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FINANCIAL MAPPING OF BRAZILIAN REGIONS: DETERMINANTS OF INDEBTEDNESS FOR PUBLICLY TRADED COMPANIES

MAPEAMENTO FINANCEIRO DAS REGIÕES BRASILEIRAS: DETERMINANTES DO ENDIVIDAMENTO DAS EMPRESAS DE CAPITAL ABERTO

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Abstract

The cultural and economic characteristics and peculiarities of each Brazilian region generate the need for a detailed study of the importance of thinking spatially about the financial system related to geography. In this context, the present paper seeks to evaluate the regional determinants of the level of indebtedness in Brazilian companies after the 2008 crisis. For this purpose, geoprocessing techniques and linear regressions through unbalanced panel data by GMM-Sys were applied. As a result, we identified that regional differences had a significant influence on the indebtedness of companies in the post-crisis period, and the more severe effects of the reduction of indebtedness were felt in the North/Northeast companies and the less severe ones were found in the Central-West companies.

Keywords: Indebtedness. Georeferencing. 2008 Crisis.

Resumo

As características e peculiaridades culturais e econômicas de cada região brasileira geram a necessidade de um estudo pormenorizado da importância de pensar espacialmente sobre o sistema financeiro relacionado à geografia. Nesse contexto, o presente trabalho buscou avaliar os determinantes regionais do nível de endividamento de empresas de capital aberto brasileiras após a crise de 2008. Para esse fim, foram aplicadas técnicas de geoprocessamento e regressões lineares através de dados em painel não balanceados por GMM-Sys. Como resultado do estudo, foi identificado que as diferenças regionais influenciaram de uma forma significativa o endividamento

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das empresas no período pós-crise, sendo que os efeitos mais severos da redução do endividamento foram sentidos nas empresas da região Norte/Nordeste e os menos severos foram encontrados nas empresas da região Centro-Oeste.

Palavras-chave: Endividamento. Georreferenciamento. Crise de 2008.

Introduction

The cultural and economic characteristics and peculiarities of each region generate the need for a detailed study of the importance of thinking spatially about the financial system related to geography (MARTIN; POLLAND, 2017). The issues related to financing and shareholder value are connected to geographical issues, being important points to understand the context that embraces the social and economic relations of the agents, so much that the geographic location and the local financial structure are crucial for the investment decision in a particular region (PIKE, 2005). This issue is even more pronounced at times like the 2008 financial crisis.

This crisis affected the whole world causing problems to financial institutions, making banks fear to release new financing, raising interest rates, more expensive credits, paralysis in investments and, consequently, decrease of the jobs (KAHLE; STULZ, 2013). In Brazil, the start of this crisis has not a considerable magnitude, beginning to be felt at a later time due to the difficulty of obtaining financing, because of banks' credit limitations, being exacerbated in later periods (COSTA, 2015), demonstrating that there may be a financial connection between different geographical areas.

However, the consequences of this crisis were not homogeneous in all regions, showing that it generated different "financial geographies" in the countries. Based on that issue, Martin (2011) argues that this crisis is a great example of "glocalization", that is, it had a local origin, but with global repercussions. One of the main consequences was the sudden decrease in indebtedness, where long-term debt has becoming short-term debt (MITCHELL; PULVINO, 2012). This fact generates the need to undertake more detailed study on the economic geography of financial bubbles in Brazil.

Due to this context, the present study aims to assess the regional determinants of the level of indebtedness of Brazilian firms after the 2008 crisis. The article aligns geoprocessing with finance, as there is little research relating these two areas. Among these researches, is the study by Aalbers (2009) and by Mawdsley (2016), which demonstrated that financial capital flows according to a spatial and temporal logic, explained by geoprocessing.

Knowing where financial problems occur and being able to view them geographically, facilitates our understanding and can help find possible solutions. The integration of finance and geoprocessing provides a broader view of the concentration of financially distressed firms over time, which serves as a basis for identifying in which regions the focus of these difficulties were most accentuated in the post-crisis period. In this context, Sokol (2017) argues that the literature fails to approach the financial implications of a phenomenon without considering regional development. Still, Pollard (2003) emphasizes that the little interaction between geography and finance creates a "black box" in studies that harms the development of theories about this theme.

This article is divided into 5 (five) sections, with the first being this introduction. The second section presents a theoretical review on the subject and in the third section, the methodological aspects used in the research. The fourth section present the results and discussions. Finally, the final considerations and the references used as basis for the development of the study are presented.

Crisis, mapping and indebtedness: Conceptions and hypotheses

Indebtedness is an important instrument for the financial increase of companies, because using debt to finance their activities and having a return on this value is the objective of financial managers. However, this strategy can generate higher debt costs, increasing the possibility of financial difficulties, especially in times of crisis (TIROLE, 2006). To better describe the literature review, this section is divided into two parts, as follows: (i) Effects of the crisis on indebtedness; and, (ii) Geographic and regional factors that influence indebtedness.

Effects of the crisis on indebtedness

The consequences of financial difficulties can be severe for companies, especially in times of crisis. The literature documents institutional impacts on business, resilience in the stock market and decreased liquidity, which lead to a greater delay in overcoming the crisis. (ANAND et al. 2013). In this same context, banks would continue to obtain advantages if they continued to honor their commitments in the midst of a financial crisis, with the support of the government, sponsoring agencies and the increase in deposits, but even though, they usually choose to restrict financing (ACHARYA; MORA, 2015).

