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MANAGEMENT OF CORPORATE DEBT DEADLINES: A LOOK AT PUBLICLY TRADED COMPANIES IN BRAZIL

Gestão dos prazos da dívida corporativa: Um olhar para as empresas de capital aberto no Brasil

Gestión de los plazos de la deuda corporativa: Una mirada a las empresas que cotizan en bolsa en Brasil

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ABSTRACT

This study investigates the maturity structure of listed non-financial Brazilian companies from 2010 to 2019 and reveals that these companies do not spread their debt maturities upon renewal, unlike the results observed by Choi et al. (2018) for US firms. Even after the rollover shock in 2015 where the Brazilian sovereign debt's investment were downgraded, these firms did not increase the maturity spread of their debt. In addition, the research evaluated corporate debt management by utilizing Brazil's downgrade as a "quasi-natural experiment" in the exogenous shock model. The results indicate that Brazilian companies may face considerable debt rollover risks due to the concentration of maturities in specific maturity ranges during future credit shocks. Proper control of financing structures is crucial to ensure that companies remain resilient and do not have to turn down profitable investments or high-quality assets during financial crises. This research has significant implications for corporate practice and the associated risks of financing profitable projects, particularly in countries with less efficient capital markets.

Keywords: Capital structure, debt profile management, rollover risk, quasi-natural experiment, monetary policy.

RESUMO

Este estudo investiga a estrutura de vencimento da dívida de 275 empresas abertas não financeiras brasileiras de 2010 a 2019. Os resultados mostram que essas empresas não dispersam seus vencimentos de dívida na renovação, ao contrário do observado por Choi et al. (2018) para empresas dos Estados Unidos. Mesmo após o choque de rolagem da dívida depois da perda do grau de investimento da dívida soberana brasileira em 2015, essas empresas não aumentaram a dispersão de vencimentos. Ao utilizar a perda do grau de investimento do Brasil como um "experimento quase-natural" no modelo de choque de crédito, o presente estudo avalia a gestão da dívida corporativa. Os resultados indicam que as empresas brasileiras podem enfrentar consideráveis riscos de rolagem da dívida devido à concentração de vencimentos em faixas específicas durante futuros choques de crédito. O controle adequado das estruturas de financiamento é crucial para garantir que as empresas permaneçam resilientes e não precisem recusar investimentos lucrativos ou ativos de alta qualidade durante crises financeiras. Esta pesquisa tem implicações significativas para a prática corporativa e os riscos associados ao financiamento de projetos lucrativos, particularmente em países com mercados de capitais menos eficientes.

Palavras-chave: *Estrutura de capital, gerenciamento do perfil da dívida, risco de rolagem, quase-experimento, política monetária.*

RESUMEN

Este estudio investiga la estructura de vencimientos de la deuda de 275 empresas brasileñas no financieras que cotizan en bolsa desde 2010 hasta 2019. Los hallazgos revelan que estas empresas no distribuyen los vencimientos de sus deudas al renovarlas, a diferencia de lo observado por Choi et al. (2018) en empresas estadounidenses. Incluso después del shock de refinanciación tras la pérdida de la calificación de inversión de la deuda soberana brasileña en 2015, estas empresas no aumentaron la distribución de vencimientos de su deuda. Al utilizar la pérdida de la calificación de inversión de Brasil como un "experimento cuasi natural" en el modelo de shock exógeno, los autores evalúan la gestión de la deuda corporativa. Los resultados indican que las empresas brasileñas pueden enfrentar considerables riesgos de refinanciación de deuda debido a la concentración de vencimientos en rangos de madurez específicos durante futuros shocks de crédito. El control adecuado de las estructuras de financiamiento es crucial para asegurar que las empresas sigan siendo resilientes y no tengan que rechazar inversiones rentables o activos de alta calidad durante las crisis financieras. Esta investigación tiene implicaciones significativas para la práctica corporativa y los riesgos asociados a la financiación de proyectos rentables, especialmente en países con mercados de capital menos eficientes

Palabras clave: *Estructura de capital, gestión del perfil de la deuda, riesgo de refinanciación, cuasi-experimento, política monetaria.*

INTRODUCTION

The maturity structure of corporate debt has been extensively studied in the literature. Hart and Moore (1994) highlight that companies with more fixed assets tend to have more long-term financing, while Diamond (1991) shows that companies with better ratings issue short and long-term debt, medium-rated companies issue more long-term debt, and companies with lower ratings take credit almost exclusively from banks and only in the short term. Larger companies with fewer growth opportunities or operating in regulated markets tend to raise longer-term debt (Barclay & Smith, 1995). CFOs choose different debt maturity profiles to mitigate rollover risk, avoiding high debt concentration on one date (Servaes & Tufano, 2006). Firms with difficulties renewing expressive amounts of their debt may have to abandon profitable projects and even dispose of assets faster, therefore, for low amounts, inducing inefficiency in the market (Almeida et al., 2011).

Choi et al. (2018) document that American firms seek to increase the dispersion of their maturities, especially after an exogenous shock in the credit rollover risk. This study analyzes the maturity profile of publicly traded non-financial Brazilian firms between 2010 and 2019. We find that these firms do not increase the spread of their debt maturities upon renewal, even after the rollover shock that followed the downgrade of the Brazilian sovereign debt's investment in 2015. Our results suggest that firms may not be able to refinance overdue debt externally and therefore need to inefficiently liquidate assets or forgo profitable investment opportunities, as highlighted by Almeida et al. (2011). These authors also noted that, in addition to the direct implications on the level of investment, debt refinancing under unfavorable conditions emerged from market shocks can impact the firms' market value.

