

# The relationship between the level of debt specialization and financial constraint of Brazilian firms over the time

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## ABSTRACT

This article sought to analyze the historical evolution, the composition, and the determinants of debt specialization of Brazilian firms traded on Brasil, Bolsa, Balcão (B3) from 2004 to 2019 in aggregate terms and in accordance with their financial constraints. This paper differs from the few studies on this topic carried out in Brazil and in other countries by promoting a discussion on the specialization of the debt structure in a context of financial constraints, as they are a relevant idiosyncrasy of emerging markets, such as in Brazil. The relevance of the study is to identify that debt specialization is a feature of only of financially constrained firms and not of the financially unconstrained ones. The impact of the study lies in a better understanding of why Brazilian firms are reducing their debt specialization, unlike other international evidences, such as the U.S. Descriptive statistics and regressions were estimated using the probit and tobit methods for 246 Brazilian firms between 2004 and 2019. The main result is that financial constrained firms are more likely to specialize their debt structure. Despite this propensity, these companies were the ones that most decreased their debt specialization between 2004 and 2019 (-27.77%), compared to the general sample (-27.5%) and unconstrained firms (-19.48%), revealing a behavior contrary to the U.S. scenario in which companies are increasingly specialists.

**Keywords:** debt structure, specialization, financial constraint, emerging market.

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## 1. INTRODUCTION

Most of the existing studies on capital structure deal with the company's choice regarding equity or debt capital to finance its activities, but this decision also involves the option on the type of debt resource to be used, that is, their debt structure. In this sense, when analyzing only the resources of debts, most studies on capital structure directed their attention to the construction of theoretical models, as well as to the treatment, considering that this source of capital is uniform (formed by only one resource) (Póvoa & Nakamura, 2014; Rauh & Sufi, 2010). However, according to Colla et al. (2013), the debt structure is not uniform, and, consequently, none of capital structure is adequate to explain debt heterogeneity.

In this sense, Rauh and Sufi (2010) demonstrated that traditional capital structure studies, which ignore debt structure, lose substantial variation in the capital structure. Thus, when treating debt as uniform, features, such as source of funds, debt maturity, transaction costs, managerial incentives, information asymmetries, among others, are ignored, but they are potentially relevant to understanding how companies structure their debt (Lou & Otto, 2020; Póvoa & Nakamura, 2014; Rauh & Sufi, 2010).

Póvoa and Nakamura (2014) and Tarantin and Valle (2015) are the pioneers in studying the specialization of the debt structure in Brazil. However, there are no studies in Brazil, as far as it has been identified, that reveal the evolution of the debt structure, as well as whether there is a tendency towards greater or lesser specialization over time. Still, the findings of Colla et al. (2013) that more constrained firms tend to specialize (concentrate on one or two debt sources) were not verified in the Brazilian literature. We understand that this factor (financial constraint) in Brazil can significantly influence the behavior of companies regarding the formation of the corporate debt structure, differentiating our study from the others, like Eça and Albanez (2022), Póvoa and Nakamura (2014), and Tarantin and Valle (2015). This argument is based on the fact that an emergent economy has different institutional characteristics, such as high interest rates, less legal protection for investors and high concentration of control, lower level of financial development, among others, which probably decrease investors' willingness to provide resources and increase the costs associated with external financing and the guarantees required for granting loans (Dyck & Zingales, 2004; La Porta et al., 1998).

Thus, this study is justified by its novelty in relating financial constraints and debt structure of Brazilian firms;

it is important to consider the constraints on the firm's ability to achieve its desired debt structure (Colla et al., 2013, 2020). In this context, this study aims to analyze the historical evolution, composition, and determinants of the debt specialization of Brazilian firms in an aggregated way and conditioned to their financial constraints.

Based on the referenced literature, the main hypothesis of the present study is that financially constrained Brazilian firms (without credit rating) have a greater degree of debt specialization over time compounding it mainly by loans, as they do not have access to a multiplicity of the products available from the financial and capital markets. For this purpose, probit and tobit regression models were estimated in which the dependent variable is represented by the Herfindahl-Hirschman index (HHI), which measures the debt specialization of Brazilian firms from seven different types of debt, as commercial paper, revolving credit, senior bonds and notes, and subordinated bonds and notes, bank debt, capital leasing, and others. We analyzed 246 public Brazilian firms present in the Capital IQ database from 2004 to 2019.

In summary, the results indicate some patterns: first, we identified that Brazilian constrained firms are more prone to debt specialization. We also identified that constrained companies depend more exclusively on a single type of debt as, at least, 37% of these companies depend 99% of their debt on a single type, while only 5% of unconstrained companies have this dependence. This result of unconstrained firms presents a completely different scenario for the Brazilian context because reveals that the dependence of U.S. firms is, at least, four times greater than the dependence of Brazilian firms, considering this threshold. Therefore, unlike the U.S. scenario, unconstrained Brazilian firms are not specialized in debt.

Second, when analyzing the debt structure historical evolution (over time), as well as the types of debt, we can identify trends and issues not revealed in the literature on Brazilian firms. Between 2004 and 2018, Brazilian firms, in general and financially constrained and unconstrained, declined their debt specialization in 27.5%, 27.77%, and 19.48%, respectively. This result diverges from that recently exposed by Colla et al. (2020), in which they revealed that U.S. firms increased their debt specialization along the time (9.85%).

Thus, while U.S. firms tend to increase their debt specialization, Brazilian firms have decreased their

specialization. Then, the Brazilian firms that most reduced their specialization were financially constrained, but, despite this more significant drop, constrained Brazilian firms continue to be more specialists than their unconstrained peers are. We justify this result based on the fact that the search for different sources of credit by constrained firms benefits their cost of capital as well as makes them less dependent on the conditions established by their creditors (Eça & Albanez, 2022; Platikanova & Soonawalla, 2020). Thus, seeking different sources of credit can be a way of seeking to relax the financial constraints faced in the Brazilian market, such as high interest rates.

Third, regarding to the debt composition of Brazilian firms, in average, we identified that the debt structure is mainly driven by the high representation of bank debt (69%), senior bonds and notes (22%), and by capital leasing (7%). In 2004, both constrained and unconstrained firms relied primarily on bank debt (92% and 87%) with a complement from senior bonds and notes (7% and 13%). In 2019, by contrast, financial constrained firms rely much less on bank debt, accounting for just 42%, followed by senior bonds and notes (33%) and capital leasing (23%). Senior bonds and notes only became more relevant in 2018, while capital leasing proved to be an alternative source for debt during the 2008 financial crisis.

Finally, in summary, our regressions confirm that Brazilian firms that are financially constrained (without credit rating) are more prone to debt specialization. In the same way, Brazilian firms that have lower

informational asymmetries [lower expenses on Research and Development (R&D) – expenses on R&D was used as a proxy for informational asymmetries, as suggested by Colla et al. (2013)], higher expected bankruptcy costs [more volatile in terms of cash flow – cash flow volatility was used as a proxy for bankruptcy costs as suggested by Colla et al. (2013)], few investment opportunities, and those that do not pay dividends tend to specialize their debt composition. The other determinants (tangibility and profitability) did not show statistical significance.

In addition, we also tested two more hypotheses for the debt structure determinants relating them to financial constraint. The first hypothesis tested was whether financially constrained Brazilian firms are more likely to have high debt specialization when information asymmetry is high. We did not find a result that corroborates this hypothesis, as financially constrained Brazilian firms are more likely to have high debt specialization when the asymmetry information is low. The second hypothesis tested if financially constrained Brazilian firms are more likely to have high debt specialization when the expected bankruptcy costs are high. We found results that corroborate this assumption.