During the 2008 crisis, financial problems occurred more frequently in companies with higher indebtedness, greater growth and lower cash, that is, those most susceptible to negative consequences of external economic shocks (BLISS et al., 2015). In this period, there were also financial restrictions that achieved sales, harming market liquidity, which were most felt, according to Beber e Pagano (2013), in Non-American countries, as the reduction in indebtedness was greater and the return on shares was not significantly positive.

When the price and conditions for bank loans to companies are affected by financial crises, Hertzberg et al. (2011) showed that a solution would be a reduction in credit and market share, thus contributing for these companies to comply with the commitment to assume debts and take on less indebtedness. Gilson (1997) identifies that transaction costs discourage debt renegotiation in periods of crisis. As a result, financially distressed companies tend to increase risk of defaults.

High-cost companies choose to reduce debt in times of crisis. In this context, George and Hwang (2010) identified that the negative returns are related to the intensification of financial difficulties and indebtedness, where companies with financial problems and with high costs, choose to a smaller debt to avoid problems, but keeping the risk to support these low costs.

Geographic and regional factors that influence indebtedness

Large economic slowdowns are, typically preceded by debt growth phenomenon. In the period before the 2008 crisis, a significant increase in corporate indebtedness was identified, due to the exacerbated growth of credit in the USA, indicating that this growth was a harbinger of the financial crisis (SCHULARICK; TAYLOR, 2012). After that period, fearing even greater harm, there was a reduction in bank credits, causing indebtedness to decrease considerably in the post-crisis period.

This crisis, which achieved the USA, quickly spread to other countries, with different degrees of exposure to the risk of contagion, according to the level of openness of their economies and participation of foreign investments in their financial markets (MURATORI, 2015). Emerging economies managed to restructure more quickly, showing signs that this crisis did not reach the geographic regions in the same proportion.

Regional issues can affect indebtedness in different ways, depending mainly on the characteristics of the crisis, economic conditions and the speed of resolution. Aalbers (2009) identified that this crisis affected more the less favored regions, and a high concentration of bankruptcies was identified in certain cities and neighborhoods, showing that the geographical location also influences the performance of companies (GOERZEN; BEAMISH, 2003).

Regional economic performance indicators, such as unemployment, can also affect indebtedness, according by Giroud and Mueller (2017), who identified that highly indebted firms had to decrease their expenses to face the financial crisis, showing a considerably higher increase in unemployment than less indebted companies, in response to domestic demand shocks. Fair (2017) also identified that the rising of the unemployment in post-crisis was related to the financial difficulties faced by companies in debt during the crisis.

One of the main issues related to indebtedness is the supply of credit. Mendoza and Terrones (2014) identified that the excess credit, in times of crisis, affects macroeconomic aggregates and variables at the firm level (mainly related to indebtedness), showing that the excessive credit increase and the macro and micro fluctuations associated with them are greater in emerging economies. This fact leads to believe that the increase in the supply of bank credit, generates a greater indebtedness, increasing the probability of default (SCHULARICK; TAYLOR, 2012), unless the crisis harms the renegotiation of debts (HE; XIONG, 2012). Due to all these assumptions, the following hypotheses are formulated:

Main hypothesis (H1): Regional differences significantly influenced the indebtedness of Brazilian publicly traded companies after the 2008 crisis.

Alternative hypothesis (H1a): Regional differences did not significantly influence the indebtedness of Brazilian publicly traded companies after the 2008 crisis.

Methodological Aspects

To achieve the objective of the study, we extracted accounting data from the ECONOMATICA®, and obtained data on regional issues from the Central Bank of Brazil (BACEN) website. The population of the present study comprises all publicly traded companies in Brazil (653 companies). However, we excluded financial companies (a procedure necessary to avoid outliers from the analysis) and companies with Tobin's Q less than zero and greater than ten from the sample (Almeida & Campello, 2007). Thus, the sample consisted of 480 companies over 20 years (1995 to 2014), totaling 4,594 observations, 419 in the North / Northeast, 153 in the Midwest, 1,008 in the Southeast (without São Paulo), 1,995 in São Paulo and 1,019 in the South. The spatial analysis in the section of the results shows how we elaborated this new division by regions. For synthesis reasons, we presented only the graphs of the last 10 years (2005 to 2014).

The data analysis was divided into three parts: (i) Mapping: For each company, the geographic location of the headquarters (where there is the greatest concentration of financial activities) was obtained through the website, that is, we collected the address, the zip code, the city and state of the headquarters of each company, which were integrated into the database. In possession of this information, we obtained the geographic coordinates of the companies (latitude and longitude), forming the database to feed the Geographic Information System (GIS). We present the results of this analysis in form of maps and graphs; (ii) Descriptive statistics; and, (iii) Influence of financial variables on indebtedness: to analyze this relationship, we applied linear regressions in unbalanced panel data by GMM-Sys (Generalized Method of Moments Systemic).

The instruments used were the lagged explanatory variables, as proposed by Almeida et al. (2010). We chose this model because, in studies that have more than three observations per cross-sectional unit and that the error term of the model in first differences has a first order serial correlation, the GMM-Sys, created by Blundell and Bond (1998), presents a more consistent structure to obtain asymptotically efficient estimators. The dynamic model was also used (where the lagged dependent variable is used to explain the model), which generates efficiency gains by relaxing the assumptions of homoscedasticity.

