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Does debt diversification impact the value of companies? Evidence from Brazil

Rodrigo Thirion Correia dos Santos
https://orcid.org/0009-0005-9348-460X

Tatiana Albanez
https://orcid.org/0000-0002-4471-6946

Abstract

Purpose: The main objective of this work is to investigate the impact of debt diversification on the market value of Brazilian listed companies in the period 2010-2021.

Design/methodology/approach: We used a sample of 206 Brazilian listed companies from 2010 to 2021. Panel data regression models were estimated, with the dependent variable represented by the market value of firms through three different proxies and the explanatory variables through three different heterogeneity indices, in addition to control variables.

Originality: The use of different forms of debt is a phenomenon present in the reality of firms. However, how this characteristic of the debt structure affects the value of companies is a topic that still needs to be investigated in depth in emerging markets, considering the specificities of these markets. In Brazil, the credit market is characterized by high banking concentration and the significant presence of development banks, in addition to an institutional environment with lower creditor protection and lower levels of corporate governance, creating a distinct environment from previous research.

Findings: It was observed that the greater the heterogeneity of firms' debt, the higher the market value of companies, pointing to the importance of debt diversification in mitigating agency costs and increasing firms' efficiency. The results highlight the importance of considering the characteristics of the local market in the effectiveness of creditor monitoring.

Practical implications: This result contributes to the decision-making process of shareholders and managers in the Brazilian market, by showing which factors can maximize investments made and, consequently, increase the value of companies.

Keywords: Debt Structure; Capital Structure; Heterogeneity; Market Value; Agency Costs.

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1 Introduction

The capital structure of companies has been among the most researched topics in corporate finance in recent decades. In general, these studies are directly related to the choice of the composition between equity and debt used by the company to finance its activities. According to Kumar, Colombage, and Rao (2017), despite being a topic present in financial literature for decades and having various theoretical approaches, the importance of studies in this area arises from topics that are still underexplored, especially considering the characteristics of emerging markets.

According to Rauh and Sufi (2010), a significant portion of the studies in the field has so far used structural models that treat debt as a uniform source of funds, without distinguishing between different debt instruments. However, as noted by the authors, a significant number of publicly rated American companies have different sources of debt in their financial statements.

Colla, Ippolito, and Li (2013) also found evidence of various types of debt, and financial debt instruments can differ in several aspects, such as origin, maturity, collateral, among others. As a result, there is a common limitation in research since debt is treated as a homogeneous block in a significant portion of the literature, despite empirical evidence, without addressing potentially significant aspects for understanding the composition of a company's capital structure and its possible impacts on firm characteristics.

In Brazil, the literature on the subject focuses on studying the relationship between heterogeneity and the determinants of the debt structure of Brazilian companies (Póvoa & Nakamura, 2014; Eça, Gomes & Valle, 2022). However, there are still no studies that relate the possible impacts of multiple financing relationships on the market value of firms. The credit market in Brazil is characterized by great accessibility to credit lines due to recent developments over the past decades, despite high banking concentration and significant presence of development banks. Taking into account that Brazilian companies operate in this credit market with specific characteristics that differ from the debt market in other countries (for example, the United States) due to high banking concentration, the presence of development banks, and varying interest rates, and additionally, considering that according to Colla *et al.* (2013) debt specialization may be related to market characteristics, it is believed that the debt structure of companies has an effect on firm value through agency relationships and costs associated with conflicts of interest between creditors and shareholders. Thus, there are conditions to obtain evidence different from previous studies.

Based on agency theory (Jensen and Meckling, 1976), the channel through which debt diversity potentially affects firm value involves the agency relationship and the costs arising from conflicts of interest among different parties involved in the firm (managers, shareholders, and other investors, such as creditors). According to Jensen (1986), the use of debt to finance company activities, as opposed to equity, reduces agency costs by reducing the free cash flow available to managers. Therefore, the role of debt in reducing agency costs becomes evident, with debt diversification having the potential to further mitigate these costs through the disciplining effect of debt on managers and their ability to reduce the inefficient use of resources. Harvey, Lins, and Roper (2004) have found that in emerging markets, where managers and families routinely employ pyramid ownership structures, the disciplining effect of debt is concentrated in firms with high expected managerial agency costs (e.g. high levels of assets in place or limited future growth opportunities) impacting the creation of value by these companies.

Rajan (1992) points to another advantage related to the use of debt to reduce agency costs. Financial institutions have additional information about firms through access to financial transactions recorded in bank statements and other controls, such as information about the quality of receivables and customers of the debtor firm. Harvey *et al*. (2004) showed that actively monitored debt creates value for shareholders of firms that face potentially extreme agency costs. Expanding on this argument, as debt heterogeneity exposes the firm to scrutiny from different participants in the credit market, it can contribute to the reduction of agency costs. Financial institutions, underwriters, and credit rating agencies are examples of market participants that instill a disciplinary role in debt, and therefore, a lower agency cost and consequently a positive impact on firm value would be expected (Jadiyappa *et al*., 2020).

In this context, Jadiyappa *et al*. (2020) assert that it is possible to expect a positive relationship between debt heterogeneity and the market value of companies, considering that this structure with different types of debt tends to mitigate agency costs and alter managers' behavior during the decision-making process, thereby increasing the value of firms.

Similarly, the studies conducted by Kysucky and Norden (2016) and Platikanova & Soonawalla (2020) find that companies with relationships with multiple creditors have greater negotiating power and, thus, can negotiate better terms in rates and deadlines, a result also obtained by Eça and Albanez (2022) for Brazilian companies.