For a better development of the study, the paper is divided into five sections, including this introduction. Section 2 shows the debt structure and financial constraint, section 3 the methodological aspects, section 4 the analysis of results and, finally, section 5 presents the conclusions, as well as the main considerations and limitations of the study.

## 2. DEBT STRUCTURE AND FINANCIAL CONSTRAINT

Most studies dealing with capital structure still consider debt structure as a uniform source of resources, but there is an international (Colla et al., 2013, 2020; Khan et al., 2021; Platikanova & Soonawalla, 2020; Rauh & Sufi, 2010) and a (restricted) Brazilian group of theoretical research that recognizes the heterogeneity of debt and seeks to understand the reasons for this fact (Eça & Albanez, 2022; Lucinda & Saito, 2005; Póvoa & Nakamura, 2014).

Rauh and Sufi (2010) are the first to identify the debt structure as an important dimension of the general choice of capital structure. These authors provide a number of new insights into capital structure decisions, recognizing that companies simultaneously use different types, sources, and priorities of debt. For this, Rauh and Sufi (2010) composed a sample of 305 companies in the period of 1996 to 2006 and used the theoretical motivation that

almost 70% of the observations in their sample comprise a debt structure of, at least, two types.

However, Rauh and Sufi (2010) were criticized by Colla et al. (2013) for presenting biased results because the sample is not representative of the population of U.S. firms [Rauh and Sufi (2010) did not consider firms unrated]. In this sense, following the proposal of Colla et al. (2013) and Rauh and Sufi (2010), we sought to examine the debt structure employed by publicly traded companies in the United States of America, using a comprehensive database, totaling 3,296 companies for the period from 2002 to 2009.

Through the HHI, the authors found that 85% of the companies in the sample comprise their structure predominantly with one type of debt, thus showing a notable tendency towards specialization. In addition,

the authors identified that debt heterogeneity, that is, the parallel use of different types of financing, is a characteristic present in firms with high credit ratings (unconstrained).

Recently, Colla et al. (2020) update their research and extend it over a longer period to identify how the debt structure has evolved over time. In addition to confirming the results observed in Colla et al. (2013), the authors show that, over the past 20 years, more than 75% of U.S. firms have borrowed exclusively with one debt instrument. Analyzing the debt specialization through the HHI, Colla et al. (2020) found that the index rose of 0.71 in 2002 to 0.75 in 2018, in which this growth occurred mainly after the subprime crisis.

In the Brazilian scenario, aiming to shed light on the debt composition, Póvoa and Nakamura (2014) showed that their results corroborate with those of Colla et al. (2013), that is, both debt patterns (specialization and diversification) can be found among the firms that operate in Brazil. However, when comparing this studies, different results can be observed, which highlights differences and idiosyncrasies between countries. Colla et al. (2013) identified that around 85% of firms seek to specialize in one type of debt. However, Póvoa and Nakamura (2014) showed that, for the reality of Brazilian firms, only 33.33% (HHI > 0.7) seek to specialize their debt structure.

On the other hand, firms that have a heterogeneous debt structure (66.67% of the sample) were divided into strongly diversified, which use, on average, 3.8 sources of funds simultaneously ( $0 < \text{HHI} < 0.4$ ), and weakly diversified, using, on average, 1.2 source of funds ( $0.4 < \text{HHI} < 0.7$ ). This pattern is confirmed later by the study of Eça and Albanez (2022), who found an average HHI of 0.65 for Brazilian companies ( $< 0.70$ ).

Another difference between the Brazilian scenario to the U.S. one can be related to the specification of debt typologies. For many years, bank loans have been viewed as the only alternative to bonds. The main difference between these two instruments is the superior capacity of banks, relative to bond investors, in screening borrowers and handling debt renegotiations (Colla et al., 2020).

From a borrower's perspective, the trade-off between bank debt and bond financing lies in the fact that intermediaries reorganize firms more efficiently than arm's-length investors, but the latter have a lower opportunity cost of capital than the former. Hence, different lenders dominate in different niches. A high-quality borrower prefers to tap the credit market directly since the borrower is unlikely to default and only wants to bypass a costly middleman; however, a borrower with poorer prospects is more likely to benefit from intermediaries'

reorganization skills and, for this reason, borrows from banks (Colla et al., 2020).

In the United States of America, over time, approximately 60% of the firms rely on senior bonds and notes for financing, and the sample mean ratio of senior bonds and notes to total debt, in 2002, was 35%, while in 2018 was 38% (Colla et al., 2020). Regarding bank loans, in 2002 was 17% and in 2018 was 18.68% (Colla et al., 2020).

However, the Brazilian reality evidenced by Eça and Albanez (2022) and Póvoa and Nakamura (2014) points out that the main source of credit comes from banks, followed by corporate bonds and subsidized debt. This difference can be considered as expected, given that Brazil is a country with low development in the capital market, with banking dependence, limited credit options and high interest rates (Boot & Thakor, 1997).

Henceforth, most of these studies, when exploring the debt structure, do not test candidate factors or theoretical models to explain (determinants) the debt specialization/diversification. Regarding to the determinants, according with Lucinda and Saito (2005), the theoretical recognition of heterogeneity and the determinants of formation of the debt unfolded along three broad lines.

The first of them emphasizes the financial constraints, the second emphasizes the role of information asymmetry and moral hazard, and the third one focuses the role of the efficiency in the liquidation process in case of insolvency. The present study was developed around the influence of the financial constraint on the debt structure, because we understand that this factor in Brazil can significantly influence the behavior of companies regarding the formation of the corporate debt structure.

This argument is based on the fact that a developing economy and with different institutional characteristics – such as high interest rates (aggravating the problems arising from information asymmetry between agents), less legal protection for investors and high concentration of control, lower level of financial development, among others, which probably decrease investors' willingness to provide resources –, increases the costs associated with external financing and the guarantees required for granting loans (Dyck & Zingales, 2004; La Porta et al., 1998).

Based on this, financial constraints can influence companies to be specialized in less onerous types of debt. To test this hypothesis, Colla et al. (2013) pointed out that firms with unconstrained access to capital should exhibit a lower degree of debt specialization, while companies with constrained access to capital should have a higher

degree of debt specialization. When they tested this last factor, Colla et al. (2013) use the firms' credit ratings as a measure of financial constraints, since, if the firms have this credit rating, it can alleviate information asymmetries, given the monitoring carried out by credit rating agencies and coverage by market analysts, which disseminate information to the capital markets.

Therefore, based on what has already been discussed here, Brazilian financially constrained firms tend to specialize their debt structure (Colla et al., 2013), whose bank debt is the main option for its composition, given its history (Eça & Albanez, 2022; Póvoa & Nakamura, 2014), as well as their propensity to need monitoring (Boot & Thakor, 1997; Diamond, 1991). Based on this, we generate the first hypothesis, which will be tested in the study.

H<sub>1</sub>: financially constrained Brazilian firms have a greater degree of debt specialization over time – they are specialists and compose their debt structure in some types, mainly by loans – as they do not have access to a multiplicity of the products available from the financial and capital markets.

In addition to the financial constraint, the literature points out that other determinants are also possible factors that can influence the debt specialization of firms. The second refers to the role of information asymmetry. This factor is based on the findings of Diamond (1991), who argues that the greater the information asymmetry, the greater the tendency to specialize their indebtedness, mainly through private placements of debt. Recently, this result is also evidenced by Platikanova and Soonawalla (2020).