We evaluate the debt profile management model, using debt data by maturity range weighted by total assets in the entire sample. We estimated the ratios between the new debt issued and the fractions of debt outstanding in each of the existing maturity periods for an assessment of publicly traded non-financial Brazilian companies between 2010 and 2019 through dynamic panel data regressions. We find a high adherence of the terms of the new issues with the existing terms. We also observed large amounts of debt maturing in the first two years, a result previously documented by Fan et al. (2012) for emerging countries and still in line with the immaturity underdevelopment of the long-term debt market, according to Lazzarini et al. (2015). We assess corporate debt management using the exogenous shock model, using Brazil's downgrade in September 2015 as a "quasi-natural experiment."

We took advantage of the shock-induced discontinuity in the demand for papers from the stock of Brazilian companies abroad and evaluated the companies' indebtedness management comparing a year before and a year after the event – between 2014 and 2016. We chose the companies with a fraction of 30% or more of their debt maturing within one year of the shock as a treatment group to compare with untreated as a control group (companies with a smaller share maturing within one year). Our results suggest that Brazilian companies apparently do not manage the dispersion of their indebtedness efficiently. Our

findings diverge from those of Choi et al. (2018) and exhibit resilience to variations in the delineation of the treatment cohort.

Our study yields relevant implications for corporate financial policy in Brazil, particularly in the risks of financing profitable projects due to debt rollover risk. To our knowledge, our study is unprecedented in addressing an important dimension of the debt profile of Brazilian companies, specifically in the granularity of maturity ranges. Previous studies such as Barclay and Smith (1995), Guedes and Opler (1996), and Perobelli and Famá (2002) have focused solely on short and long-term debt. Our results are robust and contrast with those of Choi et al. (2018) and remain so even when changing the definition of the treatment group.

The findings suggest that Brazilian companies may face significant debt rollover risks in future credit shocks due to the concentration of maturities in certain maturity ranges. Even companies with low levels of indebtedness may be negatively affected by these adverse events. Efficient control of the financing structure makes companies robust enough not to be forced to reject good investments or high-quality assets during times of financial crisis.

Our study has significant implications for corporate practice and the risks associated with financing profitable projects. These implications have international relevance, especially for countries with less efficient capital markets where companies may face similar debt rollover risks.

LITERATURE REVIEW

Since Modigliani and Miller (1958), numerous studies have analyzed companies' capital structure to determine the optimal composition between equity and debt. The debt maturity dimension has been addressed by Guedes and Opler (1996) and Hart and Moore (1994, 1998), who evaluated the importance of aligning assets and liabilities (debt) for a firm. While long-term debt generally finances fixed assets such as property and machinery, short-term debt balances companies' working capital. The different profiles and types of companies also determine the search for shorter or longer-term debt. Barclay and Smith (1995) analyzed the determinants of corporate debt maturity through an empirical assessment in the United States between 1974 and 1992. They confirmed the contracting-cost hypothesis, where large or regulated firms opt for long-term debt, while those with more growth opportunities, evaluated by the market-to-book proxy, opt for short-term issuance. Perobelli and Famá (2002) conclude that larger companies in Brazil are more prone to long-term debt.

Choi et al. (2018) advanced the debate on the debt maturity structure by analyzing the maturity of new issues for publicly traded companies in the United States between 2002 and 2012. They found that the maturities of new issues were influenced by the existing indebtedness profile, implying that companies avoid "maturity towers" by issuing new debts with maturities different from those in their preexisting profile. The risk of debt rollover or refinancing is another important aspect of the literature related to corporate indebtedness. Almeida et al. (2011) concluded

that companies with a larger proportion of long-term debt maturing at the onset of the 2007 crisis in the United States experienced a more significant decline in investment compared to similar companies. Hu (2020) identified an increase in refinancing risk during the peak of the same economic crisis. Paula and Faria (2012) observe that the corporate market for private debt in Brazil was influenced by the macro-institutional environment, which affected the debt issuance itself. This instability implies a short-term debt profile with a significant portion consisting of securities linked to the Selic rate and the DI. Thus, it is possible that macroeconomic aspects produce substantial effects on the debt issuance and may influence the analysis of data for the period of the study, thus contributing to explaining possible results different from those found by Choi et al. (2018).

This study examines the impact of Brazil's rating downgrade as an external shock on firms with higher proportions of short-term debt than long-term debt. The downgrade forces such firms to roll over their debt in the short run, resulting in differential impacts across firms. The announcement of a downgrade can also trigger the forced selling of risky assets by large corporate investors, such as pension funds (Freitas & Minardi, 2013). This effect is exacerbated in emerging markets like Brazil, where bonds are highly dependent on the behavior of the stock and corporate debt (bond) markets. Moreover, the timing of such announcements is generally not anticipated until a week or two before the announcement (Afonso et al., 2012). Finally, the downgrade of a country's credit risk rating generates greater volatility in the stock market and corporate debt (bonds) market, with sovereign debt as the benchmark (Dittmar & Yuan, 2008). 'According to previous studies on sovereign rating reviews, a downgrade has implications for flow, cost of capital, and credit availability (Chen et al., 2016).

Similar to Franzotti and Valle (2020), who analyzed a shock and the consequent behavior of companies in financing management, this study aims to assess the impact of financially constrained and unconstrained firms in Brazil. However, the cited authors more directly assess the impact of the 2008 crisis on the short-term leverage of constrained firms. Hu (2020) and Almeida et al. (2011) argue that debt rollover risk is a critical factor during periods of economic shocks, leading to the construction of a more dispersed portfolio of debt over time, anchored in the lowest costs linked to debt issuance. They note that the marginal spread of Bond issuances in US dollars in the 1990s tended to increase over time. In the same vein, but under the prism of a lack of liquidity in secondary markets due to the fragmentation of papers, Lybek and Sarr (2002) indicate that market participants associate liquidity with the high volume available for trading without affecting the price.

