467	1.5138	6.8370	723
Southeastern	0.0791	81.4931	3.8005	1.9186	6.1009	1,246
Southern	0.1286	17.9395	1.8963	1.1985	2.0816	816
Central Western	0.0966	32.7326	1.0719	0.5338	2.2871	279
Brazil	**0.0791**	**81.4931**	**2.9875**	**1.4852**	**5.3614**	**3,205**

For an additional characterization of this variable in Brazil, we followed with the assistance of an indicator created for the net absorption of resources based on (15):

$$IAL_{jt} = \begin{cases} 1, \text{ if } \ \text{TLA}_{\text{jt}} > 1 \\ 0, \text{ otherwise.} \end{cases} \quad (16)$$

Thus, an index $IAL_{jt} = 1$ indicates that the municipality j is a net absorber of resources at moment t. The table 7 presents the description of this indicator for the sample of Brazilian municipalities for 2002 and 2003.

Table 7 - Descriptive statistics: indicator of net absorption of resources, 2002 and 2003

	Minimum	Maximum	Average	Median	Standard Dev.	Number of Obs.
Year: 2002						
Northern	0	1	0.7659	1	0.4249	141
Northeastern	0	1	0.7787	1	0.4154	723
Southeastern	0	1	0.8627	1	0.3442	1,246
Southern	0	1	0.6568	1	0.4750	816
Central Western	0	1	0.3046	0	0.4611	279
Brazil	**0**	**1**	**0.7385**	**1**	**0.4395**	**3,205**
Year: 2003						
Northern	0	1	0.5957	1	0.4925	141
Northeastern	0	1	0.7469	1	0.4351	723
Southeastern	0	1	0.8226	1	0.3821	1,246
Southern	0	1	0.5796	1	0.4939	816
Central Western	0	1	0.2939	0	0.4563	279
Brazil	**0**	**1**	**0.6877**	**1**	**0.4635**	**3,205**

As this is an indicator, the average value of 0.74 obtained for Brazil for 2002, indicates that, on average, 74% of Brazilian municipalities are net raisers of resources. Contrary to this general characterization, the picture seems to vary greatly as regards the Brazilian regions, with the average value for the indicator oscillating significantly. It can be noted that, in this regard, with the exception of the Northern region, all the regions have a hypothesis of equality with the Brazilian average, rejected at 1%. In this sense, the Southeastern region appears as the largest raiser of resources in Brazil, followed by the Northeastern region, which also has an average level of net resource raising higher than the Brazilian average. The Southern region is next, with a level lower than that of the country’s average net absorption. The Central Western region, in turn, is the only one that does not present itself as a net absorber of resources, with only 30% of its municipalities showing that characteristic. In other words, the banking system is a net loaner of resources in the majority of cases within this region.

Another statistic that deserves to be highlighted is the standard deviation presented. As a measure of dispersion of a given probability distribution, the standard deviations calculated show that the banking system is most homogenous in the Southeastern region. On the other hand, the banking system operates in the most heterogeneous manner in the Northern and Southern regions.

For 2003, with the exception of the Central Western region, which remains stable and in the condition of a net loaner of resources, we observe a fall in the average number of net resource raising municipalities throughout all the regions. Notwithstanding this, the results qualitatively reproduce the description for the previous year.

Thus, some observations should be emphasized. In first place, the Brazilian banking system as a whole has a very clear position as a net absorber of resources. The exception is the Central Western region, which is the only Brazilian region whose banking system demonstrates the behavior, on average, of a net loaner of resources. The flip side of the coin would be the Southeastern region, which is the country's largest financial center, notably characterized by a net resource absorbing banking system. Finally, the observation that the banking system for the Southeastern region performs with the most homogeneity, should be noted.

3.3 The determinants for the net absorption of resources in Brazil

The discussion regarding the determinants for the net absorption of resources in Brazil basically follows the theoretical line traced for the case of the banking turbulence rate. This being the case, similarly to that presented in the previous chapter, we shall consider the aspects related to the market's size and structure as potential determinants in the absorption of resources.