In this sense, Equation (1) presents the regression model used in the study:

$$End_{it} = \beta_0 + \beta_1 End_{it-1} + \beta_2 Q_{it} + \beta_3 \mathrm{Re}nt_{it} + \beta_4 Tang_{it} + \beta_5 Tam_{it} + + \beta_6 Risco_{it} + \beta_7 PósCrise_t + \beta_8 Crédito_{rt} + \beta_9 Inad_{rt} + \beta_{10} Desemp_{rt} + \sum EFTemp + \sum EFind + \mu_{it} \quad (1)$$

Where, End_{it} – Indebtedness; β – Intercept or angular coefficient; End_{it-1} – dynamic variable; Q_{it} – Tobin's Q; $Rent_{it}$ – Profitability index; $Tang_{it}$ – Tangibility of assets; Tam_{it} – Size; $Risco_{it}$ – Business risk; $PósCrise_t$ – Post-Crisis d*ummy*; $Crédito_{rt}$ – supply of credit for firms; $Inad_{rt}$ – Default of the firms; $Desemp_{rt}$ – Unemployment; ∑EFtemp – Temporal fixed effects; ∑EFind – Sector fixed effects; μ_{it} – Error term; i – Companies; t – period of time; r - region.

In addition, Figure 1 shows the variables used in the regression model.

Figure 1: Variables used in the model

Variables	Formulas	Authors	Signal	Description
Dependent				
End: Indebtedness	$End = \frac{PC + PNC}{\text{PL}}$	Lang et al. (1996); Rajan e Zingales (1995)		Relationship between debt and equity.
Independent				
Tobin's Q	$Q = \frac{VM}{\text{AT}}$	Lang et al. (1996)	+	The greater growth opportunities, more companies seek debt.
Profitability: **- ROA**	$ROA = \frac{LL}{AT}$	Myers (1984); Frank e Goyal (2009)	Pecking order -	The higher profitability, less companies resort to debt.
			Trade off +	The company must raise its indebtedness to an optimum point, which the value of the WACC is minimal.
Tang: Tangibility	$Tang = \frac{\text{FA}}{AT}$	Almeida e Campello (2007)	+	Assets that serve as ensure are important to obtain more funding.
Size: **Total Assets**	$TAM = \log(AT)$	Frank e Goyal (2009)	+	Larger companies generally have less financial constraints, opting for greater debt.
		Rajan e Zingales (1995)	-	The more profitable large companies are, the less they resort to debt.
Risk: **Business**	$RISCO = \frac{DP\,(\text{RO})}{AT}$	Rajan e Zingales (1995)	+	The cost of default is higher for riskier companies.
Post-Crisis	Dummy: 1 three years after the 2008 crisis;	Anand et al. (2013)	-	The post-crisis period provides insecurities in the market, generating more caution for companies to obtain debts and for
Supply of credit for firms **(Sup. Cred)**	log(supply of credit of firms)	Schularick e Taylor (2012)	+	The increase in the supply of bank credit generates an increase in indebtedness, being a precursor to financial crises.
Default of firms	% default of firms	Schularick e Taylor (2012)	+	An increase in bank credit (generating greater indebtedness) causes a reduction in loan restrictions, increasing the probability of default.
		He e Xiong (2012)	-	The decrease in indebtedness leads to an increase in the risk of default as it can affect the renegotiation of debt in times of crisis.
Unemployment **(Unempl.)**	% Unemployment	Giroud e Mueller (2017)	+	Companies that are more indebted show higher layoffs during crises, in response to shocks in domestic demand.

Legend: PC = Current Liabilities, PNC = Non-Current Liabilities; PL = Equity; VM = Market Value; AT = Total assets; FA = Fixed Assets; LL = Net Profit; SD = Standard Deviation; RO = Operating Revenue; CC = Otherwise.
Source: Elaborated by the authors.

To perform the analysis, we applied the following tests: (i) correlation; (ii) Arellano and Bond (1991): verifies the existence of a serial correlation; (iii) overidentification by Hansen (1982); and, (iv) Chi-square (χ^2). The variables were winsorized to 1% (extreme data were eliminated), corrected by the IGP-DI and the absolute variables were converted into dollars.

Analysis of results

To better understanding the results achieved, we divided the analysis into three parts, as follows: (i) Spatial analysis of the regions; (ii) Descriptive statistics; and, (iii) Analysis of the impact of financial and regional variables on indebtedness.