In the Brazilian market, Giacomoni and Sheng (2013) and Almeida and Bazilio (2015) demonstrate that the secondary debenture market is still small and undeveloped, below the level of government bonds, thus showing that this may be a factor of less concern for companies for issues carried out in Brazil, since the illiquidity condition is inherent to the current market structure, in analyses conducted over the first decades of the 21st century. The result of the Brazilian authors is consistent with Fan et al. (2012), who found, in a study on capital structures

analyzing 39 countries, that firms in countries with a higher share of sovereign bonds have more debts in the short term, indicating that such bonds tend to repel long-term corporate debt.

Franzotti et al. (2021) analyze the capital structure and maturity of Brazilian companies' debts during the 2002, 2008, and 2015 crises. They concluded that Brazilian companies reduce long-term debt and increase short-term debt in crises. However, the authors work with the total debt, while this article breaks down the debt by annual period from the first to the sixth year of maturity and maturing from seven years, a contribution not yet found for Brazilian companies. Another factor differentiating the Brazilian context from the North American market is the financing carried out by the Brazilian Development Bank (BNDES). Despite BNDES purpose as a financial institution maintained by the government mainly concerned with the supply of long-term capital for the industry, Lazzarini et al. (2015) conclude in a study carried out for publicly traded companies between 2002 and 2009 that BNDES subsidizes companies that could be financed with other sources of capital. The segmentation of companies carried out by the bank creates selectivity, leaving the larger risks to the private sector, which somehow inhibits the formation of a long-term private market. Although BNDES financing has been decreasing in the Brazilian market since 2015, according to the Securities and Exchange Commission of Brazil (CVM, 2019), this bank's performance influenced and impacted not only the companies' debt profile but also the local credit market in general, especially after the end of TJLP in 2018. At the same time, the offer of long-term credit is fostered by an expansion in private funding via bond issuance (Aparecida et al., 2021).

Tarantin and Valle (2015) argue that the advent of CVM Instruction n. 476/2009 made it possible for large Brazilian companies listed on B3 (then BM&FBOVESPA) to access a long-term local capital market, making BNDES indebtedness an intermediate-term composition.

Furthermore, adopting International Financial Reporting Standards (IFRS) in Brazil has had significant implications for the structure of debt contracts and financial covenants. Beiruth et al. (2017) found that after IFRS adoption, companies increased the number of covenants. Additionally, Silva et al. (2013) suggest that financial covenants and short-term debt act as substitutes for minimizing agency conflicts. Companies with growth opportunities can exchange short-term debt for long-term debt based oncovenants, without hindering their financing options. Konraht and Soares (2020) highlight the complementary and substitutive roles played by financial covenants in bond issues in Brazil, depending on whether the issuer or guarantor is responsible for fulfilling the covenant. Furthermore, Funchal and Monte-Mor (2016) demonstrate the positive effect of laws and regulations, such as the Sarbanes-Oxley Act, on firms' access to the credit market, reducing the cost of debt and increasing total debt through long-term and private debt.

Bankruptcy law reform in Brazil in 2005 and recently in 2021 also impacted the credit market. Martins (2020) found that the bankruptcy reform in Brazil, which increased creditors' protection, led to a decrease in risk-taking by firms with concentrated ownership structures. Rosa et al. (2022) analyzed the impact of Brazil's amended Bankruptcy Law and concluded that it had made the sale of assets of companies undergoing judicial reorganization more attractive to foreign investors. Silva and Saito (2020) conducted a survey of bankruptcy and reorganization literature

and concluded that information asymmetry, coordination problems, and heterogeneity between creditors are pivotal to the resolution of financial distress. Zeidan (2020) reviewed the literature on the determinants of credit spreads in Brazil and posited that higher market concentration is part of a well-defined strategy by the Brazilian Central Bank that favors prudence over efficiency.

METHODOLOGY

We employed a methodology in this study that involved using a sample of publicly traded Brazilian companies between fiscal years 2010 and 2019. The data was obtained from Capital IQ (S&P), which sources information from regulatory authorities of the capital market, such as the Securities Commission and the CVM in Brazil. We categorized the companies based on the Global Industry Classification Standard developed by Morgan Stanley Capital Information (MSCI) and in collaboration with S&P, available within Capital IQ. We excluded companies classified as belonging to the "financial sector" from the sample due to their unique characteristics and regulations within the national financial system.

To assess the long-term rating on a global scale of S&P, Moody's, and Fitch for the period of analysis, we used data extracted from Bloomberg in the shock model. This is due to the limited information available on the Capital IQ platform. To standardize and assess changes in classification within the sample, we ordered and scaled the agencies' ratings unitarily. Variations between periods were obtained through annual evaluations. Companies without rating assessments in the period were assigned a variation of non-existence since they did not have annual data.

The debt profile management model used in this study consisted of 2,509 firm-year observations between 2010 and 2019. In contrast, the shock model only considered the interval of one year before and one year after the event, i.e., the downgrade of Brazil's rating in September 2015. Thus, the set had data between 2014 and 2016, consisting of 813 firm-year observations.

Due to the significance of analyzing the direct effect of companies that have debts with BNDES in the Brazilian context, we find it relevant to include this segregation. However, the categorization of debt instruments in Capital IQ or similar tools does not provide this information directly, making it difficult to analyze this nature with the available data.

Description of variables

The response variable for the debt profile management model will be the fraction of new debts issued by time band j, of each firm i and in each year t, thus being described as I_{it}^{j}, where such metric will be weighted by the firm's total assets. The time range j represents an annual maturity range ($1 \leq j \leq 6$), with the last maturity range representing issues $j \geq 7$ years. The issuance of new debt is a component disclosed by publicly traded companies in the publication of their balance sheets, thus allowing for adequate comparison over time in a feasible manner.