3.3.1 A model for the absorption of resources

This section proposes an approach for the net absorption of resources that explicitly incorporates the issue of spatial dependence, considering panel data composed by Brazilian municipalities for the years 2002 and 2003. To these ends, the econometric model introduced in section 2.3.1 shall be used for the study of the continuous variable of absorption of resources (15), in counterpart to the indicator of absorption analyzed in the previous subsection (16). Maintaining the notation used until now, the model becomes:

$$\begin{cases} y_{it} = k + \beta_1 x_{1it} + \cdots + \beta_p x_{pit} + c_i + e_{it} \\ e_{it} = f(W, E_t, Y_t\ , X_{1t} \cdots X_{pt}) + u_{it},\ u_{it} \sim N(0,\sigma^2) \\ f(W, E_t, Y_t\ , X_{1t} \cdots X_{pt}) = f(\sum_j w_{ij} e_{it}, \sum_j w_{ij} y_{it}, \sum_j w_{ij} x_{1it} \cdots \sum_j w_{ij} x_{pit}) \end{cases} \tag{17}$$

where W is a neighborhood matrix, as discussed in section 2.3.1 of this paper. Furthermore, $E_t, Y_t\ , X_{1t} \cdots X_{pt}$ are $n \times 1$ vectors, bringing the cross-section dimension to moment *t* of the elements for $e_{it}, y_{it}, x_{1it} \cdots x_{pit}$, respectively. Finally, c_i is a non-observed variable specific to the individual, *i*.

The function $f(W, E_t, Y_t\ , X_{1t} \cdots X_{pt})$ is any combination of the errors, dependent variable and the explicative variables, spatially lagged in accordance with the neighborhood criterion implicit in the neighborhood matrix, W. This function establishes the pattern of spatial dependence that we aim to incorporate into the problem.

Through the use of (17), the net absorption of resources shall be analyzed under a panel data framework in which the specific and non-observable effects of the Brazilian municipalities are explicitly considered. Furthermore, the spatial neighborhood effects are incorporated in the form of the dependency function $f(W, E_t, Y_t\ , X_{1t} \cdots X_{pt})$.

An important reference as regards the spatial panel models, is Elhorst (2003). This author undertakes an effort of taxonomic consolidation for the most popular specifications, as well as the principal estimation techniques for these models. For our purposes, it is important to focus on the statement by the author that the most common strategy for the estimation of parameters for spatial panel models is the elimination of fixed effect terms, c_i, through the use of a transformation of the structural equation and the subsequent estimation of the transformed model.

The method suggested by Elhorst (2003) is the elimination of the fixed effects through the transformation of the model's constituent variables as deviations in relation to their temporal averages. This procedure is equivalent to the inclusion of individual dummy variables, which would give the estimates for the parameters of specific effects. Such an approach, which uses dummy variables to control the fixed effects, is used, for example, by Chagas (2004) and Azzoni and Silveira-Neto (2005). One problem that appears with this option is the incidental parameters, which lead to inconsistency of estimates for fixed effects, c_i, when T is fixed and $N \to \infty$ [Wooldridge (2002)]. In spite of this, the estimators for the model's remaining parameters may be obtained in a consistent manner, which makes this procedure attractive for cases where the interest is concentrated on the coefficients, β*'s* and not on the fixed effects.

For the present case, in which t = 1,2, the technique of taking deviations in relation to the averages is numerically equivalent to the procedure of taking the first differences of the variables considered in the model [Wooldridge (2002)]. Likewise, the coefficients, $\{\beta_1, \ldots, \beta_p\}$ may be estimated in a consistent manner, resorting to a transformed version of (17). Thus, under the hypothesis that the function *f(.)* is linear in its parameters, we have:

$$\Delta y_{it} = \beta_1 \Delta x_{1it} + \cdots + \beta_p \Delta x_{pit} + f(\sum_j w_{ij} \Delta e_{it}, \sum_j w_{ij} \Delta y_{it}, \sum_j w_{ij} \Delta x_{1it} \cdots \sum_j w_{ij} \Delta x_{pit}) + \Delta u_{it}$$

Once the fixed effects have been eliminated, we continue with the spatial dependency models presented in the first part of this paper, proposing three distinct specifications for the function $f(W, E_t, Y_t, X_{1t} \cdots X_{pt})$. The estimation equations for the spatial models in the first difference are:

(i) SEM: $\Delta y_{it} = \theta + \beta_1 \Delta x_{1it} + \cdots + \beta_p \Delta x_{pit} + \lambda \sum_j w_{ij} \Delta e_{it} + \xi_{it}$

(ii) SAR: $\Delta y_{it} = \theta + \beta_1 \Delta x_{1it} + \cdots + \beta_p \Delta x_{pit} + \rho \sum_j w_{ij} \Delta y_{it} + \xi_{it}$

(iii) SDM: $\Delta y_{it} = \theta + \beta_1 \Delta x_{1it} + \cdots + \beta_p \Delta x_{pit} + \rho \sum_j w_{ij} \Delta y_{it} + \alpha_1 \sum_j w_{ij} \Delta x_{1it} + \cdots + \alpha_p \sum_j w_{ij} \Delta x_{pit} + \xi_{it}$

Where θ is a constant term and $\xi_{it} = \Delta u_{it} \sim N(0, 2\sigma^2)$ are the transformed regression residuals. Furthermore, the spatial matrices, *W*, presented above, follow the same proximity pattern defined in section 2.3.3 and which were employed throughout the first chapter of this paper.

It is important to note that the transformation carried out to the model makes it possible to identify the parameters associated only to the explicative variables with variation in time. Thus, the combination of variables to be used in the understanding of the net absorption of resources is limited to *GDP*, *Diversification*, *Branches/Area* and *Agriculture*.

The estimation strategy for these panel models follows the description provided in the first chapter of this paper. Thus, we begin with the estimation of the OLS model and the Moran I test as regards the respective regression residuals, presented in Table 8. As can be seen, the null hypothesis of absence of spatial autocorrelation is rejected by this test.

We therefore initiate the modeling of this spatial dependence with the inclusion of the spatial lag absorption variable in the SAR model. Yet again, there seems to be indices of persistence for spatial autocorrelation, in accordance with that attested by the SAR LM statistic reported in Table 8.

Continuing with the procedure, we undertook the expansion of the spatial controls, estimating the SDM model and subsequently, proposing a particular form of the spatial dependence, as defined in the SEM model (Table 8). As happened with the regressions in the first chapter of this paper, the spatial lag explicative variables were not sufficient to eliminate the spatial autocorrelation, as indicated by the Moran I test reported for the SDM model. Alternatively, for the SEM model, the asymptotic tests (Wald, LM and LR) for the comparison of this model to the OLS regression confirm the spatial dependence in the residuals for this last model.

From the obtained results, three should be highlighted. Firstly, in spite of our precautions regarding the eventual effects of a non-specified spatial dependence in the regressions, there is a great similarity in the estimates derived from the various models used.

Even so, the expressive spatial persistence present in the banking models tested in this paper, in the form of the parameters ρ and λ, should be noted. In fact, the local attributes of the net absorption of resources (as with the turbulence case), within the banking performance strategy, seem to make sense only when events related to the banking systems of its neighboring municipalities are taken into account. Yet again, the argument of economies of scale in inter-municipal banking performance could be used to justify such a dependency between the locales.

Of the variables included in the models, only two appear in statistically significant form for the determination of the *net absorption of resources*: *GDP* and *Diversification*.

In the case of *GDP*, the evidence is that of a concentrating performance, in the sense that the poorer municipalities are eminently raisers of banking resources. The locales with the highest incomes, on the other hand, are characterized by lower net absorption of resources.