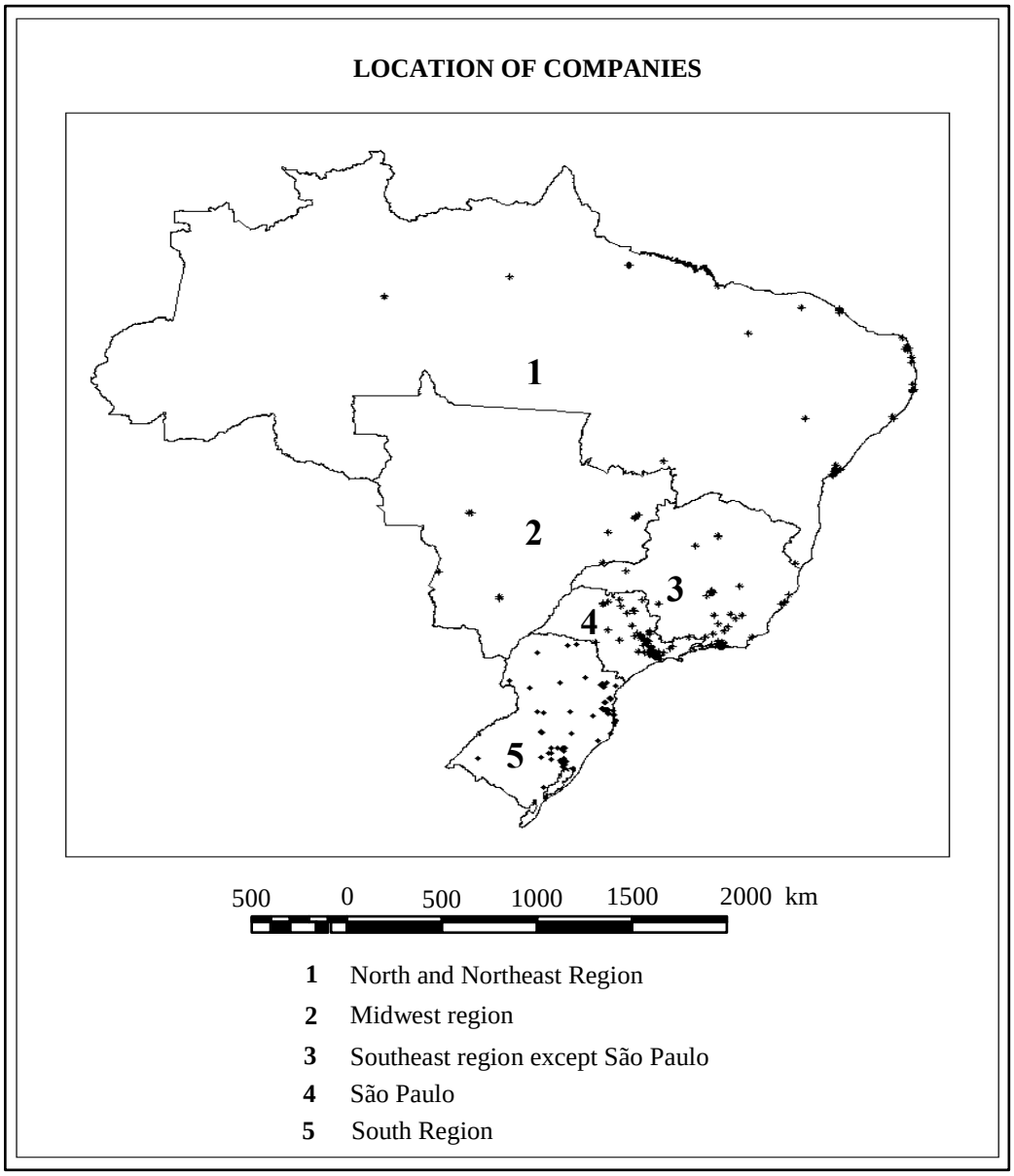
Spatial analysis of the regions

As described in the methodology, for the analysis of the data, we create a geographic database to feed the GIS, allowing the separation of companies by regions and graphical analysis.

In this sense, Figure 2 shows the geographic location of the headquarters of the publicly traded Brazilian companies that make up the sample. As can be seen, the great majority is located in the South and Southeast (22.18% and 65.37%, respectively). The division was made, then, based on the focus of companies' concentration, subdividing the Southeast region in two parts, due to the high level of concentration of companies in São Paulo (43.42%), higher than the number of companies in all other states in the region (21.95%). We united the North and Northeast regions in one, reaching 9.12% of the total. The new division is described below (Figure 2): North/Northeast (N/N), Midwest (CO), Southeast, without São Paulo (S-SP), São Paulo (SP) and South (S).

In order to verify the indebtedness of the regions in the years before and after the 2008 financial crisis (from 2005 to 2014), Figure 3 was elaborated, also considering the number of companies and the indebtedness by year and by region, indicating to which percentile belongs each group.