According to Diamond (1991), borrowers initially seek loans from banks, but can later issue debt directly, without using an intermediary, in which the credit record acquired when monitored by a bank serves to predict future borrower behavior when they are not being monitored. Therefore, if moral hazard is sufficiently pervasive (high information asymmetry), new borrowers will begin to acquire their reputation by being monitored by banks and, later, they will start issuing debt directly (public debt) (Lucinda & Saito, 2005).

Platikanova and Soonawalla (2020) reinforce that firms with low quality of contracting financial information, rise their information asymmetries in debt contracting, justifying, therefore, the constrained access to debt markets, greater risk premiums, more restrictive contract terms, and debt specialization. As mentioned before and according with Stiglitz and Weiss (1981), the existence of

information asymmetries between individuals can cause and intensifies the financial constraints; once lenders set the interest rate on loans, a possible excess demand will not be corrected by a positive change in price (increase in interest rate), causing borrowers to be unable to obtain the desired volume of credit.

Then, we explore the relation between the financial constraints and the degree of debt specialization when this is conditioned by the presence of information asymmetry, i.e., Brazilian financially constrained firms are more likely to have high debt specialization when the information asymmetry is high. The hypothesis is presented below.

H<sub>2</sub>: financially constrained Brazilian firms with greater information asymmetry tend to specialize their debt structure.

Finally, the last determinant refers to the role of liquidation based on the results of Hart (1995). The author analyzed the high costs associated with an eventual liquidation, arising from the choice between private placements of debt in relation to public offerings. According to Myers and Rajan (1998), banks have a greater ability to deal with companies in financial distress, as well as the need to take decisions between forcing the company to liquidate or renegotiate its debts. Thus, there is a direct relationship between the company's liquidation propensity (with higher expected bankruptcy costs) and the debt specialization to reduce the renegotiation costs associated with multiple creditors (Colla et al., 2020; Khan et al., 2021), as well as to maximize their liquidation value.

Then, we explore the relation between the financial constraints and the degree of debt specialization when this is conditioned by the expected bankruptcy costs, i.e., Brazilian financially constrained firms are more likely to have high debt specialization when the expected bankruptcy costs are high. The hypothesis is presented below.

H<sub>3</sub>: financially constrained Brazilian firms with higher bankruptcy costs tend to specialize their debt structure.

Finally, in the empirical evidence about firms' debt specialization, the variables age, size, market-to-book, leverage, dividends, and profitability are usually included as its determinants (control variables) (Colla et al., 2013; Khan et al., 2021; Póvoa & Nakamura, 2014). According to Khan et al. (2021) and Póvoa and Nakamura (2014), age

is considered a significant reputation signal on the market and it can reduce some agency problems, information asymmetries, and financial distress costs (Khan et al., 2021). As a result, these companies can access different types of debt, increasing their diversification.

Another determinant is size, which is expected that larger companies diversify their debt structure given that they have greater access to different types of debt (such as bonds), resulting in less propensity to default (Colla et al., 2013; Khan et al., 2021). The debt structure can also be determined by its investment opportunities (market-to-book); however, there is no consensus in the literature about this topic. According to Colla et al. (2013) and Khan et al. (2021), firms with greater growth opportunities can specialize the debt sources justified by the greater perception of risk, making it difficult to access diversified sources of financing. On the other hand, Póvoa and Nakamura (2014) point out that Brazilian firms (emerging market), which have greater growth opportunities, need higher indebtedness levels, favoring heterogeneity in the debt structure.

### 3. METHODOLOGICAL ASPECTS

To analyze the historical evolution, the composition and the determinants of the debt specialization of Brazilian firms traded on B3 according to their financial constraint, we applied a descriptive research based on quantitative methods. Basic data related to the balance sheet, income statement, and debt structure were taken from Capital IQ and data referring to Initial Public Offering (IPO) and credit ratings were provided by the Laboratório de Finanças e Risco (RiskFinLab) of Faculdade de Economia, Administração, Contabilidade e Atuária, Universidade de São Paulo.

Capital IQ splits the total debt into seven mutually exclusive types, as follows: (i) commercial paper (CP – short-term debt issued by large firms); (ii) revolving credit (RC – short-term debt for managing corporate liquidity needs) (Colla et al., 2020); (iii) senior bonds and notes (SeBN – raising funds through the issuance of senior corporate bonds with public or private placement) (Póvoa & Nakamura, 2014; Rauh & Sufi, 2010); (iv) subordinated bonds and notes (SuBN –

The other determinant is dividends. These one, according to Colla et al. (2013) and Khan et al. (2021), have a positive impact on debt specialization, because firms that pay more dividends signal solvency to the market, as well as lower agency conflicts, thus reducing information asymmetries, which allows greater diversification of their debt sources. Finally, previous studies evidenced ambiguous results about profitability. As long as Khan et al. (2021) identify that profitable firms generally use diversified debt structures, Colla et al. (2013) and Póvoa and Nakamura (2014) show that those are more likely to use specialized debt structures.

All these determinants, the main ones (financial constraints, information asymmetry, and expected bankruptcy costs) and the control ones (age, size, market-to-book, leverage, dividends, and profitability), come from the interrelation of the theoretical models of Diamond (1991) and Hart (1995) and the empirical evidence of Colla et al. (2013, 2020), Eça and Albanez (2022), Khan et al. (2021), Platikanova and Soonawalla (2020), and Póvoa and Nakamura (2014).

raising funds through the issuance of subordinated corporate bonds for public or private placement) (Póvoa & Nakamura, 2014; Rauh & Sufi, 2010); (v) bank debt (BD – funds raised through this source originate from banks) (Colla et al., 2013; Póvoa & Nakamura, 2014); (vi) capital leasing (CL – includes all forms of leasing contracts, which take the financed asset as collateral for the business) (Póvoa & Nakamura, 2014); and (vii) others (O – sources not classified among those exposed by Capital IQ) (Colla et al., 2013).

The sample refers to firms that have shares traded on B3, covering the period available from 2004 to 2019 (16 years), totalizing 246 companies or 2,081 observations. To achieve the objective, first, we measured the degree of debt specialization among companies considering the aforementioned debts. For this purpose, the methodology of Colla et al. (2013, 2020) was applied, based on HHI, which is normalized by the type of debt. Thus, the calculation basically follows two steps, as shown in equations 1 and 2.

$$SSI_{i,t} = \frac{CP_{i,t}}{TD_{i,t}} + \frac{RC_{i,t}}{TD_{i,t}} + \frac{SeBN_{i,t}}{TD_{i,t}} + \frac{SuBN_{i,t}}{TD_{i,t}} + \frac{BD_{i,t}}{TD_{i,t}} + \frac{CL_{i,t}}{TD_{i,t}} + \frac{Others_{i,t}}{TD_{i,t}} \quad 1$$

where  $SSI_{i,t}$  is the sum of the squared debt type indices for firm  $i$  in year  $t$ ,  $CP_{i,t}$ ,  $RC_{i,t}$ ,  $SeBN_{i,t}$ ,  $SuBN_{i,t}$ ,  $BD_{i,t}$ ,  $CL_{i,t}$  and  $Others_{i,t}$  refer to commercial paper, revolving credit, senior bonds and notes, subordinated bonds and notes, bank debt, capital leasing and others debts, respectively, and, finally,  $TD_{i,t}$  refers to the total debt. Afterwards, the calculation of  $HHI_{i,t}$  is shown in equation 2.

$$HHI_{i,t} = \frac{SSI_{i,t} - \frac{1}{7}}{1 - \frac{1}{7}} \quad 2$$

HHI is equal to 0 (Colla et al., 2013, 2020). Consequently, higher HHI values indicate a tendency for firms to specialize in fewer types of debt (Colla et al., 2013, 2020).