In turn, the independent variable of the model in question will be the indebtedness profile existing in each company at the time of issuance of new debts, where, in an equivalent way, it will be given by m_{it}^{j} - the proportion of outstanding debt per time band j, of each firm i and in each year t. Similarly, the variable will be weighted by the firm's total assets at the same time earned.

Thus, the time range j will be a measure of annual variation (1 year ≤ j ≤ 6 years) and j ≥ 7 for the last time range. Thus, such metric will comprise both the preexisting debt profile, measured through the variable m_{it}^{j}, and the issuance of new debt I_{it}^{j}.

In the second objective, through the quasi-natural experiment (shock model), the response variable seeks to understand whether there was an increase in debt dispersion (Di,t), using the quasi-natural experiment that occurred (downgrade of Brazil's rating in September 2015) and comparing the treatment and control groups. The debt dispersion metrics were based on the methodology carried out by Choi et al. (2018).

The calculation of debt dispersion was based on the inverse of the Herfindahl-Hirshman (IHH) index, which is a measure of concentration:

$$D_j = \frac{1}{IHH_j}, \quad (1)$$

where $IHH_j = \sum_i (w_i)^2$ *and* $w_i = \frac{x_i}{\sum_i x_i}$ represents the proportion of debt maturity in each time band.

Therefore, if a company has n debt maturities with equivalent weights for each period, the $IHH_j = {}^{1}/_{n}$ and the debt dispersion measure is $D = n$.

The main independent variables for the model are (a) a dummy variable "event" which will be equal to one if the period is after the September 2015 downgrade, and zero otherwise, and (b) a variable "treatment" which will be a dummy not correlated with the time factor for firms that have more than 30% of debt securities maturing in the first year after the shock, i.e. September 2015.

In the American market, Choi et al. (2018) use a percentage of 5% for the same metric. This change is due to differences in market size between countries, as indicated by CVM (2019), in which the United States has a private debt ratio under GDP 3.2x higher than the Brazilian level, and the concentration of debt of Brazilian companies in the short term. Nevertheless, Silva and Valle (2008), when analyzing the evolution of the debt of Brazilian and American companies from different sectors at the turn of the 2000s, observed that in 2003, the last year of evaluation, therefore closer to this study and that of Choi et al. (2018), that the proportion of short-term debt of Brazilian companies was about four times higher than that of American companies. Finally, the fact that companies account for debt service in the short term and the local interest reference measured by the daily SELIC rate has increased by more than 5% p.a., leaving 8.2% p.a. in 2013 to 14.0% p.a. in 2016, they support the growth of such metric, where fixed income assets by themselves already have a natural tendency toward greater volume.

We also consider a dummy variable "downgrade" to capture the possible impact of the companies' risk rating drop after the event. The inclusion of the dummy "downgrade," which is a negative review of the credit score, is supported by the literature by Barclay and Smith (1995) and Guedes and Opler (1996), who consider aspects of firm quality and credit risk as factors that influence the debt term. It is noteworthy that, according to S&P General Criteria: Country Risk Assessment Methodology and Assumptions (2013), the sovereign rating does not mean a maximum rating threshold for companies, since "a sovereign default does not imply that all entities in the country will default."

In addition to the response variable described above, the shock model has control variables similar to Choi et al. (2018) to assess the ability to compare the treatment and control groups. Such variables range from parameters linked to the companies' net indebtedness such as total debt (TD: ratio of total debt to total assets), cash (Cash: ratio of cash and cash equivalents and short-term financial investments to total assets), the percentage of debt instruments such as Bonds (BondPct: proportion of debt classified as Bonds in relation to total debt) and bilateral banking (TLPct: proportion of debt classified as term loans in relation to total debt) and profile of outstanding debt (Nomd: counts the different number of maturities existing for the outstanding debt, ranging from 0 to 7), and general characteristics related to efficiency such as company value (MtB: market-to-book ratio that considers the relationship between market capitalization, that is, the firm's market value, in relation to the book value, that is, equity), size (Size: natural logarithmic of total assets), leverage (Debt/EBITDA: ratio of net debt to EBITDA, as available directly in Capital IQ), profit (Profitability: ratio of operating profit to total assets), and investment in fixed assets (CAPEX: ratio of net fixed assets, plant and equipment (CAPEX) in relation to total assets).

Econometric model

For the debt profile management model, we followed the methodology in Choi et al. (2018) and estimated panel linear regressions of debt issuance for each period in maturity "j". The response variable represents the fraction of new debts relative to total assets in the maturity period "j". At the same time, the fractions of outstanding debt in each of the existing maturity periods, relative to total assets, are the independent variables. If firms avoid the concentration of debt in the same time band, new issues in period "j" should be negatively related to the maturity profile in the same period "j". We consider firm and time fixed effects in the estimate.

Equation (2) defines the empirical model:

$$I_{it}^{j} = \alpha_0 + \alpha_1 m_{it}^{1} + \alpha_2 m_{it}^{2} + \alpha_3 m_{it}^{3} + \alpha_4 m_{it}^{4} + \alpha_5 m_{it}^{5} + \alpha_6 m_{it}^{6} + \alpha_7 m_{it}^{7} + a_i + b_t + \varepsilon_{it}^{j}, \quad (2)$$

where I_{it}^{j}, is the fraction of new debt issues in relation to total assets for each annual maturity range j ($1 \leq j \leq 6$), with the last maturity range representing issues $j \geq 7$ years, m_{it}^{j} is the proportion of debt that matures in relation to total assets for each annual period j ($1 \leq j \leq 6$), with

j ≥ 7 years representing the last range of debt maturities, a_i and b_t represents the unobserved effect of firm and time and $\varepsilon_{i,t}$ is the idiosyncratic error. In this model, as Choi *et al.* (2018), firm and time characteristics are controlled using fixed effects in regression with panel data that account for the unobserved heterogeneity of the companies.