Figure 2: Location of companies by concentration focus

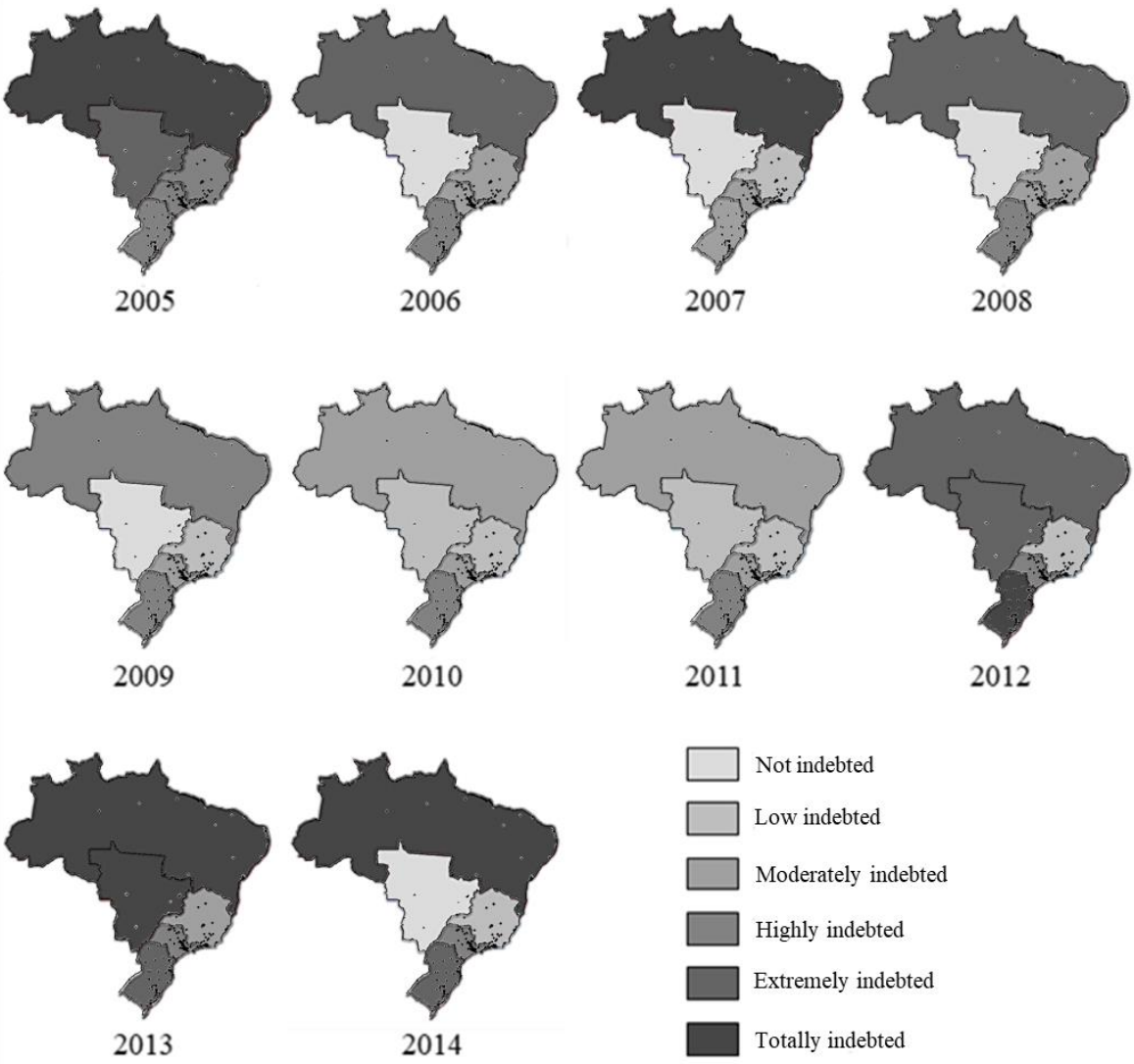


Source: Elaborated by authors.

In a general analysis, we identified that the regions reduced their indebtedness since 2009, probably due to the greater caution of companies in getting debt in times of crisis, also because banks are stricter in loans. However, after 2012, with the crisis was over, companies started to getting debt again. When analyzing each region, we can see that companies in the North/Northeast, in all years, had a high indebtedness, except for 2010 and 2011, in which they were moderately indebted. Companies in the Midwest region have shown, for the most part, to be no financially leveraged (except in 2013).

Figure 3: Analysis of indebtedness in the last 10 years by regions

Legend: E - Number of companies; END - Average indebtedness; P - Percentile. Classification through the analysis



	E	END	P	E	END	P	E	END	P	E	END	P	E	END	P
	2005			2006			2007			2008			2009		
South	111	1,1675	p75	113	1,0950	p75	125	1,0267	p50	111	1,2306	p75	111	1,1263	p75
Midwest	21	1,2812	p90	15	0,5799	p10	17	0,4359	p10	17	0,4380	p10	17	0,4869	p10
São Paulo	168	1,1795	p75	170	0,9074	p50	226	0,7818	p50	222	1,0631	p50	232	1,0225	p50
Southeast - SP	87	1,1743	p75	87	0,8605	p50	113	0,6569	p25	109	0,7975	p50	109	0,6296	p25
North-Northeast	46	1,7416	<90	46	1,3758	p90	44	1,2909	p90	44	1,3947	p90	44	1,2029	p75
	2010			2011			2012			2013			2014		
South	115	1,2165	p75	101	1,2569	p75	111	1,5191	<90	101	1,3078	p90	20	1,4868	p90
Midwest	15	0,6190	p25	13	0,7028	p25	15	1,2826	p90	16	1,7842	<90	7	0,0596	p10
São Paulo	232	0,9979	p50	236	1,0747	p50	226	1,0891	p75	240	1,1706	p75	43	1,0854	p75
Southeast - SP	119	0,5895	p25	128	0,6125	p25	127	0,7297	p25	123	0,8074	p50	6	0,7204	p25
North-Northeast	46	1,0194	p50	42	1,0016	p50	44	1,4655	p90	42	1,5570	<90	21	2,3933	<90

of the percentiles: Not indebted = p10 (from 0 to 0.5885); low indebted = p25 (from 0.5886 to 0.7428); moderately indebted = p50 (from 0.7429 to 1.0801); highly indebted = p75 (from 1.0802 to 1.2751); extremely indebted = p90 (from 1.2752 to 1.4900); totally indebted = <90 (from 1.4901).