Thus, it would be expected that firms with multiple sources of financing and significant debt heterogeneity have more incentives to become efficient, resulting in lower agency costs due to greater alignment of interests between creditors and managers, and, therefore, can generate more value for shareholders. In addition, investors are expected to also consider the potential impacts of debt diversification on companies' bankruptcy costs and their access to the capital market in their investment decisions. Consequently, debt diversification may be potentially relevant for asset pricing.

On the other hand, another line of literature from agency theory argues that the effectiveness of monitoring decreases when there are multiple creditors, as this situation can lead to free rider problems and coordination problems in case of the need for financial restructuring (Carletti *et al*., 2007; Brunner and Krahnen, 2008). In practice, Carletti *et al*. (2007) state that, in the presence of multiple banking relationships, the amount of credit granted by each participant is reduced, so the monitoring incentives of each agent are lower, which may lead to the delegation of monitoring to other participants. If multiple creditors delegate monitoring to other agents, the total volume of monitoring will be lower, increasing the potential agency costs of debt. As a result, Jadiyappa *et al*. (2020) claim that the market value of companies may be reduced in the presence of debt heterogeneity.

The literature also points to another disadvantage of a more diversified debt structure, which is related to the difficulty of coordination among creditors in the event of a company's liquidation (Ivashina, Iverson, and Smith, 2016; John, Kaviani, Kryzanowski, and Maleki, 2018; Lou and Otto, 2020). Lou and Otto (2020) emphasize that companies with heterogeneous debt have higher bankruptcy costs due to a greater likelihood of disagreement among creditors regarding the recovery strategy of the debtor company, resulting in a coordination failure in case of default.

In this context, the main objective of this work is to investigate the impact of debt diversification on the market value of non-financial Brazilian companies in the period 2010-2021, using a database composed of Brazilian companies listed on the Brazilian stock exchange and present in the Capital IQ database.

As the main results, it was observed that the greater the heterogeneity of the firms' debt, the higher the market value of Brazilian companies, pointing to the role of debt in reducing agency costs, aligning interests, and making the company more efficient. These results indicate the relevance of diversifying the debt structure in the decision-making process for the choice of financing sources by managers and the importance of local market characteristics in the effectiveness of creditor monitoring. Thus, it is expected that the research will contribute to the decision-making process of shareholders and managers in the Brazilian market, by investigating which factors can determine the maximization of Investments.

2. Theoretical Framework

According to Rauh and Sufi (2010), corporate debt is characterized by heterogeneity due to the diversity of maturities, cash flow priorities, and sources of resources in a company's debt structure. The results obtained by the authors indicate that the use of multiple sources of financing is a primary characteristic of the debt structure and a reality for companies, although this aspect is disregarded in many other studies on the subject. Additionally, the results suggest that the same type of debt can vary depending on some basic characteristics, such as the right to preferential cash flow and the term of the transactions. Rauh and Sufi (2010) emphasize that an understanding of a company's capital structure will only be achieved when there is knowledge of the motivation behind companies using different sources, instruments, and debt with preferential rights.

Among the research related to debt heterogeneity, there is evidence both in favor of and against greater diversification of a company's debt, as it can bring advantages and disadvantages to the firm and generate shareholder value. Firstly, the positive aspects will be discussed, starting with the agency theory perspective.

Since the seminal articles by Jensen and Meckling (1976) and Myers (1977), research on the subject has focused on understanding the conflict of interests between shareholders and creditors and its implications for the capital structure of companies (Colla *et al.*, 2013). Jensen and Meckling (1976) initially defined that contractual relationships are at the core of firms, with relationships with employees, suppliers, shareholders, and customers equally important for operational continuity. Within this context, the authors emphasize that there are agency problems in these relationships, and consequently, effective monitoring is needed for all these contracts to mitigate the costs arising from conflicts of interest among different agents. Furthermore, Colla *et al.* (2013) highlighted the importance of potential conflicts of interest among different groups of creditors and how these conflicts shape the decisions of companies in choosing sources of financing.

In this context, considering that in the presence of information asymmetry and conflicts of interest, investors incur costs to obtain information, it only makes sense to incur these costs when there are sufficient incentives, such as a high volume of funds lent to a firm, or when there is a high degree of information disclosure. As a result, debt and company management structures are created to mitigate informational problems and promote incentives for monitoring (Colla *et al.*, 2013).

For Bolton and Scharfstein (1996), the relationship between firm value and debt diversification is crucial. They argue that the heterogeneity of the debt structure, along with the presence of secured creditors, plays a significant role in increasing firm value. This debt diversification not only reduces the cost of capital but also facilitates financial restructuring processes, resulting in higher firm valuation.

Rauh and Sufi (2010) also argue that debt diversity can potentially increase a firm's value by reducing risk, lowering the cost of capital, enhancing financial flexibility, and improving investor perception. However, it's important to note that the actual impact of debt diversity may vary depending on factors such as the firm's specific circumstances, industry dynamics, and prevailing market conditions. Rauh and Sufi (2010) suggest that firms with well-diversified debt portfolios may be viewed more favorably by investors, as they are seen as less vulnerable to specific risks or disruptions in financial markets. This positive perception can lead to a higher market valuation for the firm.

Similarly, for Colla *et al.* (2013), debt diversity potentially has a significant impact on firms' value. It can potentially decrease risk, lower the cost of capital, enhance financial flexibility, and reduce agency costs, all of which can contribute to an increase in firm value. However, the specific effects of debt diversity on firm value may vary depending on factors such as the industry, market conditions, and the firm's overall financial strategy.