For the shock model, we consider the downgrade of Brazilian sovereign debt's investment in September 2015 by the S&P rating agency, as a "quasi-natural experiment." Therefore, the rollover risk due to the credit downgrade event creates a shock in the beliefs of companies about the risk of debt rollover, especially for those with business models linked to the local economy, such as companies of service and retail. From the total sample, we identified the causal effect of corporate debt rollover risk using firms that had in 2014 (before the shock) more than 30% (trigger) of debt maturing in the first year, thus forming the treatment group.

The control group is formed by untreated observations below the trigger to be considered by the "matching" process with variables that can affect debt issuance and maturity options. Thus, each treatment group variable will be "matched" (with replacement) with the untreated variables.

Thus, we evaluated the management of corporate debt dispersion for the two groups by examining a one-year period both before and after the event, between 2014 and 2016. We estimate a Difference-In-Difference (DID) model using a balanced panel regression, with firm and time fixed effects and control variables.

Equation (3) defines the empirical model:

$$D_{i,t} = \alpha_0 + \alpha_1 Event_t . Treatment_i + \alpha_2 Event_t + \alpha_3 Treatment_i + Controls + a_i + b_t + \varepsilon_{i,t} , \quad (3)$$

where $D_{i,t}$ is the measure of debt dispersion, $Event_t$ is a dummy variable with a value equal to 1 (one), if the period is after the September 2015 downgrade, $Treatment_t$ has a value equal to 1 for firms that have more than 30% of debt securities maturing in the first year after 2014, a_i and b_t represent the unobserved effect of firm and time and $\varepsilon_{i,t}$ is the idiosyncratic error.

Next we analyze whether, when faced with an increase in rollover risk, firms increase the dispersion of their debt maturities. Therefore, if treatment group firms respond to an increased rollover risk by further dispersing their debt structure over time, it is expected that $\alpha 1$ is positive.

RESULTS

Table 1 summarizes data from 2,509 observations from 275 companies collected between 2010 and 2019 and data from 813 observations for 276 companies, considering the shock model, which covers the period between 2014 and 2016, with 2015 being the year marked by the downgrade of Brazil's rating.

The number of existing maturities of outstanding debt (Nomd) and the number of periods of debt issued (Nissued) demonstrate the variation in the debt profile in the sample. While there are 4.21 distinct periods in the average of outstanding debt with a standard deviation of 2.82, the average distinct period of debt issued is 2.60 with a standard deviation of 2.16. Disparities are also observed for the median values earned.

In terms of debt distribution, there is a greater share of long-term debt (LTD) compared to short-term debt (STD) either from an average or median view, with an equivalence of deviations between the data. The dispersion of debt (D1) shows that companies opt for a greater concentration of maturities since such indicators are below the average possible period (3.5).

We observed that firms have an average net indebtedness condition for the control variables, as they have more debt than cash (55% and 12%, respectively), both weighted by total assets. In turn, the categories of debt related to bank financing (TLPct) and Bonds (BondPct) represent about 72% of the average total debt of the analyzed firms.

Table 1. Descriptive statistics of variables

Variable	Mean	Standard deviation	1st quartile	Median	3rd quartile	n
Nodm	4.21	2.82	1.00	6.00	7.00	2,509
Nissued	2.60	2.16	1.00	2.00	5.00	2,509
$I_{it}j=1$	0.056	0.20	0	0	0.036	2,509
$I_{it}j=2$	0.025	0.09	0	0	0.015	2,509
$I_{it}j=3$	0.012	0.03	0	0	0.009	2,509
$I_{it}j=4$	0.010	0.02	0	0	0.009	2,509
$I_{it}j=5$	0.007	0.02	0	0	0.004	2,509
$I_{it}j=6$	0.005	0.02	0	0	0	2,509
$I_{it}j=7$	0.016	0.04	0	0	0.008	2,509
m_{it} j=1	0.148	0.60	0.04	0.08	0.15	2,509
m_{it} j=2	0.058	0.11	0	0.02	0.08	2,509
m_{it} j=3	0.034	0.05	0	0.01	0.05	2,509
m_{it} j=4	0.027	0.04	0	0.01	0.04	2,509

Continue

Table 1. Descriptive statistics of variables

Concludes

Variable	Mean	Standard deviation	1st quartile	Median	3rd quartile	n
m_{it} j=5	0.019	0.03	0	0.01	0.03	2,509
m_{it} j=6	0.015	0.03	0	0	0.02	2,509
m_{it} j=7	0.045	0.11	0	0	0.05	2,509
STD	0.39	0.28	0.16	0.33	0.55	765
LTD	0.61	0.28	0.45	0.67	0.84	765
Duration	2.88	1.35	1.89	2.8	3.9	813
TD	0.55	2.58	0.16	0.32	0.45	813
Cash	0.12	0.11	0.03	0.09	0.16	813
BondPct	0.24	0.29	0	0.10	0.42	813
TLPct	0.48	0.36	0.13	0.46	0.80	813
MtB	1.39	8.08	0.29	0.82	1.86	622
Size	7.64	2.04	6.54	7.82	8.92	813
Debt/EBITDA	4.07	7.65	0.68	2.2	4.14	662
Profitability	0.03	1.52	0	0.05	0.09	813
CAPEX	0.25	0.24	0.03	0.21	0.39	813