Source: Elaborated by authors.

Descriptive Statistic

For descriptive statistics, Table 1 containing general divided data by region.

Table 1: Descriptive Statistic

	END	Q	ROA	Tang.	AT[1]	Risk	Sup. Cred.[1]	Default	Unempl.
A – General									
Average	1.138	1.383	0.0404	0.0563	4.755.34	0.067	963.941.40	0.0196	0.0726
Median	0.664	0.976	0.0420	0.0140	1.759.25	0.048	917.741.40	0.0201	0.0701
Variance	1.745	1.405	0.0079	0.0051	5.16x107	0.003	1.930x1011	0.0000	0.0005
Stand.	1.321	1.185	0.0891	0.0717	7.181.86	0.057	439.227.90	0.0046	0.0222
B – North/Northeast									
Average	1.305	1.173	0.0384	0.0554	4.330.27	0.068	469.696.80	0.0254	0.1042
Median	0.962	0.867	0.0446	0.0296	2.210.88	0.053	452.774.00	0.0236	0.1036
Variance	1.761	0.996	0.0082	0.0045	3.40x107	0.003	3.890x1010	0.0000	0.0007
Stand.	1.327	0.998	0.0903	0.0668	5.828.53	0.058	197.280.30	0.0036	0.0271
p-value	0.03**	0.01**	0.49	0.50	0.00***	0.49	0.00***	0.00***	0.00***
C – Midwest									
Average	1.109	1.076	0.0362	0.0100	7.871.92	0.061	237.386.90	0.0218	0.0774
Median	0.355	0.703	0.0352	0.0016	4.010.54	0.040	253.655.60	0.0220	0.0789
Variance	1.956	1.142	0.0069	0.0008	9.09x107	0.003	8.760x109	0.0000	0.0003
Stand.	1.398	1.068	0.0832	0.0274	9.535.98	0.055	93.574.96	0.0047	0.0178
p-value	0.37	0.00**	0.48	0.30	0.00***	0.47	0.00***	0.04**	0.00***
D – Southeast (-SP)									
Average	0.896	1.388	0.0400	0.0407	6.709.79	0.069	884.658.20	0.0178	0.0609
Median	0.487	1.063	0.0411	0.0007	2.773.65	0.051	912.264.90	0.0188	0.0628
Variance	1.423	1.315	0.0081	0.0043	7.57x107	0.003	1.020x1011	0.0000	0.0002
Stand.	1.193	1.147	0.0901	0.0653	8.702.87	0.057	318.792.80	0.0034	0.0136
p-value	0.00**	0.48	0.49	0.43	0.00***	0.49	0.00***	0.08*	0.00***
E - São Paulo									
Average	1.137	1.514	0.0432	0.0532	4.846.31	0.068	1.281.897.0	0.0193	0.0795
Median	0.670	1.113	0.0440	0.0123	1.825.43	0.049	1.316.399.0	0.0201	0.0840
Variance	1.728	1.515	0.0080	0.0049	5.27x107	0.003	1.090x1011	0.0000	0.0003
Stand.	1.314	1.231	0.0895	0.0697	7.257.75	0.057	329.853.90	0.0048	0.0183
p-value	0.49	0.07*	0.48	0.48	0.00***	0.50	0.00***	0.41	0.00***
F – South									
Average	1.317	1.247	0.0373	0.0848	2.400.39	0.064	585.462.10	0.0198	0.0569
Median	0.821	0.819	0.0413	0.0769	8.230.72	0.043	619.438.70	0.0205	0.0560
Variance	1.962	1.389	0.0076	0.0061	1.70x107	0.003	3.230X1010	0.0000	0.0002
Stand.	1.400	1.178	0.0874	0.0780	4.123.76	0.058	179.629.70	0.0034	0.0155
p-value	0.02**	0.06*	0.48	0.37	0.00***	0.491	0.00***	0.43	0.00***

Legend: *** - Sig. 1% (0.01); ** - Sig. 5% (0.05); * - Sig. 10% (0.10). [1] In thousand; END: Indebtedness; Q: Tobin's Q; ROA: Return on asset; Tang: Tangibility; AT: Total asset; Risk: Risk of Business; Sup. Cred: Supply of credit; Default: Default of firms; Unempl.: Unemployment.
Source: Elaborated by authors.

In this line, some variables showed high disparities between the average and the median, with high variances and standard deviations, to which we applied 1% winsorization. We use the Z test to compare averages, in which 2 groups were considered (firms in the analyzed region and firms in the other regions), in order to verify whether there is a significant difference between them.

Analyzing the general data (Table 1-A), we can infer that, in terms of indebtedness, debt, on average, is 13.87% greater than equity, that is, for each $1.00 of equity, the company is indebted at $ 1.14. Regarding the Tobin's Q, the market value exceeds, on average, 38.38% of the equity value. For the return on assets (ROA), the profit represents, on average, 4.04% of total assets. Fixed assets represent around 5.63% of the total assets of companies. The risk of not obtaining the desired return on assets reached, on average, 6.77%. The total assets of companies are around $ 4.75 million, while

the supply of credit to legal entities is, on average, $ 963.94 million, with a default index of 1.96%. Unemployment in Brazil reaches 7.26% of the economically active population.