In addition to understanding the importance of debt heterogeneity in the literature, there are studies that examine why companies structure their debt into various distinct forms (Park, 2000; Bolton and Freixas, 2000). According to Park (2000), structuring different contracts with creditors can serve as a mechanism to reduce total monitoring costs incurred and also minimize moral hazard. In other words, the use of external capital in companies to finance riskier activities is possible using monitoring to reduce problems arising from informational asymmetry, serving as an example of the motivation behind companies using various forms of debt.

From another perspective, Bolton and Freixas (2000) argue that the main distinction between bonds and bank financing lies in the ability to monitor by banks. Thus, in the case of low company profitability and an increasing possibility of default, financial institutions will have an easier time projecting the company's future profitability and cash flow due to closer monitoring compared to bondholders, and, therefore, can choose the best decision for receiving the invested capital.

Based on the cited literature, it is evident that the presence of more diversified debt can have a direct impact on companies in terms of monitoring. In this regard, Jadiyappa *et al.* (2020) state that a positive relationship can be expected between debt heterogeneity and the market value of companies since this structure tends to mitigate agency costs and alter the opportunistic behavior of managers during the decision-making process, increasing the value of firms. In summary, the use of various forms of debt and different creditors creates an environment with more effective monitoring, and such monitoring of activities by various distinct agents can be considered a disciplining measure on companies.

However, from another perspective, there are studies that indicate a possible negative impact of the presence of multiple creditors on companies. According to Carletti *et al.* (2007), companies that have debt with various financial institutions may experience reduced profit margins, financial and legal inefficiencies due to problems related to monitoring duplication and free riding. As Carletti *et al.* (2007) suggest, since monitoring is individually costly and not observable, each banking institution has an incentive to reduce monitoring efforts, believing that they will be compensated by the benefits of monitoring performed by other creditors.

Other studies also present arguments in favor of a more homogeneous debt structure. Brunner and Krahnen (2008) argue that companies with multiple creditors may face significant coordination problems in the event of the need for financial restructuring, with the potential for increased monitoring costs in a default environment.

From a similar perspective, Lou and Otto (2020) provide another argument in favor of a more homogeneous debt structure, considering that the participation and amount lent by each participant in the group of creditors tend to be smaller in companies with multiple relationships using third-party capital. In this scenario, creditors would have less incentive to monitor and track the economic and financial situation, and consequently, become less informed about key developments in the invested companies, directly impacting the quality and efficiency of strategic decisions.

In summary, there are factors that can affect the value of companies with greater diversification in their debt, such as monitoring inefficiencies, the presence of free riders, and possible increases in coordination costs in the event of default. Therefore, due to the increase in agency and coordination costs, these aspects could negatively impact the firm's value (Carletti *et al.*, 2007).

Therefore, this research aims to investigate the relationship between debt heterogeneity and the value of Brazilian companies, given the divergence of views in the literature and the specific conditions of the national market that may be potentially relevant to understanding the debt structure of firms in the country. Considering that Brazilian companies operate in this credit market with specific characteristics, such as high banking concentration, the presence of development banks (e.g. BNDES), and heterogeneous interest rates, and that the debt structure of companies influences firm value through agency relationships and costs associated with conflicts of interest between creditors and shareholders, there are conditions for obtaining evidence different from what previous studies have found.

Furthermore, drawing from the findings of Harvey *et al.* (2004) and acknowledging Brazil's notable presence of influential shareholder groups overseeing publicly traded firms, it is believed that there would be a lower propensity for free riding behavior in Brazil. Therefore, it is considered that in the country there are better conditions for monitoring efficiency through the use of different types of debt, which may impact the value of Brazilian companies.

Thus, this study proposes to investigate the relationship between debt heterogeneity and firm characteristics based on the markets in which these firms operate, with the hypothesis that the heterogeneity of the debt structure affects the market value of firms. It should be noted that this hypothesis has not been directly addressed by the majority of the literature, making it a distinctive aspect of the study, especially considering the characteristics of emerging markets.

3. Data

3.1 Data and Sample

The sample consists of Brazilian companies listed on the Brazilian stock exchange (B3). The data were collected from the Capital IQ database for the period from 2010 to 2021, with each observation referring to the end of the fiscal year. Additionally, the Economatica database was also used to collect data.

As a first step, companies in the utilities sector [Standard Industrial Classification (SIC) codes 4900–4949] and financial companies (SIC codes 6000–6999) in the Capital IQ database were excluded due to specificities in their financing format. As additional filters, companies with zero debt, companies with negative net equity (due to the financial deterioration of these companies, with natural potential for destruction of value), and firms with less than two consecutive years of data for analysis were also excluded.

Additionally, companies that did not have data related to the type of debt used in their debt structure in the Capital IQ database were removed, considering that they do not allow the calculation of the main variable in the proposed modeling. After applying all the filters, the final study sample consists of 206 companies.

3.2 Measurement of Debt Structure Heterogeneity

The first proxy is called the Herfindahl-Hirschman Index (HHI), the secondary measure used is the Excl90 index, and finally, the Ntype metric. It is worth noting that these indicators are used in the studies by Colla *et al.* (2013), Lou and Otto (2020), Platikanova and Soonawalla (2020), Mansi, Qi, and Wald (2021), and Eça and Albanez (2022).

