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ORIGINAL ARTICLE

Does debt structure heterogeneity reduce the cost of capital?*

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ABSTRACT

This paper seeks to investigate the relationship between the level of debt structure heterogeneity and the cost of debt of publicly and privately held Brazilian companies in the period from 2020 to 2019. Debt structure heterogeneity is a relatively recent topic in the financial literature related to capital structure. As far as is known, the direct relationship between debt heterogeneity and the cost of debt has not yet been addressed in previous studies in the national and international literature. Research that broadens the knowledge regarding factors that attenuate the cost of debt is pertinent, especially in a context such as that of Brazil, in which high funding cost spreads end up compromising the economic viability of many projects and, consequently, the capacity for companies to generate value. The research results have impacts over the financial decision-making process, given the association identified between heterogeneity and debt cost, leading to reflections on the definition of a company's capital structure. Thus, it is closely related with firm value, whose maximization is the object of interest of managers and shareholders. Panel data regression models were estimated in which the dependent variable is represented by the cost of debt and the explanatory variables are represented by the heterogeneity level of companies' debt structure, which in turn is represented by two different proxies, aiming to give greater robustness to the results. The results are original and highlight the role of the debt structure in reducing the cost of debt. It is verified that the greater the debt heterogeneity, the lower companies' cost of debt. This relationship is even more intense for companies that are more susceptible to high agency costs.

Keywords: heterogeneity, debt structure, cost of debt, agency costs, monitoring.

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1. INTRODUCTION

The topic of capital structure, widely debated in the field of finance, continues to arouse debates in the financial literature, but some aspects have been scarcely explored. One of those is addressed by Rauh and Sufi (2010), who reveal a common limitation in most capital structure studies: debt is treated as something homogenous. According to the authors, this homogeneity constitutes a relevant limitation of the studies, given that debt diversification, and its heterogeneity level, is a common characteristic in the reality of companies.

Rauh and Sufi (2010) sustain this argument showing that U.S. (United States) companies have different types of debt in their financing structure. Another important aspect found in their results concerns the occurrence of changes in sources of financing in companies, but without incurring alterations in their leverage levels. In a previous study, using a more comprehensive sample of U.S. companies, Colla et al. (2013) also revealed the existence of different types of debt in the financing structure of companies, as also verified by Póvoa and Nakamura (2014), in the Brazilian market, and Tarantin and Valle (2015).

This topic gains even more relevance when analyzing the potential impacts that a more or less diversified debt structure can have over the firm. Some studies have focused on investigating the relationship between debt heterogeneity and agency costs, a relationship which, according to Jadiyappa et al. (2020), tends to affect the firm's value. More specifically, as debt heterogeneity exposes the firm to the scrutiny of different credit market participants, it can contribute to reducing agency costs. Financial institutions, subscribers, and credit rating agencies are examples of market participants that play a disciplinary role in debt, for which reason a lower agency cost would be expected and, consequently, a positive impact on the firm's value (Jadiyappa et al., 2020).

Another positive aspect related to the effects of a more diversified debt structure concerns less dependence of the firm on a single creditor, which can lead to increased funding costs (Kysucky & Norden, 2016; Platikanova & Soonawalla, 2020). In other words, by having access to different sources of financing, the borrower tends to increase its bargaining power by comparing different fundraising rates offered by different agents, including the possibility of changing creditor in the case of unattractive funding cost conditions. These factors would have positive impacts over the firm's value, due to the potential reduction in cost of capital, as well as the generation of better results.

On the other hand, some studies indicate disadvantages in relation to a more heterogeneous structure. Lou and Otto (2020) suggest that the presence of different creditors in the debt structure of companies can lead to greater difficulty for creditors to coordinate in cases of default, which would increase the costs of financial difficulties and, consequently, the costs of financing, given that the creditors would price that risk *ex ante*. Debt heterogeneity can also cause the so-called free rider problem in monitoring. In other words, if the company finances itself via different sources, each individual creditor will have only a small portion of the company's total debt. This can discourage monitoring by the creditors by enabling managers to have greater decision-making discretion, negatively impacting the company's value (Jadiyappa et al., 2020).