Table 8 - Banking turbulence determinants, 2003

	Model used[1]			
Explicative variables[2]	**OLS**	**SAR**	**SDM**	**SEM**
P		0.817	0.782	
		(0.000)	(0.000)	
λ				0.820
				(0.000)
GDP	-1.075	-1.051	-1.060	-1.070
	(0.012)	(0.023)	(0.032)	(0.025)
Diversification	2.016	1.926	1.498	1.814
	(0.044)	(0.072)	(0.177)	(0.096)
Branches/Area	-0.106	-0.048	0.194	0.018
	(0.882)	(0.946)	(0.817)	(0.980)
Agriculture	0.096	0.096	0.074	0.085
	(0.699)	(0.698)	(0.775)	(0.732)
Neighboring locales				
GDP			-2.068	
			(0.696)	
Diversification			16.857	
			(0.202)	
Branches/Area			-3.935	
			(0.622)	
Agriculture			1.716	
			(0.676)	
Moran I Test	4.668		2.328	
	(0.000)		(0.020)	
SAR LM Test		20.670		
		(0.000)		
Wald Test				16.736
				(0.000)
LM Test				14.078
				(0.000)
LR Test				12.174
				(0.000)
Number of Observations	3,205	3,205	3,205	3,205
Adjusted R^2	0.001	0.007	0.004	0.004
Log-Likelihood	-7,580.40	-7,574.15	-7,572.8	-7,574.4
Restriction test (χ^2):	16.60	80.82	233.14	20.79
H_0: Non-significant explicative variables	(0.000)	(0.000)	(0.000)	(0.000)

Note: P-value between parentheses. [1] All the models were estimated with a constant not reported in the above table. [2] Dependent and explicative variables transformed using the natural logarithm, with the exception of the dummies variables for capital and region.

As regards the economy's *Diversification*, the indices raised move toward the establishment of a positive causal relationship between this variable and the *net absorption of resources*. The evidence, in this case, is less robust in statistical terms, seeing as the variable's statistic relevance in the SDM model can only be considered at a significance level of 17%. If we take the degree of economic diversification as a measure of the monopolization potential of the demand for resources, this evidence highlights the banking system competition as a stimulating factor for loan operations directed to the locale, in counterpart to banking resource raising.

It is important to note that such a conjecture also encounters empirical support in the paper by Fonseca (2005). According to the author, the explanation for this phenomenon lies within the information and monitoring problems that the banks have to face when loaning resources and which are not present when receiving deposits. A corollary of this asymmetry in the banks' routines is that the regions possessing the most banking competition tend to benefit from lower fees charged on loans and higher volumes of loaned resources, although there the same effects are not applied to rates paid and volumes raised in these regions.

In this way, as in the case of GDP, there seems to be a concentrating behavior on the part of the Brazilian banking system, in which there is a migration of resources coming from locales possessing less banking competition to those with higher competition among their banks.

4. Final Considerations

Based on the concepts established in the areas of Industrial Organization and Labor Economics, the present paper proposes two new measures for the characterization of the banking sector.

In first place, an indicator for the level of banking intermediation for a given locale was suggested. This measure considers the gross resource entry and exit flows in the locale and is denominated the *banking turbulence rate*. Analyzing the data for Brazil, it can be seen that the distribution of the banking turbulence among the municipalities is extremely asymmetric to the right. This result indicates the presence of a solid majority of municipalities with extremely low levels of banking turbulence and some locales possessing a relatively elevated rate of banking intermediation. On the other hand, the econometric study undertaken herein allows for the principal association of the turbulence rate with the level of income and banking competition.

The second measure is denominated the *net absorption of resources rate* and deals with the entry of resources relative to the loans realized in the locale. Therefore, it refers to the net resource entry and exit flows in a locale. The results show that the banking system in Brazil may be primarily characterized by resource raising, or entry operations. Among the Brazilian regions, the data indicates the Southeastern region as the main resource raising one in the country. The econometric exercises undertaken allow to associate the net resource raising with the locale's income and, to a lesser degree, with the concentration of the local banking sector.

According to this evidence, the Brazilian banking system has been marked by an asymmetric and resource concentrating performance. This characterization emerges, in first place, from a banking system that is extremely spatially concentrated, whose *banking turbulence* is a growing function of the level of income. Aggravating this picture is the fact that *net absorption of resources* is realized in locales with lower incomes, as opposed to more wealthy ones, where the characteristic is primarily that of a resource lender.

These results have important implications for economic policy. Brazil, which presents an enormous disparity in incomes, is still characterized by a pronounced asymmetry at the level of banking intermediation. The significant spatial dependence, especially in relation to the income seen from the data for each locale, tends to worsen this scenario. These aspects call attention to the role of the government in promoting competition among the banks, a factor that could provide an incentive for the increase in banking intermediation, primarily through the use of increased loan operations, or resource exits.

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