In general terms, the Herfindahl-Hirschman Index (HHI) is used for each company *i* in each year *t*, with its calculation carried out in two stages. The first stage consists of summing the squares of the ratio between the volume of the various sources of debt present in the Capital IQ database and the total amount of debt for each firm *i* over the years *t*. According to previous studies, this work used the seven debt classifications present in Capital IQ, according to equation (1).

$$SS_{it} = \left(\frac{CP}{TD_{it}}\right)^2 + \left(\frac{DC_{it}}{TD_{it}}\right)^2 + \left(\frac{TL_{it}}{TD_{it}}\right)^2 + \left(\frac{SBN_{it}}{TD_{it}}\right)^2 + \left(\frac{SUB_{it}}{TD_{it}}\right)^2 + \left(\frac{CL_{it}}{TD_{it}}\right)^2 + \left(\frac{Other_{it}}{TD_{it}}\right)^2 \quad (1)$$

SS_{it} is the sum of the squared seven debt type ratios for firm *i* in year *t*; CP refers the volume of commercial paper issued in the international or domestic market; DC refers to the volume of drawn credit lines; TL represents the volume of term loans (such as working capital lines, fixed asset financing, credit operations provided by development banks, guaranteed accounts, and advance lines on exchange contracts); SBN is related to the senior amount of bonds and notes issued in the domestic and international market; SUB is equal to the volume of subordinated bonds and notes issued in the domestic and international market; CL refers to the volume of capital leases; *Others* equals the volume of debt not categorized in the previously described classifications; TD is the sum of total debt of firms.

After obtaining the results from the calculation of Equation (1), the next stage of the HHI index is derived from Equation (2):

$$HHI_{it} = \frac{SS_{it} - {}^{1}/_{7}}{1 - {}^{1}/_{7}} \quad (2)$$

SS_{it} (sum of squares) is obtained through the 7 categories of debt described in Equation (1).

The HHI index varies from 0 to 1. If the company uses only a single category of debt, the HHI index is equal to 1, while if the firm simultaneously uses all seven categories of debt in the same proportion, the HHI index is equal to 0. Thus, the lower the index, the greater the diversification of the company's debt.

With the purpose of assessing a company's economic specialization in a single type of debt, the Excl90 index will be used as an alternative indicator to HHI. The use of this proxy is in line with studies conducted by Colla *et al.* (2013), Lou and Otto (2020), Platikanova and Soonawalla (2020), Mansi *et al.* (2021), and Eça and Albanez (2022). Thus, the Excl90 index is a dummy variable for a company *i* in year *t*, which takes a value of 1 (one) when the firm has more than 90% of its debt concentrated in a single type of debt, indicating homogeneity, and 0 (zero) otherwise.

As proposed by Platikanova and Soonawalla (2020), in order to capture the use of different categories in a company's debt structure, the Ntype metric is also used. The index is composed of categorical variables according to Equation (3).

$$NTYPE_{it} = (1,2,3,4,5,6,7) \quad (3)$$

Through the seven categories of debt present in the Capital IQ database, the index varies from 1 (one) to 7 (seven). It assigns the minimum value of 1 (one) when the firm has only one type of debt and the maximum value of 7 (seven) for companies that have all debt categories in each period.

3.3 Econometric Model

To test the research hypothesis and assess the effect of debt heterogeneity on firm value, panel data regression models with fixed effects were used. In the proposed model, the dependent variable is defined by different proxies for the market value of companies, as firm value reflects the firm's ability to provide satisfactory returns to all stakeholders. Thus, 3 proxies are used to measure the market value of companies, aiming to provide greater robustness to the findings. The econometric models are constructed according to the general Equation (4) highlighted below.

$$ValorFirma_{it} = \beta_0 + \beta_1 HeterogeneidadeDívida_{it} + \beta_2 TAM + \beta_3 Div_{it} + \beta_4 Tang_{it} + \beta_5 Liq_{it} + \beta_6 Risk_{it} + \beta_7 Rent_{it} + \beta_8 Lev_{it} + \alpha_i + \alpha_t + \varepsilon_{it} \quad (4)$$

The dependent variable, , is represented by three different indicators: Tobin's Q, Price-to-Book (P/B) ratio, and Market-to-Book ratio. The explanatory variable, , is represented by three different proxies: HHI refers to the Herfindahl-Hirschman index; EXCL90 is equal to the debt specialization indicator, and NTYPE represents the debt specialization index.

Regarding the control variables: *Size* characterizes firm size; Div represents dividend distribution by companies; Tang characterizes tangibility; Liq represents the market liquidity of stocks; Risc refers to firms' systemic risk through the Beta index; Profit represents firms' profitability; Lev is equal to leverage.

The coefficient of interest in Equation (4) is denoted as . According to the proposed hypothesis, is expected to be significant, but the expected sign of the coefficient cannot be determined a priori and could be either positive or negative.

The variables included in the models are detailed in Table 1. Aiming to provide robustness to the findings, we used different proxies for the dependent, control and explanatory variables, in alternative econometric models.

Table 1
Dependent and Explanatory Variables

Dependent Variables	Code	Operationalization	Reference
Tobin's Q	*Tobin*	$q = \frac{\text{Market Value of Equity} + \text{Debt}}{Total\ Assets}$	Tobin (1969), Berger e Ofek (1995), Hennessy (2004), Jadiyappa *et al.* (2020)
Price-to-Book	*P/B*	Market Value of Equity to Book Value of Equity	Fama e French (1993), Jensen, Johnson e Mercer (1997), Hilliard e Zhang (2015)
Market-to-Book	*M/B*	Market Value of Total Assets to Book Value of Total Assets	Berger e Ofek (1995), Schlingemann *et al.* (2002), Albanez e Schiozer (2022)
Explanatory Variables	**Code**	**Operationalization**	**Reference**
Herfindahl-Hirschman Index	*IHH*	As presented in subsection 3.2	Colla *et al.* (2013), Giannetti (2019), Lou e Otto (2020), Platikanova e Soonawalla (2020)
EXCL90 Index	*EXCL90*	*Dummy equal to 1 for firms with more than 90% of debt concentrated in only one type, and 0 otherwise.*	Colla *et al.* (2013), Lou e Otto (2020), Platikanova e Soonawalla (2020)
Debt Specialization Index	*Ntype*	Categorical variable ranging from 1 to 7, representing the number of distinct debt categories of firms.	Platikanova e Soonawalla (2020)