Comparing the regions with the general analysis we can identify that the lowest indebtedness is in companies of the Southeast (- SP), which the debt, on average, represents 89% of equity, with the largest indebtedness being in companies in the south, where debt exceeds equity by 31.73%, both significantly different from other regions. In relation to Tobin's Q, on average, São Paulo has the highest Tobin's Q, indicating that the market value exceeds companies' equity value by 51%. The lowest average is in the Midwest, where the market value is 7.67% higher than the equity value. These measures are statistically significant.

ROA and tangibility are very close in all analyzes, with no significant differences between the averages. In terms of size, the companies with the largest total assets ($7.87 million) are in the Midwest, while the lowest total assets ($2.4 million) are in the south. The largest supply of credit is in São Paulo ($1.28 billion) and the lowest is in the Midwest ($237.38 million), reaching up to a quarter of the overall average. The North/Northeast region has the highest default rates (2.54%) and unemployment (10.42%). The lowest averages were in the Southeast (-SP), with 1.78% of default, and in the South, with 5.69% of unemployment.

Analysis of the impact of financial and regional variables on indebtedness

Before estimating the regression models, we calculated the statistical tests. When checking the Hansen (1982) overidentification test at the bottom of Table 2, it is evident that, in all analyzes, we cannot reject the null hypothesis, indicating that the instruments are not related to the error. In the Chi-square test (χ^2), we reject the null hypothesis, indicating that there is an association between the variables of the model. Finally, in the Arellano and Bond test (1991) (Ar1 and Ar2), in all analyzes, we can reject the null hypothesis for first order serial autocorrelation (Ar1), but we cannot reject the second order (Ar2). Therefore, the model has a serial correlation of order 1, justifying the use of GMM-Sys and the dynamic model. We do not use the variables that showed high correction in the same analysis.

At the top of Table 2, we present six regressions, the first general and the others separated by regions. In the general analysis, we identified that Tobin's Q positively influences indebtedness by 22.55%, at a significance level of 5%, that is, for each 1% increase in growth opportunities, the corporate indebtedness increases by 0.23%. Regarding the profitability, it has a 4.41% negative impact on indebtedness at a 1% significance level, that is, the 1% increase in the return on assets causes to decrease the companies' indebtedness by 0.04%.

In addition, the supply of credit to legal entities positively influences indebtedness by 47.19%, at a 10% significance level, that is, the 1% increase in the supply of credit causes to increase the corporate indebtedness by 0.47%. Default, on the other hand, negatively influences indebtedness by 20.09% to 1% of significance, showing that the 1% increase in default generates a 0.20% decrease in corporate indebtedness. Finally, the fact that the companies are located in São Paulo and in the Southeast (-SP), negatively influences indebtedness by 95.79% and 72.93%, at a significance level of 10% and 5%, respectively. The other variables are not significant.

When analyzing the regressions by region, we can infer that Tobin's Q and profitability are significant in almost all analyzes (except for the Midwest), emphasizing companies in the South, where growth opportunities positively influence the indebtedness at 16.17%, at a 5% significance level, and the return on assets negatively influences indebtedness at 4.98%, at 1% significance. The Midwest stands out in terms of tangibility, where the 1% increase in collateral assets generates a 1.69% increase in corporate debt.

Table 2: Sectorial analyzes of the determinants of companies' indebtedness

Variable	General	N/N	CO	S-SP	São Paulo	South
ENDt-1	0.6468***	0.7220***	0.4866***	0.5542***	0.4435***	0.5892***
Z	4.0700	11.6000	5.7400	5.8600	5.4100	9.3300
Q	0.2255**	0.0962**	-0.0350	0.1118**	0.1016**	0.1617**
Z	2.2800	2.0400	-0.2100	2.1200	2.2300	2.3000
ROA	-0.0441***	-0.0453***	-0.0070	-0.0204*	-0.0250***	-0.0498***
Z	-2.5600	-3.2100	-0.3500	-1.8800	-3.1600	-4.5400
Tang.	-0.0616	0.0305***	1.6937***	0.0602*	0.0608**	-0.0051
Z	-1.1100	3.4900	2.7900	1.8800	2.1100	-0.3800
AT	0.1263	0.2748***	0.0587	0.0615	0.4430	0.0409
Z	0.8300	4.0600	0.9000	0.5600	1.4100	0.2100
Risk	0.0086	0.0420**	-0.0183	0.0021	0.0149*	0.0043
Z	0.3900	2.3600	-1.1700	0.1600	1.6700	0.3100
Post-crisis	0.0261	-0.1907*	-0.1098	-0.0124	-0.0456	0.0271
Z	0.5600	-1.8900	-1.1400	-0.2000	-1.0900	0.4400
Sup. Cred.	0.4719*	0.0139	0.7391	-0.4215	0.4959*	0.6646*
Z	1.6400	0.0400	1.3300	-0.8000	1.6700	1.6700
Default	-0.2009***	-0.1536	-0.0805	-0.0958	-0.2328***	-0.3510***
Z	-2.6400	-1.0900	-0.8100	-1.0000	-2.5300	-3.4900
Unempl.	0.0303	-0.0001	-0.0276	-0.1675	0.0228	0.0783
Z	0.6700	0.0000	-0.3700	-1.1400	0.5600	1.1100
N/N	0.0945					
Z	0.2900					
CO	-0.6307					
Z	-0.7800					
S-SP	-0.7293**					
Z	-1.9500					
SP	-0.9579*					
Z	-1.7900					
South	-0.2993					
Z	-0.9500					
Const.	-6.7536	-1.5306	-9.9018	9.4357	9.3804	-10.3000
Z	-1.5700	-0.2900	-1.2300	1.0100	0.3200	-1.5600
EF Temp	Yes	No	No	No	No	No
EF Ind	Yes	Yes	Yes	Yes	Yes	Yes
χ^2	121.9771	358.0000	326.0449	307.7744	87.7754	373.5745
χ^2 p	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Hansen	31.6477	7.9681	0.0000	56.9347	120.5386	39.4697
Hansen p	0.3841	1.0000	1.0000	1.0000	1.0000	1.0000
Ar1	-3.6492	-1.9407	-1.8186	-2.0684	-3.0457	-2.6035
Ar1 p	0.0003	0.0523	0.0690	0.0386	0.0023	0.0092
Ar2	0.4756	1.4967	-0.4634	0.1514	-0.2118	-0.8824
Ar2 p	0.6343	0.1345	0.6431	0.8797	0.8322	0.3776