After measuring the debt specialization level of Brazilian firms, the sample was separated into constrained and unrestricted firms, according to the presence of the credit rating. There are a number of plausible approaches to classifying companies into financially constrained and unconstrained firms. The credit rating measure (Table 1) was chosen due to the fact that the main U.S. references on debt specialization (Colla et al., 2013, 2020; Rauh & Sufi, 2010) and also Brazilian ones (Póvoa & Nakamura, 2014, 2015) use this metric to capture potential financial constraints.

**Table 1**  
Variables definition

Variables	Authors	Sig.	Description
<b>Dependent variable</b>			
HHI	Colla et al. (2013, 2020), Póvoa and Nakamura (2014)		HHI is equal to 0 if a company simultaneously employs all seven types of debt in equal proportion; otherwise, if a company employ just one type of debt, the HHI is equal to 1.
<b>Independent variables</b>			
Financial constraint (credit rating) – H <sub>1</sub>	Colla et al. (2013, 2020), Rauh and Sufi (2010)	-	Dummy equal to 1 if the company has a credit rating for at least one year of the time series, and 0 otherwise.
Information asymmetry (R&D) – H <sub>2</sub>	Colla et al. (2013, 2020), Platikanova and Soonawalla (2020)		Ratio between R&D expenses and TA.
<b>Default costs – Independent variable – H<sub>3</sub></b>			
Expected bankruptcy costs (TANG) – H <sub>3</sub>	Colla et al. (2013, 2020), Khan et al. (2021), Platikanova and Soonawalla (2020)	-	Ratio between FA and TA.
	Póvoa and Nakamura (2014)	-	Ratio between the sum of FA and I in relation to TA.
Expected bankruptcy costs (Risk – CF VOL or EBIT VOL) – H <sub>3</sub>	Colla et al. (2013, 2020), Khan et al. (2021), Platikanova and Soonawalla (2020)	+	Ratio between $\sigma^2$ CF and TA.
	Khan et al. (2021), Póvoa and Nakamura (2014)	+	Ratio of the difference between $\sigma^2$ EBIT and its average (EBIT) in relation to TA.
<b>Control variables</b>			
IPO	Póvoa and Nakamura (2014), Khan et al. (2017, 2021)	-	Time in years since the company's IPO.
SIZE	Colla et al. (2013), Khan et al. (2021), Póvoa and Nakamura (2014)	-	Ln of TA.

**Table 1**  
Cont.

Variables	Authors	Sig.	Description
<b>Dependent variable</b>			
MB	Colla et al. (2013, 2020), Platikanova and Soonawalla (2020), Rauh and Sufi (2010)	+	Ratio between the sum of the MV equity, TD, and PS in relation to TA.
	Póvoa and Nakamura (2014)	-	Ratio between the MV and the book value of equity.
LEV	Khan et al. (2021), Platikanova and Soonawalla (2020), Póvoa and Nakamura (2014)	-	Ratio between TD and TA.
DIV	Colla et al. (2013), Khan et al. (2021)	-	Dummy equal to 1 if the firm pays dividends, and 0 otherwise.
ROA	Colla et al. (2013, 2020), Platikanova and Soonawalla (2020), Rauh and Sufi (2010)	+	Ration between EBITDA and TA.
	Khan et al. (2021), Póvoa and Nakamura (2014)	-	Ration between NP and TA.

$\sigma^2CF$  = cash flow standard deviation;  $\sigma^2EBIT$  = earnings before interest and taxes (EBIT) standard deviation;  $CF\ VOL$  = cash flow volatility;  $DIV$  = dividends;  $EBIT$  = earnings before interest and taxes);  $EBIT\ VOL$  = EBIT volatility;  $EBITDA$  = EBIT depreciation and amortization;  $FA$  = fixed assets;  $HHI$  = Herfindahl-Hirschman index;  $I$  = inventory;  $IPO$  = Initial Public Offering;  $LEV$  = leverage;  $Ln$  = natural logarithm;  $MB$  = market-to-book;  $MV$  = market value;  $NP$  = net profit;  $PS$  = preferred shares;  $R\&D$  = Research and Development;  $ROA$  = return on assets;  $TA$  = total assets;  $TANG$  = tangibility;  $TD$  = total debt (the sum of senior bonds and notes).

**Source:** Elaborated by the authors.

Thus, we sought to identify the trend of Brazilian firms regarding the debt specialization over time, as there is no evidence, in the Brazilian context, of studies that have analyzed such a long period. In addition, the analysis proposed by this study can be considered unprecedented, taking into account the comparison of debt specialization

levels through the separation of firms into financially constrained and unconstrained firms.

Finally, we sought to identify the determinants of the debt specialization for Brazilian firms. To achieve this goal, the analyzes were based on classic U.S. studies (Colla et al., 2013, 2020), whose regression is described in equation 3.

$$HHI_{i,t} = \beta_0 + \beta_1 CR_{i,t} + \beta_2 R\&D_{i,t} + \beta_3 TANG_{i,t} + \beta_4 CFVol_{i,t} + \beta_5 Size_{i,t} + \beta_6 MB_{i,t} + \beta_7 ROA_{i,t} + \beta_8 DIV_{i,t} + \varepsilon_{it} \quad \boxed{3}$$

where  $HHI_{i,t}$  is the debt specialization for company  $i$  at time  $t$ , the coefficients in their sequential order represent linear coefficient ( $\beta_0$ ), credit rating ( $\beta_1$ ), research and development ( $\beta_2$ ), tangibility ( $\beta_3$ ), cash flow volatility ( $\beta_4$ ),

size ( $\beta_5$ ), market-to-book ( $\beta_6$ ), return on assets ( $\beta_7$ ) and dividends ( $\beta_8$ ), and  $\varepsilon_{it}$  represents the stochastic error term. Also, based on the Brazilian studies (Póvoa & Nakamura, 2014), the equation 4 was developed.

$$HHI_{i,t} = \beta_0 + \beta_1 CR_{i,t} + \beta_2 TANG_{i,t} + \beta_3 EBITVol_{i,t} + \beta_4 IPO_{i,t} + \beta_5 Size_{i,t} + \beta_6 MB_{i,t} + \beta_7 ROA_{i,t} + \beta_8 LEV_{i,t} + \varepsilon_{it} \quad \boxed{4}$$

where  $IHH_{i,t}$  is the debt specialization for company  $i$  at time  $t$ , the coefficients, in their sequential order, represent linear coefficient ( $\beta_0$ ), credit rating ( $\beta_1$ ), tangibility ( $\beta_2$ ), earnings before interest and taxes (EBIT) volatility (risk) ( $\beta_3$ ), IPO (age) ( $\beta_4$ ), size ( $\beta_5$ ), market-to-book ( $\beta_6$ ), return on assets ( $\beta_7$ ), leverage ( $\beta_8$ ), and  $\varepsilon_{it}$  represents the stochastic

error term. All definitions of these variables are shown in Table 1.

Through equations 3 and 4, we seek to identify the main determinants of debt specialization, in which, through the  $\beta_1$  coefficient of both regressions, the aggregate relationship between financial constraints and debt specialization was

tested. In order to contemplate the models of Colla et al. (2013) and Póvoa and Nakamura (2014) and their variations (i.e., differences in explanatory variables), we initially estimated these two models, considering the proxy for financial constraint (credit rating).

Additionally, we reestimated both models, with the sample segregated into firms by the credit rating. This estimation allows us to verify whether the determinants considered by the aforementioned authors change according to the financial constraint. From the firm's point of view, the context of financial constraints may constitute an additional incentive to seek the optimal debt structure (diversified or specialist), influencing the relationship that determines it.