Control Variables	Code	Operationalization	Reference
Size	*TAM_1*	Natural Log of Total Assets	Cameran e Campa (2020), Lin *et al.* (2019), Mansi *et al.* (2021)
	TAM_2	Natural Log of Total Revenues	
Dividend	*Div_1*	Dividends paid to Total Assets	Albanez e Schiozer (2022), Colla *et al.* (2013)
	Div_2	Dividends per share over share price	
Tangibility	*Tang*	Fixed Assets to Total Assets	Colla *et al.* (2013), Lou e Otto (2020), Platikanova e Soonawalla (2020)
Liquidity	*Liq*	Volume of shares traded in the year over total available shares	Batten e Vo (2019), Bekaert, Harvey e Lundblad (2007), Tran, Hoang e Tran (2018)
Risk	*Risk*	Market beta of the asset, which is equal to the slope coefficient of the linear regression between the annual return of the shares and the annual return of the market index (Ibovespa) for the last 60 months, calculated by Capital IQ.	Chen, Xu e Yang (2021); Lameira, Ness Jr e Macedo-Soares (2007); Peixoto (2012)
Profitability	*Rent_1*	EBITDA to Total Assets	Colla *et al.* (2013), Lou e Otto (2020), Platikanova e Soonawalla (2020)
	Rent_2	Net Income to Total Assets (ROA)	
Leverage	*Lev*	Total Debt to Total Assets	Cameran e Campa (2020), Mansi *et al.* (2021), Platikanova e Soonawalla (2020)

Notes: Total Debt is the sum of interest-bearing short and long-term liabilities; EBITDA represents earnings before interest, taxes, depreciation, and amortization; ROA refers to the Return on Assets, measured by the ratio of net income to total assets; the Market Value of Equity is defined as the sum of the quantity of shares multiplied by the price for each class of shares, obtained from Economatica; Debt is the book value of current liabilities minus current assets plus the book value of long-term debts; the Market Value of Assets is defined as Total Assets minus Book Equity plus Market Equity. Information regarding items from the financial statements of the companies and necessary for the elaboration of the main variables of the model was extracted from the Capital IQ database.

It should be noted that the choice of the fixed effects model with clustered robust standard errors, instead of the random effects model, is due to the theoretical premise of the latter model in which there is the assumption that there is no correlation between the unobserved heterogeneity of the regression and the remaining independent variables. According to Angrist and Pischke (2008), this assumption can be considered unrealistic in studies related to the finance field. Nevertheless, even though there is consensus in the finance literature about the greater adequacy of the fixed effects model, given its theoretical assumptions, the Hausman test is presented, which also confirmed the choice of the fixed effects model.

Additionally, the metric variables were winsorized at the 2.5% and 97.5% percentiles to mitigate the effect of outliers. The possible existence of multicollinearity problems was analyzed through correlation analyses between the explanatory variables.

4. Results

4.1 Descriptive Analysis

Table 2 presents the results of descriptive statistics for all the variables used in the models and for the variables used in the HHI measure.

Table 2
Summary statistics

Variables used in the models							
Variable	Observations	Mean	SD	Min	Max	Q25	Q75
TOBIN	1204	0,870	0,790	0,023	2,675	0,365	1,142
P/B	1204	4,503	4,765	0,023	8,731	0,232	3,895
M/B	1204	1,877	0,844	1,060	4,647	1,291	2,134
EXCL90	1204	0,278	0,443	0,000	1,000	0,000	1,000
NTYPE	1204	3,002	1,150	1,000	6,000	2,000	4,000
HHI	1204	0,582	0,261	0,111	1,000	0,380	0,817
SIZE_1	1204	7,270	15,831	0,026	22,722	0,554	4,758
SIZE_2	1204	11,161	20,517	0,118	31,684	1,061	9,284
DIV_1	1204	0,027	0,026	0,000	0,100	0,000	0,023
DIV_2	1204	0,435	0,994	0,000	5,272	0,000	0,382
TANG	1204	0,255	0,209	0,000	0,729	0,077	0,356
LIQ	1204	0,058	0,092	0,011	0,477	0,021	0,068
RISK	1204	0,589	0,620	-0,572	2,313	0,173	0,879
PROFIT_1	1204	0,097	0,085	-0,100	0,252	0,042	0,140
PROFIT_2	1204	0,193	0,149	-0,012	0,596	0,100	0,263
LEV	1204	0,315	0,187	0,019	0,718	0,188	0,427
Variables used in the HHI measure							
CP/TD	1204	0,009	0,024	0,000	0,026	0,003	0,014
DC/TD	1204	0,017	0,027	0,000	0,033	0,005	0,025
SBN/TD	1204	0,213	0,076	0,082	0,346	0,167	0,256
SUB/TD	1204	0,030	0,009	0,000	0,056	0,007	0,033
TL/TD	1204	0,667	0,115	0,521	0,932	0,624	0,789
CL/TD	1204	0,048	0,055	0,000	0,097	0,011	0,067
OTHER/TD	1204	0,017	0,047	0,000	0,093	0,007	0,035

Notes: The calculation of the variables used in the models was detailed in Table 1; CP/TD: Commercial paper divided by total debt; DC/TD: drawn credit lines divided by total debt; SBN/TD: Senior Bonds divided by total debt; SUB/TD: Subordinated Bonds divided by total debt; TL/TD: Term Loans divided by total debt; CL/TD: Capital Leases divided by total debt; OTHER/TD: debt not categorized in the previously described classifications divided by total debt.