Legend: *** - Sig. 1% (0.01); ** - Sig. 5% (0.05); * - Sig. 10% (0.10).
Source: Elaborated by authors.

In addition, the size is only significant in the North/Northeast, that is, a 1% increase in this variable increase the indebtedness by 0.27%, with a significance level of 1%. In terms of business risk, in the North/Northeast this variable positively influences debt by 4.20%, at a 5% significance level. The effects of 2008 post-crisis are negative in almost all states, but are only significant in the

North/Northeast, where this variable negatively influences debt by 19.07%, at a significance level of 10%. The credit supply is positive and significant for São Paulo and for the South, with emphasis on the last, where a 1% increase in bank credit generates a 0.66% increase in indebtedness. Finally, defaults are also significant for these two states, but with a negative influence, especially in the south, where this variable negatively affects debt by 35.10%. The dynamic variable was significant in all analyzes; on the other hand, unemployment was not significant in any regression. We do not apply fixed temporal effects in some regressions to avoid collinearity with regional variables.

Final Remarks

The present study analyzed the regional determinants of indebtedness of publicly traded companies in Brazil. The results corroborate the findings of Pike (2005) and Martin (2011) and indicate that the regional differences significantly influenced the indebtedness of Brazilian companies after the 2008 crisis. Aspects related to growth opportunities (Q), profitability (ROA), tangibility (Tang), size (AT), business risk (Risk), credit supply (Supl. Cred) and Default would be regional determinants of the level of indebtedness for firms in Brazil. Thus, we cannot reject the main hypothesis (H1) of the study.

In this line, regarding the influence of variables on indebtedness, we identified that Tobin's Q and profitability significantly influence indebtedness in practically all regions (with the exception of the Midwest), but with opposite effects, where the greatest influence of these variables is found in companies from South. This result corroborates with Lang et al. (1996), who argues that the more opportunities for growth, the more companies seek debt; and with the pecking order concepts of Meyers (1984), who stated that the more profitable companies are, the less they need to resort to debt.

Regarding the tangibility of assets, this variable is positive and significant in practically all regions (except in South), showing that the greater the fixed assets, the greater the companies' indebtedness. Almeida and Campello (2007) also found this result, indicating that the more assets companies have, the more collateral they have to obtain financing.

The size of the companies was only significant in the North/Northeast region, showing that the bigger the company, the more it resorts to debt in this region, corroborating with Frank and Goyal (2009), who indicated that larger companies generally have less financial restrictions, choosing greater indebtedness. Furthermore, the greater the business risk, the more companies resort to debt in São Paulo and in the North/Northeast, corroborating with Rajan and Zingales (1995), who claim that the cost of default is higher for riskier companies.

The supply of credit and defaults for legal entities were significant in companies from São Paulo, with a positive sign, corroborating with Schularick and Taylor (2012), who argues that the increase in the supply of bank credit generates an increase in indebtedness, being a precursor of financial crises; and from the South, with a negative sign, in line with He and Xiong (2012), who indicated that the decrease in indebtedness leads to an increase in the risk of default, as it harms the renegotiation of debts in times of crisis.

Regarding the results found in the spatial analysis, we can identify that companies in the North/Northeast were the ones that most reduced their indebtedness in the post-crisis periods (2009 to 2011). This result is corroborated by the regressions, where the referred region was the only one that showed a significant negative relationship with this variable. The possible reasons for this fact are in the descriptive statistics, where this region was the one that presented the highest level of defaults in the years studied, and the supply of credit to legal entities is practically half of the average in Brazil, although these variables were not significant in regressions.

The companies in the south region also showed high levels of indebtedness, but remained at this level over time, do not noticing significant differences in the post-crisis period. Overall, companies in the Midwest region were the least indebted, probably due to the low supply of credit to legal entities, which represents a quarter of the general average, and low tangibility of assets (highly significant in regressions).

These results suggest that, after the crisis, companies were more afraid to seek debts, also, banks began to be stricter in granting credit and, regarding to indebtedness by regions, the more severe effects of the reduction of debts were felt in companies in the North/Northeast and the least severe were found in companies in the Midwest. Finally, we believe that a more accurate investigation of the capital structure, considering other regional characteristics, would be good themes for future research.

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