To estimate equations 3 and 4, we applied the probit and tobit on an unbalanced panel data, as these models are commonly used for regressions in which the dependent variable is bounded (Woodridge, 2002). As our dependent variable is the HHI, we chose to apply these methodologies. We sought to estimate both tobit and probit regressions for two reasons: (i) robustness of the results, i.e., reporting and analyzing the results by two different methods; and (ii) to compare the results with Colla et al. (2013, pp. 18, 19, 2020), as the authors use both methodologies.

## 4. ANALYSIS OF RESULTS

This section is divided into two parts, as follows: 4.1) Historical evolution and composition of debt specialization; and 4.2) Determinants of debt specialization and financial constraint.

### 4.1 Historical Evolution and Composition of Debt Specialization

Before starting the analysis, descriptive statistics were estimated in order to demonstrate the consistency of the

Finally, additional tests were performed. The result presented by the correlation and variance inflation factor (VIF) test did not indicate multicollinearity between the variables of the model since the values presented were lower than 2 for all explanatory variables. In the same way, the Breusch-Pagan and Cook-Weisberg test for heteroskedasticity did not reject the null hypothesis that the variance is homoskedastic (0.88). Therefore, these assumptions were relaxed.

Afterwards, the presence of normality and serial autocorrelation was tested. The result obtained by Doornik-Hansen test for bivariate normality (0.00) and Shapiro-Wilk W (0.00) test indicated the rejection of the null hypothesis that the data have a normal distribution. In the same way, the Woodridge test (0.00) indicated the rejection of the null hypothesis that the data has no first-order autocorrelation. These assumptions were not relaxed and, to avoid possible biases in the data, the models were estimated with robust standard errors and clustered by firm. Finally, time and industrial dummies were also inserted to consider the influence of macroeconomic factors that could affect the models. In addition, all metric variables were winsorized at the 1 and 99% percentiles, in order to mitigate the effect of outliers.

data and to present some important measures for the study. As shown in Table 2, the averages of the HHI can be observed, as well as the averages of each type of debt, both for the general sample and for the constrained and unconstrained Brazilian firms from 2004 to 2019. As can be seen, Brazilian firms have an average HHI of 0.76 (higher HHI values indicate a tendency for specialization) for the general sample, 0.82 for constrained firms, and 0.62 for unconstrained firms, revealing that constrained firms are more prone to debt specialization.

**Table 2**  
*Debt structure and debt types of Brazilian firms over time (2004 to 2019)*

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
HHI	General	0.88	0.89	0.88	0.84	0.81	0.78	0.75	0.75	0.75	0.75	0.75	0.71	0.73	0.72	0.74	0.64	0.76
	Constrained	0.90	0.93	0.94	0.92	0.90	0.86	0.85	0.86	0.82	0.83	0.82	0.76	0.82	0.79	0.74	0.65	0.82
	Unconstrained	0.77	0.67	0.65	0.68	0.61	0.60	0.57	0.57	0.63	0.63	0.63	0.64	0.62	0.62	0.62	0.62	0.62
	<i>t</i> test	2.13***	4.46***	6.72***	5.08***	6.18***	6.27***	6.94***	7.30***	4.70***	4.93***	4.70***	2.83***	4.49***	4.17***	2.80***	3.14***	16.81***
SuBN	General	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.03	0.03	0.01	0.01
	Constrained	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.00	0.01
	Unconstrained	0.00	0.00	0.00	0.05	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.02	0.02	0.02	0.01
	<i>t</i> test	0.39	0.00	-2.00**	0.82	-2.59***	-2.68***	-1.92*	-1.58	-1.37	-0.42	0.43	0.68	0.20	0.46	0.63	0.40	-2.80***
SeBN	General	0.08	0.11	0.12	0.17	0.13	0.14	0.19	0.21	0.25	0.25	0.27	0.22	0.24	0.31	0.31	0.34	0.22
	Constrained	0.07	0.07	0.06	0.10	0.08	0.06	0.11	0.08	0.14	0.13	0.16	0.15	0.12	0.15	0.31	0.33	0.15
	Unconstrained	0.13	0.35	0.35	0.31	0.27	0.31	0.34	0.40	0.44	0.44	0.44	0.32	0.32	0.50	0.50	0.50	0.38
	<i>t</i> test	-4.12***	-3.60***	-7.04***	-5.40***	-3.27***	-3.31***	-4.17***	-4.60***	-4.12***	-4.54***	-2.57***	-3.65***	-4.82***	-3.65***	-3.15***	-4.37***	-10.69
CP	General	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Constrained	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Unconstrained	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>t</i> test	0.00	0.00	0.00	-1.63	-1.55	0.62	0.00	-1.90*	-1.51	0.00	-1.28	0.00	0.00	-1.23	0.00	0.00	-3.26***
BD	General	0.92	0.88	0.86	0.79	0.77	0.75	0.69	0.67	0.64	0.68	0.64	0.70	0.69	0.62	0.63	0.43	0.69
	Constrained	0.92	0.93	0.93	0.88	0.81	0.78	0.73	0.77	0.72	0.78	0.72	0.73	0.78	0.74	0.63	0.42	0.74
	Unconstrained	0.87	0.65	0.60	0.63	0.68	0.62	0.60	0.52	0.51	0.53	0.52	0.64	0.64	0.46	0.46	0.46	0.57
	<i>t</i> test	0.98	4.03***	5.84***	3.74***	1.87*	2.95***	2.05**	4.12***	3.17***	4.79***	3.28***	1.49	3.40***	5.05***	3.12***	3.60***	9.88***
CL	General	0.00	0.00	0.00	0.03	0.09	0.11	0.11	0.10	0.09	0.05	0.07	0.07	0.05	0.05	0.04	0.23	0.07
	Constrained	0.00	0.00	0.00	0.02	0.11	0.14	0.15	0.13	0.13	0.07	0.10	0.09	0.07	0.08	0.04	0.23	0.09
	Unconstrained	0.00	0.00	0.01	0.07	0.03	0.05	0.04	0.05	0.03	0.03	0.03	0.03	0.03	0.01	0.01	0.01	0.03
	<i>t</i> test	0.41	0.43	-1.28	-1.18	1.45	1.74	2.33***	1.87*	2.11**	1.50	1.79	2.10	1.95*	2.28***	1.90*	1.95*	5.92***

**Table 2**

Cont.

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Mean
RC	General	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Constrained	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Unconstrained	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>t</i> test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	General	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Constrained	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Unconstrained	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	<i>t</i> test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Leverage	General	0.30	0.23	0.23	0.23	0.19	0.26	0.23	0.24	0.30	0.24	0.28	0.30	0.27	0.27	0.24	0.27	0.28
	Constrained	0.32	0.23	0.30	0.24	0.20	0.29	0.25	0.25	0.30	0.24	0.31	0.34	0.29	0.26	0.27	0.32	0.28
	Unconstrained	0.32	0.31	0.26	0.25	0.26	0.25	0.28	0.29	0.32	0.28	0.29	0.30	0.28	0.32	0.30	0.30	0.29
	<i>t</i> test	-0.00	-0.69	0.33	-0.03	-1.23	0.59	-0.47	-0.60	-0.21	-1.02	0.28	0.44	0.23	-0.85	0.60	0.72	-0.46

**Note:** Financially unconstrained firms are those that have a credit rating (CR) in at least one year of the historical series (CR = 1) and financially constrained firms are those that are not rated (CR = 0).

BD = bank debt; SuBN = subordinated bonds and notes; CL = capital leasing; CP = commercial papers; HHI = Herfindahl-Hirschman index; RC = revolving credit; SeBN = senior bonds and notes.