Note. Nodm represents the number of existing outstanding debt maturities. Nissued shows the number of debt periods issued. $Iitj$ and $mitj$ are, respectively, the fraction of new debt issues and the proportion of debt maturing, both in relation to total assets, for each annual maturity range j ($1 \leq j \leq 6$), being the last maturity range representing emissions $j \geq 7$ years. The indicators show the proportions of short-term (STD) and long-term (LTD) debt. The dependent variables represent measures of debt dispersion, where D1 is the inverse of the Herfindahl-Hirshman index of the debt maturity fractions for its composition. The TD and Cash control variables consider the ratio of total debt and the balance of cash and cash equivalents and short-term financial investments, respectively, both in relation to total assets. BondPct and TLPct are debt fractions classified as Bonds and term loans (bank financing), respectively. MtB means the market-to-book ratio that considers the relationship between market capitalization (firm's market value) in relation to book value (Equity). Size brings the natural log of the total asset. Debt/EBITDA represents the ratio of net debt to EBITDA, as available directly in Capital IQ. Finally, Profitability and CAPEX bring the ratio between operating profit and net fixed assets, plant, and equipment, respectively, both in relation to total assets.

Source: Elaborated by the authors.

Debt profile template

This section presents the results of the debt profile management model. Table 2 summarizes the regressions performed using equation (2) with a fixed effect on the estimate for company and year.

Based on the analysis of the results in Table 2, it is possible to reject the hypothesis that firms avoid the concentration of debt in the same period. Assessing the diagonal coefficients, we observe that, except for period j = 1 in $m_{1i}{}^{t}$, they are statistically significant at 95% confidence, considering that new issues in period j are positively related to the maturity profile in the range $m_{it}{}^{j}$, demonstrating that the firms apparently care little about the concentration of debt, forming the so-called maturity towers. This result contrasts those in Choi et al. (2018) for the US, where firms manage maturity dispersion in that newly issued corporate bonds complement preexisting bond maturity profiles instead of concentrating like our result.

Additionally, through such results, it is possible to validate the economic relevance of certain emissions. With 99% confidence, it is possible to verify, for example, that new debts issued for maturity in up to 3 years ($I_{it}{}^{3}$) decrease by 10.5% for an increase of one percentage point in the fraction of debt maturing from year 5 to total assets.

To enhance the robustness of the model, alternative regressions were employed to validate the results. To minimize the influence of outliers on the results, the analyzed data underwent winsorization of the variables to 1% of the lower values and 1% of the higher values. Additionally, regressions were conducted for each of the ten sectors provided by Capital IQ based on the Global Industry Classification Standard. The results obtained from these regressions generally confirm the conclusions reached in the previous analysis.

Table 2. Panel regression for debt profile model

	Dependent Variable						
	$I_{it}j=1$	$I_{it}j=2$	$I_{it}j=3$	$I_{it}j=4$	$I_{it}j=5$	$I_{it}j=6$	$I_{it}j=7$
m_{it} j=1	0.001	-0.001	0.0001	-0.001	-0.002	-0.0004	-0.001
	(0.018)	(0.001)	(0.0004)	(0.001)	(0.001)	(0.0004)	(0.001)
m_{it} j=2	-0.393***	0.329***	-0.008	-0.007	-0.007	-0.006	0.009
	(0.065)	(0.088)	(0.011)	(0.006)	(0.005)	(0.005)	(0.009)
m_{it} j=3	-0.462***	0.035	0.431***	-0.001	-0.018	-0.025*	0.034
	(0.058)	(0.068)	(0.033)	(0.027)	(0.017)	(0.011)	(0.028)
m_{it} j=4	-0.370***	-0.023	-0.036	0.439***	-0.005	0.011	-0.005
	(0.109)	(0.031)	(0.027)	(0.062)	(0.023)	(0.017)	(0.036)

Continue

Table 2. Panel regression for debt profile model — Concludes

	Dependent Variable						
m_{it} j=5	-0.207	-0.137***	-0.105***	-0.092*	0.336***	-0.018	0.044
	(0.123)	(0.052)	(0.028)	(0.042)	(0.046)	(0.032)	(0.042)
m_{it} j=6	0.042	0.005	-0.025	0.003	0.062	0.372***	-0.161***
	(0.185)	(0.066)	(0.035)	(0.048)	(0.051)	(0.072)	(0.037)
m_{it} j=7	-0.179**	0.003	-0.010	-0.025*	-0.031**	-0.035***	0.162**
	(0.059)	(0.014)	(0.007)	(0.011)	(0.011)	(0.010)	(0.058)
n	2509	2509	2509	2509	2509	2509	2509
R^2	0.124	0.147	0.327	0.318	0.253	0.265	0.130

Note. In the estimate, fixed effects for firm and year were considered. In parentheses are the standard error values. ***, ** and * denote statistical significance at 0.1%, 1%, and 5%, respectively.

Source: Elaborated by the authors.

Shock model

Through the quasi-natural experiment related to the credit downgrade in Brazil (September 2015), we analyzed whether this event led companies to spread the maturity of their obligations, thus avoiding the risk of rollover.

In this analysis, we begin by considering the treatment group of firms with more than 30% of their outstanding debt maturing in the short term (up to one year) prior to the Brazil downgrade. This is due to the potential for the shock to cause these companies to inefficiently liquidate their assets or roll over debts under unfavorable conditions to meet existing liabilities, which could compromise their investment opportunities, growth, and overall firm value, as demonstrated by Almeida et al. (2011). Therefore, we anticipate these companies would seek greater dispersion of their short-term debt maturity. As a result, we expect the control group to have a less significant debt dispersion compared to the treatment group since the dispersion of debt maturity in the short term is a less relevant management issue for these companies. To test the robustness of the credit shock model analysis, we conducted paired tests between firms, considering a treatment group with more than 20% of their outstanding debt maturing in the short term before the downgrade in Brazil.