Regarding the main results in Table 2, the values obtained for the main explanatory variables stand out. On average, the variable HHI had a value of 58.2%. According to Póvoa and Nakamura (2014), firms with heterogeneous debt structures tend to have this index below 70% in the Brazilian scenario. Therefore, it can be concluded that the companies in the sample tend to have greater debt heterogeneity. When comparing, the level of debt diversification within the Brazilian sample appears to be on par with, or even exceeds, that observed in developed economies. According to Colla *et al.* (2013), the average IHH in the US market is 0.70, whereas based on the findings by Lou and Otto (2020), the average IHH stands at 0.66.

Through the descriptive analysis, it is observed that the study's sample includes companies ranging from those with total concentration in a single debt type (HHI = 1) to firms with significantly heterogeneous third-party leverage, with indicators close to 0 (HHI = 0.11). It is also possible to note that the most used type of debt is term loans (such as working capital lines, fixed asset financing, credit operations provided by development banks, guaranteed accounts, and advance lines on exchange contracts) and senior bonds and notes issued in the domestic and international market.

To further analyze the degree of leverage of the listed firms in the country, an analysis of the Q25 and Q75 percentiles was carried out as part of the descriptive analysis. Descriptive statistics for the HHI variable indicate that in addition to the presence of companies with distinct and opposite levels of debt heterogeneity, there is a good distribution of the debt structure of the companies, with values of 0.38 and 0.82 for Q25 and Q75, respectively.

Considering that, by definition, the HHI variable has a minimum value of 0 and a maximum value of 1, and also that the values obtained for the Q25 and Q75 percentiles are reasonably distant and distributed over a reasonable portion of the variable's range, it can be observed that Brazilian firms use different levels and concentrations of debt by type. Therefore, despite the trend towards a more diversified debt structure in the sample based on the average HHI variable, the degree of heterogeneity is well distributed among Brazilian firms with no significant concentration.

Similarly, the explanatory variable NTYPE indicates that, on average, companies use approximately 3 different debt types to finance their activities. However, just as indicated by the HHI index, there are different degrees of heterogeneity in the sample. The categorical variable NTYPE can take values from 1 to 7, with a value of one (1) when the company has only one debt type and seven (7) when the firm uses all distinct forms of third-party capital financing.

Thus, based on the maximum value of six (6) obtained for the NTYPE variable, there are companies with high usage of different types of debt, but it is noted that there is no company in the sample that uses all seven (7) debt types detailed in the literature and available for capital raising in the Brazilian market. The minimum value of one (1) in the descriptive statistics indicates the presence of companies using only one debt type.

As found for the HHI index, Q25 and Q75 of the NTYPE variable, as well as the maximum and minimum values, indicate the absence of concentration in debt utilization by Brazilian publicly traded firms, with Q25 representing the use of 2 distinct sources of third-party capital and Q75 highlighting the use of 4 debt types.

Finally, it can be observed that only 28% of the companies have more than 90% of their debt concentrated in just one category, as indicated by the EXCL90 dummy statistics.

4.2 Panel Data Models Analysis

Tables 3 and 4 differ in the use of different proxies for control variables employed in the econometric model. In Table 3, the results were obtained using the first options for control variables: size_1, dividend_1, and profitability_1. Regarding the results found for the dependent variables, columns (1), (2), and (3) are associated with the estimations produced for the Tobin's Q proxy (TOBIN). Additionally, columns (4), (5), and (6) present the values for the Price-to-Book ratio (P/B), and the last columns, (7), (8), and (9), are related to the Market-to-Book ratio (M/B).

Columns (1), (4), and (7) represent the results of estimations with the Herfindahl-Hirschman (HHI) as the independent variable. In columns (2), (5), and (8), estimations are for the EXCL90 Index as the independent variable, and finally, columns (3), (6), and (9) present the results of estimations for the Debt Specialization Index (NTYPE).