\*, \*\*, \*\*\* = significance at 10%, 5%, and 1%, respectively.

**Source:** Elaborated by the authors.

Specifically, the debt structure of firms that have an average HHI of 0.76 is mainly driven by the high representation of bank debt (69%), senior bonds and notes (22%), and also by capital leasing (7%) on total debt. These three types of debt are responsible for the formation of, at least, 98% of all externally raised financing. Likewise, the debt structure of constrained and unconstrained firms follows this trend of composition of their debt arising from bank, senior bonds and notes, and capital leasing, changing only the relevance of each debt.

However, when analyzing the debt structure over the years, as well as the types of debt, we can identify trends and issues not revealed in the literature on Brazilian firms. First, firms had an average overall HHI of 0.88 in 2004 and, after 16 years, the HHI dropped to 0.64 (-27.27%), demonstrating an expressive decline in the specialization of debt sources. This result diverges from that recently exposed by Colla et al. (2020), in which they revealed that U.S. firms increased their debt specialization along the time, as they had an HHI of 0.71 in 2002 and of 0.78 in 2018 (9,85%). Thus, while U.S. firms tend to increase their debt specialization, Brazilian firms have decreased their specialization. Therefore, this result suggests that, over the last 16 years, despite keeping their debt stable (average of 28%), Brazilian firms are using more types of debt, reflecting empirical patterns not reported in the Brazilian literature so far.

A possible explanation for this decrease in the specialization of companies in Brazil can be found in Eça and Albanez (2022). The Brazilian macroeconomic context leads the authors to theorize and identify that more diversified debt structures are beneficial, because,

by accessing different sources of credit, Brazilian firms are able to reduce their cost of debt given the increase in bargaining power, as well as the reduction of dependence on a single creditor.

Specifically, the assumption that financially constrained firms have higher levels of debt specialization than their unconstrained peers is observed for the Brazilian scenario, both in average terms and over the years. However, the constrained Brazilian firms dropped their HHI of 0.90 in 2004 to 0.65 in 2019 (-27.77%) and the unconstrained one dropped theirs of 0.77 in 2004 to 0.62 in 2019 (-19.48%). Therefore, in the period of 2004 to 2018, the Brazilian firms that most reduced their specialization were financially constrained. Despite this more significant drop, constrained Brazilian firms continue to be more specialists than their unrestricted peers are.

We justify this result based on the fact that the search for different sources of credit by constrained firms benefits their cost of capital, as well as makes them less dependent on the conditions established by their creditors (Eça & Albanez, 2022; Platikanova & Soonawalla, 2020). Thus, seeking different sources of credit can be a way of seeking to relax the financial constraints faced in the Brazilian market, such as high interest rates. Another way to check the level of debt specialization is to calculate the fraction of observations in the sample and obtain the significant amount of its debt arising from a single type (Colla et al., 2013). Thus, we have employed a wide spectrum of thresholds ranging from 10 to 99% to identify the significant use of certain type(s) of debt(s). This analysis was performed both for the general and for the financially constrained sample. Table 3 reports these results.

**Table 3**  
*Reliance of Brazilian firms in one type of debt*

	Thresholds (%)								
	10	30	50	60	70	80	90	95	99
<b>General</b>									
Subordinated bonds and notes	0.03	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
Senior bonds and notes	0.42	0.31	0.21	0.15	0.11	0.08	0.04	0.03	0.02
Commercial paper	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.00
Bank debt	0.91	0.81	0.70	0.64	0.00	0.52	0.46	0.43	0.39
Capital leasing	0.13	0.08	0.06	0.05	0.05	0.04	0.03	0.03	0.02
Rotating credit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	149.00	123.00	98.00	85.00	75.00	64.00	54.00	49.00	42.00
<b>Constrained firms</b>									
Subordinated bonds and notes	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Senior bonds and notes	0.24	0.15	0.10	0.08	0.06	0.04	0.03	0.02	0.01
Commercial paper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

**Table 3**  
Cont.

	Thresholds (%)								
	10	30	50	60	70	80	90	95	99
Bank debt	0.68	0.58	0.53	0.50	0.48	0.44	0.40	0.38	0.35
Capital leasing	0.24	0.08	0.06	0.05	0.04	0.04	0.03	0.02	0.01
Rotating credit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	118.00	82.00	70.00	64.00	59.00	52.00	46.00	43.00	37.00
<b>Unconstrained firms</b>									
Subordinated bonds and notes	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Senior bonds and notes	0.24	0.17	0.11	0.07	0.05	0.04	0.02	0.01	0.01
Commercial paper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Bank debt	0.28	0.23	0.17	0.14	0.11	0.08	0.06	0.05	0.04
Capital leasing	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rotating credit	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	65.00	41.00	29.00	22.00	16.00	12.00	8.00	7.00	5.00

**Note:** Financially unconstrained firms are those that have a credit rating (CR) in at least one year of the historical series (CR = 1) and financially constrained firms are those that are not rated (CR = 0).

**Source:** Elaborated by the authors.

As can be seen in Table 3, for each type of debt and threshold, the representativeness of observations that use a particular type of debt at a certain threshold or above was reported (Colla et al., 2013). For example, the 50% column shows the share of observations with more than 50% of their debt coming from one type. As well as Colla et al. (2013), the Total line presents the sum across all types of debt of significant use, in which if the firm used the seven types of debt equivalently, the total from the 10% column would add up to seven. Similarly, if firms specialized in just one type of debt, the total of all thresholds would be one.

The analysis reveals that constrained firms depend more exclusively on a single type of debt, as at least 37% of these companies depend 99% of their debt on a single type of debt, while only 5% of unconstrained firms have this dependence. Furthermore, more than half of constrained firms (52%) obtain around 80% of their loans from a single type of debt, while just 12% of unconstrained firms have this dependence.

These results are in line with those reported by Colla et al. (2020), who identified that approximately 45% of constrained firms depend exclusively on a single type of debt, while around 68% of constrained firms obtain 80% of their loans from a single type of debt. However, the results to unconstrained firms present a completely different scenario for the Brazilian context. Comparatively, Colla et al. (2020) demonstrate that at least 20% of unconstrained firms depend exclusively on a single type of debt. This

result reveals that the dependence of U.S. firms is, at least, four times greater than the dependence of Brazilian firms, considering the last threshold. This relationship remained higher if the other thresholds are considered (except 50, 30, and 10%). Therefore, unlike the U.S. scenario, unconstrained Brazilian firms do not specialize in debt, revealing significant differences.

To identify which debt sources justify this behavior, it is necessary to analyze the debt structure of Brazilian firms. In 2004, both constrained and unconstrained firms relied primarily on bank debt (92 and 87%) with a complement from senior bonds and notes (7 and 13%). In 2019, by contrast, financial constrained firms rely much less on bank debt, accounting for just 42%, followed by senior bonds and notes (33%) and capital leasing (23%). Senior bonds and notes only became more relevant in 2018, while capital leasing proved to be an alternative source of debt during the 2008 financial crisis.

This result seems to follow what was exposed by Diamond (1991) regarding the role of information asymmetry, in which borrowers initially seek loans from banks to, later, issue debt directly. In this case, the credit record acquired when monitored by a bank serves to predict future borrower behavior when not monitored. Therefore, in 2004, Brazilian firms relied mainly on bank debt and, 16 years later, they balanced their financing with other types of debt, such as market debt, being justified by the acquisition of reputation arising from bank monitoring.