Table 3 compares the treatment and control group. Of the 276 companies in the sample, we took as a basis a balanced set of data and only those companies that had outstanding debts in the three years (2014 to 2016) of analysis of the model, resulting in 131 firms. Thus, we have a set of 69 companies treated and 62 not treated.

Table 3. Descriptive statistics and comparison between treated and control companies

	Mean		T-Test	
Variable	Treated	Controlled	t	p-value
Duration	2.253	3.738	-11.35	<0.001
TD	0.298	0.328	-1.650	0.103
Cash	0.127	0.126	0.060	0.952
BondPct	0.226	0.292	-2.450	0.015
TLPct	0.520	0.497	0.750	0.451
Nodm	5.275	5.787	-2.240	0.026
MtB	1.827	2.074	-1.160	0.247
Size	7.933	8.616	-4.990	< 0.01
Debt/EBITDA	2.861	2.714	0.340	0.735
Profitability	0.070	0.079	-1.860	0.084
CAPEX	0.238	0.229	0.410	0.679
Pseudo R^2 = 0.051				

Source: Elaborated by the authors.

The matching process was based on the Mahalanobis distance, as done by Choi et al. (2018). As shown in Table 5, the treatment and control groups are similar after the matching process, using a significance level of 5%, except for Bonds (BondPct), outstanding debt profile (Nomd), and size (Size). Although Resende and Oliveira (2008) indicate that the inclusion of these variables does not tend to impact the estimate of the shock model, they will be considered as control variables in the model to verify the direct impact on the dispersion of the firms' debt after the downgrade in Brazil, as evidenced by equation (3).

Table 4 summarizes the estimation of equation (4), made using firm fixed effects. Several models were estimated to assess the results obtained more specifically, by including or removing control variables and considering firms' downgrade and average debt duration. The results in Model 1 indicate that the treated firms, on average, spread their debts, but less than the control group. This lesser dispersion of debt maturities of treated companies in relation to companies in the control group is robust even after the inclusion of controls, the downgrade effect, and the effect of the duration, as seen in models 2 to 6. According to Servaes and Tufano (2006) and Choi et al. (2018), this result is the opposite of what is expected after a shock.

Our results are in line with Diamond's (1991) theoretical model whereby companies with higher credit risk end up taking more short-term credit through banks instead of issuing longer

debts in the capital market and, therefore, not managing to disperse more than they seek. Note in models 5 and 6 that the debt duration has a relevant and positive impact on increasing the dispersion of debt, confirming our statement above and in line with Paula and Faria (2012) and Franzotti et al. (2021).

Table 4. Panel regression for shock model using debt dispersion as the response variable

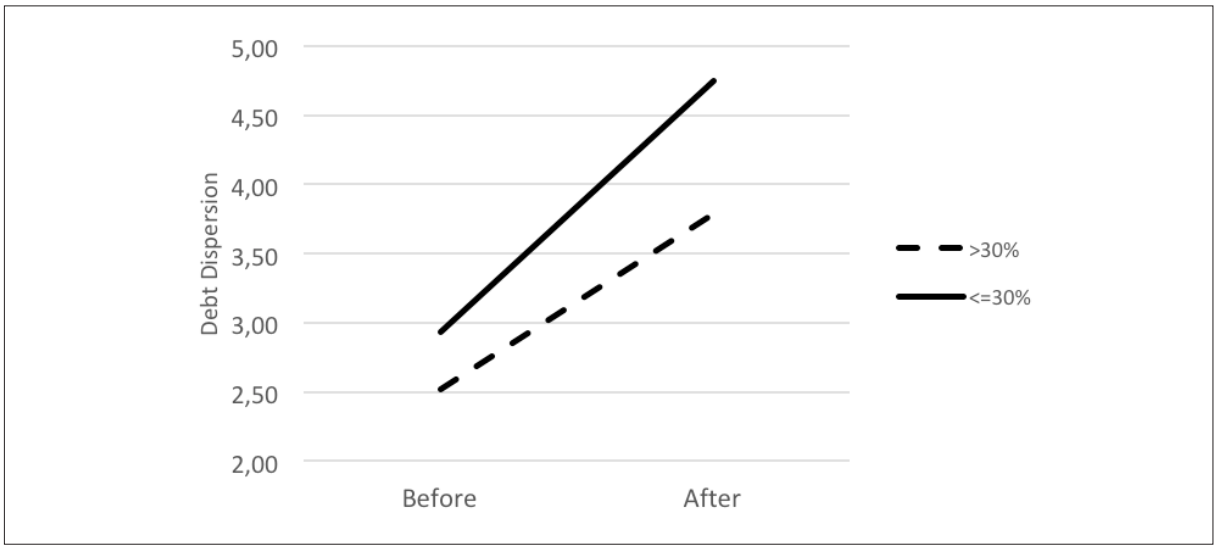
Variable	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Event*Treatment	-0.544	**	-0.474	***	-0.465	**	-0.472	***	-0.389	***	-0.386	***
	(0.267)		(0.139)		(0.280)		(0.147)		(0.146)		(0.154)	
Event	1.816	***	0.306	***	1.790	***	0.268	***	0.2679	***	0.2294	**
	(0.194)		(0.114)		(0.205)		(0.119)		(0.113)		(0.121)	
Treatment	-0.416		-0.157		-0.416		-0.170		-0.082		-0.094	
	(0.275)		(0.183)		(0.275)		(0.184)		(0.189)		(0.189)	
Treatment*Downgrade					-0.616		0.103		-0.616		0.0978	
					(0.562)		(0.322)		(0.562)		(0.322)	
Downgrade					0.135		0.160		0.135		0.1628	
					(0.343)		(0.193)		(0.343)		(0.192)	
Duration									0.1239	**	0.1249	**
									(0.058)		(0.059)	
Intercept	2.940	***	0.710		2.937	***	0.770		0.5837		0.6503	
	(0.201)		(0.481)		(0.199)		(0.485)		(0.199)		(0.485)	
Company effect	Yes		Yes		Yes		Yes		Yes		Yes	
Controls	No		Yes		No		Yes		No		Yes	
R2	0.22		0.70		0.22		0.71		0.70		0.70	

Note. In parentheses are the robust standard error values. ***, ** and * denote statistical significance at 1%, 5%, and 10%, respectively.