Table 3

Regressão em Painel com Efeitos Fixos

	TOBIN			P/B			M/B		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HHI	-0,042**			-0,053**			-0,039**		
	(0,072)			(0,079)			(0,075)		
EXCL90		-0,037*			-0,058***			-0,038*	
		(0,040)			(0,342)			(0,041)	
NTYPE			0,009**			0,027**			0,013**
			(0,020)			(0,172)			(0,021)
SIZE_1	0,142**	0,141**	0,143**	1,393***	1,352***	1,361***	0,125**	0,124**	0,124**
	(0,032)	(0,032)	(0,032)	(0,274)	(0,275)	(0,276)	(0,033)	(0,033)	(0,033)
DIV_1	4,692***	4,698***	4,700***	22,661***	23,049***	22,974***	4,858***	4,862***	4,846***
	(0,827)	(0,826)	(0,828)	(7,134)	(7,137)	(7,150)	(0,862)	(0,862)	(0,864)
PROFIT_1	2,651***	2,647***	2,658***	4,501*	4,642*	4,626*	2,935***	2,931***	2,940***
	(0,287)	(0,288)	(0,287)	(2,481)	(2,484)	(2,482)	(0,300)	(0,300)	(0,300)
TANG	0,979***	0,972***	0,967***	1,020	0,807	0,818	0,516**	0,512**	0,509**
	(0,209)	(0,209)	(0,208)	(1,805)	(1,801)	(1,801)	(0,218)	(0,218)	(0,217)
RISK	0,022	0,022	0,022	-0,071	-0,079	-0,079	0,022	0,021	0,021
	(0,024)	(0,024)	(0,024)	(0,206)	(0,206)	(0,206)	(0,025)	(0,025)	(0,025)
LIQ	0,899***	0,904***	0,893***	3,825**	3,677**	3,702**	1,014***	1,019***	1,012***
	(0,214)	(0,214)	(0,214)	(1,845)	(1,849)	(1,845)	(0,223)	(0,223)	(0,223)
LEV	-0,023*	-0,027*	-0,014*	-5,163**	-4,887**	-4,938**	-0,721**	-0,716**	-0,720**
	(0,148)	(0,148)	(0,148)	(1,279)	(1,281)	(1,282)	(0,155)	(0,155)	(0,155)
Observations	1,204	1,204	1,204	1,204	1,204	1,204	1,204	1,204	1,204
R^2	0,749	0,749	0,749	0,848	0,847	0,847	0,756	0,756	0,756
R^2 Adjusted	0,695	0,695	0,695	0,815	0,814	0,814	0,704	0,704	0,704
F Statistics	13,87	13,86	13,83	25,85	25,80	25,78	14,41	14,44	14,39
p-value	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman Test									
Chi2	54,06	51,53	64,96	49,06	47,02	26,28	43,27	39,94	38,58
Prob>chi2	0,000	0,000	0,000	0,000	0,000	0,003	0,000	0,000	0,000

Notes: *p<0.1; **p<0.05; ***p<0.01; The calculation of the variables was detailed in Table 1.TOBIN: Tobin's Q indicator; P/B: Price-to-Book ratio; M/B: Market-to-Book ratio; EXCL90: Economic specialization index, calculated using a dummy equal to 1 when there is 90% or more concentration in a single debt type; NTYPE: Debt specialization index, developed from categorical variables ranging from 1 to 7; HHI: Herfindahl-Hirschman index, a proxy for debt structure heterogeneity; SIZE_1, equal to the natural logarithm of Total Assets; DIV_1: dividends, equal to the amount of dividends paid on total assets; TANG: tangibility; LIQ: liquidity; PROFIT_1: profitability, equal to EBITDA over total assets; LEV: leverage, equal to total debt over total assets.

Based on the coefficients presented in Table 3, two out of the three main variables of interest in the study, HHI and EXCL90, have negative and significant values with the proxies for the market value of Brazilian firms. In other words, the greater the homogeneity of debt, the lower the pricing of shares of the companies in the study. That is, companies with a higher degree of debt heterogeneity have a higher market value, highlighting the impact of using different forms of financing on the generation of value for companies.

For example, based on the regression estimators presented in Table 3, a reduction of 0.10 in the Herfindahl-Hirschman Index (HHI) is associated with an increase of 0.0042 in the market value calculated by the TOBIN proxy or an increase of 0.0053 by the P/B metric, and finally, an addition of 0.0039 to the M/B index. Similarly, from the data in Table 3, a negative relationship is also observed between the EXCL90 indicator and the market value of firms. This proxy represents the degree of specialization of companies in the use of different types of debt. According to the results obtained, when a company is overly dependent on a specific type of debt (EXCL90 = 1), on average, there is a reduction of 0.037 in its market value measured by the Tobin's Q metric. Using the P/B and M/B proxies, the same negative and significant relationship is observed. For example, companies with a high degree of debt homogeneity (EXCL90 = 1) decrease, on average, by 0.058 and 0.038 in their market value, respectively.

Finally, it is worth highlighting the independent variable NTYPE, as despite having the opposite sign to the others (HHI and EXCL90), according to the definition of this proxy, similar interpretations of the results are observed. NTYPE is composed of categorical variables with values ranging from one (1) to seven (7), being equal to one (1) when only one type of debt is used, and equal to seven (7) when all types of debt highlighted in this study are used. Thus, as the NTYPE variable estimators have positive and significant values, this means that an increase in debt heterogeneity is related to an increase in the market value of firms, a result consistent with the other heterogeneity proxies.

In summary, the results show that greater diversification of debt types used by companies is associated with an increase in market value, according to the results presented for all debt heterogeneity proxies.

The results in Table 3 are consistent with Kysucky and Norden (2016) and Platikanova and Soonawalla (2020), indicating a positive and significant relationship with firm value. According to Kysucky and Norden (2016) and Platikanova and Soonawalla (2020), companies with a more diversified debt profile have relationships with multiple creditors. Consequently, they gain greater negotiation power in obtaining credit, benefiting from better terms, rates, and durations, with can affect firm value.

Therefore, according to Bolton and Scharfstein (1996) and Colla *et al.* (2013), the findings in this study can be explained by the role of debt diversification in reducing bankruptcy costs. That is, the heterogeneity of debt and the presence of secured creditors can increase firm value, both by reducing the cost of capital and by facilitating financial restructuring processes.

Specifically in the Brazilian context, the evidence found by Eça and Albanez (2022) suggests that companies with heterogeneous debt profiles have lower credit costs. Therefore, considering that the cost of credit is relevant to the investment decision-making process of investors, firms with a more diversified debt profile have a higher market value than others.

From another perspective, the main results differ from the studies of Carletti *et al.* (2007) and Jadiyappa *et al.* (2020), as these authors present evidence found in other markets for a negative relationship between debt heterogeneity and firm value. The main argument for a negative association between variables highlights the possibility of reducing the effectiveness of monitoring companies using various debt types. Therefore, the lower efficiency of monitoring would occur due to the presence of free-riding creditors and the potential increase in coordination costs in the event of default in companies using a diversified debt structure. Thus, since such characteristics are relevant to investors' decision-making processes, the pricing of companies with more heterogeneous debt would be reduced.