Another interesting result can be observed in 2007, where constrained Brazilian firms used only 2% of capital leasing, while in 2008, 2009, and 2010 its use increased to 11, 14, and 15%, respectively. This result is in line with Eisfeldt and Rampini (2009), who point out that leasing is valuable for firms with financial constraints, given that the lessor implicitly extends more credit than a creditor whose right is guaranteed by the same asset. Thus, the ability of a lessor to repossess an asset is the great benefit of leasing, allowing new access by constrained firms. In addition to the increase of the leasing in 2019, we noticed that, in this year, the Comitê de Pronunciamentos Contábeis (CPC, 2017) came into force. The CPC 06 required firms to recognize in balance sheet the leasing contracts. Thus, part of the variation in capital leasing in 2019 is a purely accounting and bureaucratic issue, not related to the greater use of this instrument.

Alternatively, unconstrained firms, in 2019, showed the main dependence on senior bonds and notes, with a representation of 50%, whereas, in 2004, this debt represented only 13%. In addition, unconstrained firms represent 46% of bank debt, followed by subordinated

bonds and notes with 2% and only 1% from capital leasing. In general, the debt composition of Brazilian firms follows Hackbarth et al. (2007), who reveal that weak (financial constrained) firms have high bank debt capacity, while strong (unconstrained) firms use a combination of bank and market debt, with the former being senior. In addition, trends of non-specialization of the debts of Brazilian companies can be observed, a result that was unknown and not previously reported.

#### 4.2 Determinants of Debt Specialization and Financial Constraint

As pointed out in the methodological procedures, to identify the determinants of debt specialization of constrained firms compared to unconstrained firms traded in B3, the probit and tobit methods are applied. In the upper part of Table 4 are presented the regressions of the models by Colla et al. (2013, 2020) and Póvoa and Nakamura (2014), as well as the regressions segregating these models into firms with and without financial constraints through the credit rating.

**Table 4**  
*Regression analysis – Debt structure and financial constraint*

HHI	Colla et al. (2013)		Unconstrained firms		Constrained firms		Póvoa and Nakamura (2014)		Unconstrained firms		Constrained firms	
	1	2	3	4	5	6	7	8	9	10	11	12
	Probit	Tobit	Probit	Tobit	Probit	Tobit	Probit	Tobit	Probit	Tobit	Probit	Tobit
CR	-0.27*	-0.13*					-0.35**	-0.12**				
T	-1.69	-1.85					-2.01	-2.31				
R&D	-0.02***	-0.01***	-0.01	-0.01	-0.02**	-0.01***						
T	-4.12	-4.12	-0.90	-0.94	-2.36	-3.02						
Tang	0.29	-0.02	-0.033	-0.01	-1.14*	-0.05**	-0.89*	-0.04**	-0.15	0.12	-1.24*	-0.02
T	0.68	-1.32	-0.34	-0.05	-1.90	-2.23	-1.75	-2.37	-0.15	0.72	-1.86	1.33
CF VOL	1.45***	5.92***	0.95	1.52	1.32*	5.46***						
p-value	2.44	3.59	0.82	0.23	1.89	3.18						
EBIT VOL							1.38*	3.34***	-0.65	1.55	2.63	4.00**
T							1.71	2.59	-0.24	0.53	0.31	2.17
IPO							-0.15	-0.03	0.18	0.13	-0.63***	-0.14***
T							-0.93	-0.86	0.56	1.33	-2.74	-3.16
Size	-0.65***	-0.26***	-1.13***	-0.07*	-0.76***	-0.26***	-0.83***	-0.17***	-0.94**	-0.04	-0.73***	-0.20***
T	-5.23	-7.13	-2.62	-1.63	-4.36	-6.46	-4.50	-5.83	-2.07	0.34	-3.43	-4.98
MB	-0.02	-0.01**	-0.51*	0.00	-0.02	-0.01*	-0.02	-0.01***	-0.21	-0.02	-0.01	-0.01
T	-1.31	-2.11	-1.77	0.02	0.37	-1.92	-1.05	-2.45	-0.68	0.55	-0.15	-0.31
ROA	-0.94	-0.25	-2.7*	-1.80**	0.95	0.16	-1.47	-0.34**	-3.09*	-1.43**	1.93*	0.18
T	-1,20	-1,17	-1,67	-2,03	0,35	0,76	-1,51	-2,11	-1,69	-1,97	1,60	-0,31

**Table 4**  
Cont.

HHI	Colla et al. (2013)		Unconstrained firms		Constrained firms		Póvoa and Nakamura (2014)		Unconstrained firms		Constrained firms	
	1	2	3	4	5	6	7	8	9	10	11	12
	Probit	Tobit	Probit	Tobit	Probit	Tobit	Probit	Tobit	Probit	Tobit	Probit	Tobit
Dividends	-0.28*	-0.08*	0.33	0.07	-0.21	-0.07						
T	-1.94	-1.81	1.00	0.64	0.22	0.14						
Leverage							-0.46**	-0.07**	-2.79**	-1.28***	-0.67***	-0.10**
T							-2,00	-2,25	-2,07	-2,71	-2,91	-2,12
Constant	3.90***	1.87***	0.98***	0.88***	4.23***	1.70***	6.14***	1.79***	8.72**	0.51***	5.88***	1.64***
T	3.07	5.59	2.41	22.72	2.62	4.90	3.58	5.99	2.22	27.74	3.04	4.50
Observations	1,083	1,505	253	394	753	1,111	859	1,331	239	381	626	950
R <sup>2</sup> (%)	29.44	34.17	22.48	34.24	33.37	39.01	26.57	35.83	23.27	37.51	33.38	40.07
IFE and TFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Note:** Financially unconstrained firms are those that have a credit rating (CR) in at least one year of the historical series (CR = 1) and financially constrained firms are those that are not rated (CR = 0).

CF VOL = cash flow volatility; Dividends = dividend payer; EBIT VOL = earnings before interest and taxes volatility; HHI = Herfindahl-Hirschman index; IFE and TFE = industrial and time fixed effects; IPO = Initial Public Offering; MB = market-to-book; R&D = Research and Development; ROA = return on assets; Size = natural logarithm of total assets; T = t-test; Tang = tangibility. \*, \*\*, \*\*\* = significance at 10%, 5%, and 1%, respectively.

**Source:** Elaborated by the authors.

Initially, we ran the models of these authors in order to contemplate the main references in the literature, as well as to test the aggregate and direct impact of financial constraint on the debt specialization. However, models 1, 2, 7, and 8 do not allow the verification of how the determinants of debt specialization are modified (or not) if conditioned to the state of financial constraint. Thus, in order to address this issue, the other models were added. In general, both the models by the authors indicate that Brazilian firms that are financially constraint (without credit rating) with lower informational asymmetries (lower expenses on R&D), with higher expected bankruptcy costs (more volatile in terms of cash flow or less tangibility), few investment opportunities, and that do not pay dividends tend to specialize their debt composition. The profitability did not show statistical significance.

As reviewed in section 2, Colla et al. (2013, 2020) point out that the credit rating classification represents the state of financial constraints. Thus, specifically, through models 1, 2, 7, and 8, can be inferred that debt specialization is negatively and significantly impacted by the corporate credit rating, that is, unconstrained firms reduce debt specialization. Likewise, constrained firms tend to increase their specialization.

Additionally, Colla et al. (2013, 2020) point out that the tangibility and cash flow volatility are proxies for expected bankruptcy costs, as less tangible and more volatile firms tend to increase them. Based on this factor, the high propensity for bankruptcy costs makes firms go

through the specialization of their debt structure. This assumption is observed on the models 1 and 2 or in the models 7 and 8.