Source: Elaborated by the authors.

Figure 1 graphically represents the results of Model 1 in Table 4. It is possible to notice that both companies with more than 30% of debt maturing in one year after September 2015 (treatment group) and companies with up to 30% (control group) increased the dispersion of debts. However, this increase in dispersion was greater for companies with up to 30% of debt maturing right after the event, as these companies have a greater volume of short-term debt.

Figure 1. Graphic representation of debt dispersion using Model 1 in Table 4 for firms with up to 30% (control group) and more than 30% (treatment group) of debt securities maturing in the first year after Sep/2015



Source: Elaborated by the authors.

To better analyze what happens with the debt duration, we estimate the model of equation (4), choosing the duration as the response variable with results in Table 5. Analyzing these models, it is evident that after the credit shock, companies seek to increase the term of their debts. However, the treated companies always increased less than the companies in the control group (see results of the interaction between Event and Treatment). This result reinforces our previous findings that companies with shorter debt maturities cannot disperse maturities to avoid risks of renewal, as expected in Servaes and Tufano (2006). Our results also contrast those of Choi et al. (2018), that find that US firms increase their debt maturity dispersion after the shock.

Table 5. Panel regression for shock model using duration as the response variable

Variable	Model 1		Model 2		Model 3		Model 4	
Event*Treatment	-0.727	***	-0.677	***	-0.682	***	-0.676	***
	(0.183)		(0.107)		(0.191)		(0.113)	
Event	1.299	***	0.287	***	1.301	***	0.289	***
	(0.133)		(0.087)		(0.140)		(0.092)	
Treatment	-0.856	***	-0.600	***	-0.856	***	-0.599	***
	(0.188)		(0.134)		(0.189)		(0.135)	
Treatment*Downgrade					-0.418		-0.016	
					(0.384)		(0.244)	

Continue

Table 5. Panel regression for shock model using duration as the response variable Concludes

Variable	Model 1		Model 2		Model 3		Model 4	
Downgrade					-0.008		-0.007	
					(0.235)		(0.146)	
Intercept	2.722	***	0.578		2.722	***	0.572	
	(0.137)		(0.371)		(0.137)		(0.375)	
Company effect	Yes		Yes		Yes		Yes	
Time effect	Yes		Yes		Yes		Yes	
Controls	No		Yes		No		Yes	
R2	0.37		0.73		0.37		0.73	

Source: Elaborated by the authors.

Although the North American study of the last decade considered only one year of variation in relation to the date of the "shock" event, it is questionable whether in a smaller and less developed debt market like Brazil, as pointed out by CVM (2019), such metric is enough for companies to manage their debt portfolio efficiently. Thus, the same previous analyses were developed for two years after the test event and did not change the evidence found.

CONCLUSIONS

In conclusion, our study found that publicly traded non-financial Brazilian firms generally seek to preserve their indebtedness terms and do not avoid the formation of maturity towers, even after a credit shock such as the downgrade of Brazil's sovereign debt rating in September 2015. Companies with greater short-term credit renewal needs cannot spread their debt maturities further compared to a control group of Brazilian companies. This effect can be explained by debt renewals being carried out in shorter average terms than the control companies.

While a dispersed debt structure can be costly due to higher total issuance costs and less liquidity in secondary markets, a more concentrated structure represents high debt rollover risks, as Almeida et al. (2011) documented. Additionally, our study suggests that macroeconomic factors, such as the drop in economic activity that occurred after the downgrade shock of Brazil's sovereign debt rating and the reduction in the use of debt issuance in the market, can also influence the formation of maturity towers with lesser dispersion of debt and shorter terms within the analyzed period (Almeida & Bazilio, 2015; Giacomoni & Sheng, 2013; Paula & Faria, 2012).

Furthermore, Altinkiliç and Hansen (2000) suggest that another reason that Brazilian companies concentrate their debt profile more may be anchored in reasons of economies of scale due to the higher issuance cost. As the US corporate debt market is 3.2 times higher than

the Brazilian market, according to the CVM (2019), there may be less incentive from the point of view of cost and synergy for local companies to have a more dispersed debt distribution.

Previous studies emphasize the significance of the debt maturity structure and the risk of debt rollover in a company's capital structure. It is recommended that firms avoid maturity towers and opt for a diversified debt portfolio anchored in the lowest costs linked to debt issuance. Furthermore, macroeconomic factors can substantially impact debt issuance and influence the data analysis of the study period. Our data indicate that, despite being pressured to renew their debt due to a larger portion of their debt being due within a year, companies in the Brazilian market do not act accordingly in normal times or even after a macroeconomic shock. Other possible explanations include the lack of debt offerings with different maturities for local firms, local bank preference for short-term debt to reduce moral hazard risk, and firms' financial constraints limiting their access to international credit sources.

In light of these findings, it is crucial for policymakers and market participants to understand the implications of a concentrated debt structure and the importance of having a diversified debt portfolio in mitigating risks associated with debt rollover. The results of this study can contribute to developing policies and practices that promote a more efficient and stable capital market in Brazil.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

AUTHORS' CONTRIBUTION

João Daniel Azevedo dos Santos: Conceptualization, data curation, formal analysis, funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Writing – original draft; Writing – proofreading and editing.

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