Particularly in the Brazilian context, considering the characteristics of the Brazilian credit market, such as high banking concentration, the presence of subsidized credit lines, and interest rates above the world average, it is believed that there is a lower likelihood of free riders. According to Stigler (1974), group size is a relevant characteristic for observing free-riding behavior among group participants, the presence of a small private banking competition and the existence of BNDES (Brazilian Development Bank) provide a possible explanation for the results. Additionally, based on the evidence found by Harvey *et al.* (2004) and considering that in Brazil there is a concentration of relevant shareholder groups in the control of publicly traded companies, it is believed that there would be a lower propensity for free riding behavior.

Table 4 presents the results of the alternative econometric model, using other proxies for the control variables (omitted results): size2, dividends2, and profitability2. The model presents similar results to those in Table 3, indicating that greater diversification of the debt profile leads to a higher market value for Brazilian companies.

Table 4
Panel Regression with Fixed Effects (Alternative Control Variables)

	TOBIN			P/B			M/B		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HHI	-0.043**			-1.238***			-0.032**		
	(0.074)			(0.614)			(0.077)		
EXCL90		-0.037**			-0.083**			-0.033**	
		(0.040)			(0.338)			(0.042)	
NTYPE			0.013**			0.139**			0.017*
			(0.020)			(0.170)			(0.021)
Observations	1.204	1.204	1.204	1.204	1.204	1.204	1.204	1.204	1.204
R^2	0.737	0.737	0.737	0.851	0.851	0.851	0.746	0.746	0.746
R^2 Adjusted	0.681	0.681	0.681	0.819	0.819	0.819	0.692	0.692	0.692
F Statistics	13.03	13.04	13.03	26.62	26.50	26.52	13.67	13.68	13.66
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hausman Test									
Chi2	34,45	36,85	41,78	43,57	41,71	39,02	47,25	53,22	15,01
Prob>chi2	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,008

Notes: *p<0.1; **p<0.05; ***p<0.01; The calculation of the variables was detailed in Table 1.TOBIN: Tobin's Q indicator; P/B: Price-to-Book ratio; M/B: Market-to-Book ratio; EXCL90: Economic specialization index, calculated using a dummy equal to 1 when there is 90% or more concentration in a single debt type; NTYPE: Debt specialization index, developed from categorical variables ranging from 1 to 7; HHI: Herfindahl-Hirschman index, a proxy for debt structure heterogeneity.

Therefore, in general terms, this means that changes in debt diversification levels lead to variations in the stock prices of publicly traded companies in Brazil, confirming the research hypothesis. Although there are divergent views on the impact of debt heterogeneity on firm value when using Agency Theory and free riding problems as a theoretical framework, the results indicate a positive and significant relationship between debt heterogeneity and firm market value in the different models tested.

In contrast to similar studies conducted in different credit markets (Carletti *et al*., 2007; Jadiyappa *et al*., 2020; Tripathy and Uzma, 2022), the estimated coefficients obtained have opposite signs to those found in the literature. Therefore, contrary to the values presented for the Brazilian market, there is no literature from other countries that points to a positive and significant relationship between debt heterogeneity and firm market value. Possible explanations may consider the specificities of the Brazilian market, such as the presence of few financial institutions, relevant concentration of shareholder groups in the control of publicly traded companies, the high relevance of subsidized credit lines, and the high cost of credit.

In addition to filling a less-explored area in the literature, the coefficients presented in this study bring relevant considerations for the decision-making process related to corporate finance. By exploring for the first time in Brazil the relationship between debt structure and firm market value, this study allowed for the comparison of results obtained in the national context with similar research conducted in other countries (Denmark, India, and Indonesia). Thus, it expands the discussions on the relevance of specific credit market characteristics in the choice of financing sources by companies.

5. Conclusions

The main objective of this work was to investigate the impact of debt diversification on the market value of non-financial Brazilian companies in the period 2010-2021, using a database composed of Brazilian companies listed on the Brazilian stock exchange. Panel data regression models were estimated, with the dependent variable represented by the market value of firms through three different proxies and the explanatory variables through three different heterogeneity indices, in addition to control variables specific to firms.

The main results indicate that an increase in debt structure heterogeneity is associated with an increase in the market value of Brazilian firms. Given the main analyses conducted and the prior literature, it is believed that, due to the specific characteristics of the local credit market, the association between debt diversification and firm market value differs from the negative relationship observed in other markets.

Despite the high degree of development of the credit market in Brazil, it is worth noting the following peculiarities of the national scenario: high banking concentration, significant participation of development banks through subsidized credit lines, relevant shareholders concentration and higher cost of credit compared to the global average. Taking these Brazilian characteristics into account, it seems there may be a reduced likelihood of free rider behavior in Brazil. The possible explanation for the results presented is based on the work of Stigler (1974), where the author states that the size of the group is directly associated with the existence of free-riding behavior. Consequently, creditors and investors are aware of the lower risks associated with monitoring and following firms when investing in Brazilian firms.

In general, the results highlight the role of firms' debt structure in the process of maximizing market value. Therefore, by presenting unprecedented empirical evidence in the country that differs from the results obtained in other markets regarding the relationship between debt structure and the market value of companies, this study will assist shareholders, managers, and investors in the decision-making process. Assuming that financing decisions are made to optimize the creation of value on invested capital, the use of a heterogeneous debt profile may mean maximizing the market value of companies in the Brazilian context.

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