Furthermore, it was identified that the proxy for information asymmetry (R&D) also influences the debt specialization of Brazilian firms. Thus, the lower the R&D expenses, the greater the debt specialization. This result is different from that observed by Colla et al. (2013, 2020), revealing differences between the influence of information opacity between countries. A possible justification for this relationship is that Brazilian firms that have higher R&D expenses may signal the market for greater investment opportunities and, therefore, they need to make their debt structure more diversified.

In addition, the other variable that diverges from the assumption by Colla et al. (2013, 2020) refers to investment opportunities, which the greater the growth opportunities, the more diversified the debt sources tended to be. This result differs from those of Colla et al. (2013), as the authors pointed out those greater growth opportunities generate greater perception of risk, making it difficult to access diversified sources of financing. However, it converges with Póvoa and Nakamura (2014) findings, who point out that Brazilian firms that have greater growth opportunities need resources that are often not sufficiently generated by retained earnings.

In terms of dividend payments, it was identified that this negatively influences debt specialization (HHI). This result is in line with Colla et al. (2013, 2020) and Khan

et al. (2021), who point out that firms that pay more dividends signal solvency to the market, as well as lower agency conflicts, thus reducing information asymmetries, which allows for greater diversification of their debt sources. In relation to company size, we identified a negative relationship with debt specialization, which is in agreement with the results reported by Colla et al. (2013, 2020) and Póvoa and Nakamura (2014), who point out that larger firms obtain scale economies in issuing corporate bonds and, therefore, accessing the capital market more frequently, as well as finding investors more easily because they have minor informational asymmetries.

Regarding the aggregate model of Póvoa and Nakamura (models 7 and 8), it can be observed very close results to those observed in the Colla et al. (2013, 2020) model; however, unlike these, the authors used EBIT volatility instead of cash flow volatility, as well as the IPO and leverage variables instead of the dummy for dividend payers and R&D expenses. In relation to the latter, in the same way as Póvoa and Nakamura (2014), it was identified no influence of going public on the specialization of debts.

In terms of leverage, it was identified that this variable negatively influences the HHI, that is, the greater the leverage, the more diversified the debt composition, according with Khan et al. (2021). Like Póvoa and Nakamura (2014), it is noteworthy that the proxy variable for leverage is probably endogenous, that is, leverage decisions, as well as their composition, are determined jointly, but since this variable was used by Póvoa and Nakamura (2014), we maintained in this work as well. As robustness, we re-estimated all our models that contained leverage as an explanatory variable and we did not identify biases generated by its inclusion.

These aggregated models do not allow to identify the determinants of debt specialization of constrained and unconstrained firms. For this, the sample was segregated into two groups: firms that have credit rating classifications at least in one year of our time series (classified as unconstrained) and those that do not have credit rating classifications (classified as constrained) (see Table 1 for variable definition). Therefore, the same models of Colla et al. (2013) and Póvoa and Nakamura (2014), but now for the group of unconstrained and constrained firms.

Based on this factor, some peculiarities were identified that could not be observed in the aggregated analysis. One of these results is that the information asymmetry (R&D) influences debt specialization for the Brazilian firms, but only for constrained ones. This result is important, as it shows that the relationship between information asymmetries and debt specialization is unique to financially constrained Brazilian firms. Therefore, we

have identified that Brazilian financially constrained firms are more likely to have high debt diversification when the information asymmetry is high. Then, we rejected our  $H_2$ .

We identified that this result is different from that observed by Colla et al. (2013, 2020), revealing differences between the influence of information opacity between countries. The Póvoa and Nakamura (2014) justification that have higher R&D expenses may signal the market for greater investment opportunities, and, therefore, they need to make their debt structure more diversified, is observed just to financially constraint firms. In addition, some lenders may be unwilling to provide the amount necessary to enable research and development projects to be carried out, given their state of financial constraint (no credit rating).

Another variable that showed a difference between constrained and unconstrained firms was the proxy for expected bankruptcy costs (cash flow or EBIT volatility and tangibility). As we hypothesized in the literature review, the increase in the expected costs of bankruptcy for constrained firms produces a stronger and significant adjustment in the specialization of their debts, if compared to unconstrained firms. Then, we have identified that Brazilian financially constrained firms are more likely to have high debt specialization when the expected bankruptcy costs are high. This result does not allow us to reject our  $H_3$ .

Other determining signs indicate that, in summary, the financial constrained firms that are younger (shorter listing time), smaller, less leveraged, less profitable (just in regression 11), and with less investment opportunities (just in regression 6) tend to specialize their debt composition, that is, to homogenize its structure. On the other hand, unconstrained firms that are more profitable, more leveraged, with more investment opportunities, and are bigger tend to diversify their debt composition, that is, to heterogenize its debt structure.

As main differences, it was observed divergent impacts of going public in relation to the financial constraints. Thus, for financial constrained firms, it was found that the younger the firms (shorter time of listing), the higher the HHI tends to be, causing them to become more specialist in the composition of their debt structure. This result corroborates with Khan et al. (2017, 2021) and Póvoa and Nakamura (2014) given that age is considered a significant reputation signal on the market and it can reduce some agency problems, information asymmetries, and financial distress costs. Another significant difference lies on profitability variable. This, unlike the aggregated models, proved to be a significant determinant for unconstrained firms, there is a negative influence on

the debt specialization. This relation, according to Khan et al. (2021), reflects the access of high level of debt as

these companies earn high profits to shelter their marginal taxes (benefits of tax).

## 5. CONCLUSIONS

This article sought to analyze the historical evolution, the composition, and the determinants of the debt specialization of Brazilian firms in an aggregate way and conditioned to their financial constraint. The theoretical motivation for this research stems from the fact that most studies dealing with capital structure still consider debt structure uniform.

This study differs from the few conducted in Brazil under this theme by promoting a discussion of the evolution and the composition of debt structure, introducing an idiosyncrasy of Brazil for having a capital market still in development, with financial constraints and high interest rates. This Brazilian idiosyncrasy is illustrated by the results that financially constrained Brazilian firms have a greater degree of debt specialization and compose their debt structure in some types, mainly by loans, reflecting that they do not have access to a multiplicity of the products available from the financial and capital markets. Based on this, we do not reject our H1.

Although financially constrained Brazilian firms tend to specialize their debt structure, we observed that these firms, over time, are decreasing their specialization. This result brings a different perspective from that approached by Colla et al. (2020) for the U.S. scenario, in which they revealed that firms increased their debt specialization over the time. This result was found, mainly because Brazilian companies access different sources of credit, being able to reduce their cost of debt. Finally,

other important determinants indicated that Brazilian financially constrained firms are more prone to have high debt specialization when the information asymmetry is low and when the expected bankruptcy costs are high. Based on this, we rejected the H2 and do not reject the H3.

This article presents theoretical and empirical contributions. In theoretical terms, it is a pioneer in exploring the evolution and composition of the debt structure of Brazilian firms conditioned to their financial constraints. In empirical terms, it provides evidence that firms, regardless of their financial constraints, are less specialists in the formation of their debt structure, revealing a completely different scenario for Brazil, compared to the U.S. one.

As limitations, the main gap in this paper refers to the types of debt analyzed, that is, the representations of each credit source on the total of debt may be driven by the types of debt collected directly by Capital IQ, that is, the tendency to homogenize may be “disguised” by not considering Brazilian characteristics, such as the absence of discrimination of Banco Nacional de Desenvolvimento Econômico (BNDES) resources and international credit, as these sources are not available in Capital IQ. However, through this debt structure, it was possible to compare with U.S. studies. Finally, as a suggestion for future research, factors other than financial constraints can be explored, such as bankruptcy costs and informational asymmetries, in more details.

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