Based on the arguments presented, in general, what is perceived is that the channel through which debt heterogeneity affects the firm's value involves the formation of its cost of capital. That is, by causing an increase or reduction in the cost of capital, debt heterogeneity contributes to an increase or reduction in the firm's value creation capacity. This shows that, within this context, better understanding the relationship between the debt heterogeneity level and the cost of debt is fundamental. Despite its importance, it is perceived that the relationship between heterogeneity and the cost of debt is not something that has been addressed in studies that cover determinants of the cost of debt in the national and international literature, perhaps as it concerns a recent aspect if compared to other ones relating to the topic of capital structure, as well as the difficulty of obtaining pre-complied detailed data on the debt structure of companies.

In the Brazilian literature, various papers have analyzed the impacts of the level of disclosure and quality of the accounting information over fundraising costs (Castro & Martinez, 2009; Lima, 2009; Santos et al., 2020). Other papers have sought to analyze the relationship between corporate governance mechanisms and the cost of debt (Fonseca & Silveira, 2016; Konraht et al., 2020), a topic also addressed in the international literature (Aslan & Kumar, 2012; Borisova & Megginson, 2011; Boubakri & Ghouma, 2010). Recent international studies, in turn, have analyzed the relationship between corporate social

performance and environmental, social, and corporate governance (ESG) practices and their impacts over the debt cost, such as those of Eliwa et al. (2019) and La Rosa et al. (2018), as well as the relationship between the cost of capital and the presence of covenants (Bradley & Roberts, 2015; Konraht & Soares, 2020; Miller & Reisel, 2012).

Therefore, it is verified that a major portion of the literature relates cost of capital to the level of disclosure and corporate governance mechanisms, among other factors such as covenants and firm characteristics, with there being a gap regarding studies that analyze the relationship between heterogeneity and cost of debt. This paper seeks to fill that gap.

Within this context, the main objective of the study is to investigate the relationship between the level of debt structure heterogeneity and the debt cost of publicly and privately held Brazilian companies in the period from 2010 to 2019. Based on agency theory and on the aforementioned literature, the hypothesis of the paper is that higher heterogeneity levels are associated with a lower cost of acquiring debt, and that this negative relationship is even more intense for companies that are susceptible to higher agency costs (such as companies with a greater free cash flow for managers' discretionary use and companies with more intangible assets, which cannot be used as debt guarantees, increasing the costs of financial distress).

For this, panel data regression models were estimated in which the dependent variable is represented by the cost of debt and the explanatory variables are represented by the level of heterogeneity (or homogeneity) of the companies' debt structure, as well as firm characteristic control variables. A total of 570 publicly and privately held companies present in the Capital IQ database in the period from 2010 to 2019 were analyzed. To give greater robustness to the findings, two proxies were used to measure heterogeneity level, namely the Herfindahl-Hirschman index (HHI) and the Excl90 index, present in the studies of Castro et al. (2020), Colla et al. (2013), Lou and Otto (2020), and Platikanova and Soonawalla (2020).

As main results, it is verified that the higher the debt heterogeneity, the lower the debt cost of Brazilian companies, with this relationship being even more intense for companies that are more susceptible to high agency costs (i.e., with more intangible assets and a greater free cash flow), thus not rejecting the research hypotheses. These results show the role of heterogeneity in reducing agency costs, causing a lower perception of risk among creditors, reducing the firm's fundraising costs.

The research provides contributions for managers and shareholders by indicating factors that can optimize the decision-making process, reflecting in lower fundraising costs and consequently increasing the company's value. Moreover, up to now, no papers have been found in the national and international literature addressing the relationship between heterogeneity and the debt cost. Thus, it is also hoped that the paper will contribute to the literature on capital structure, by providing new evidence and new perspectives for studies in the area.

2. THEORETICAL FRAMEWORK

2.1 Effects of Heterogeneity and Determinants of the Cost of Debt

For Rauh and Sufi (2010), a large number of studies on capital structure address debt structure homogeneously, even though the diversification of sources of financing is a phenomenon that is present in the reality of companies. The authors identified that most companies in the sample simultaneously use bank and non-bank credit. In addition, the diversification of sources of financing tends to be more accentuated in companies with lower credit quality. In contrast, Colla et al. (2013) verified that debt heterogeneity is more intense in companies with high credit rating levels.

Despite the divergence between the studies, in both cases there is a notable presence of diversification of sources of financing in companies' debt structure. This diversification is relevant when analyzing capital structure, due to the particular characteristics that each type of debt presents. Rights over cash flows, sensitivity to information, and maturity are examples of characteristics that differ between debts (Rauh & Sufi, 2010). For that reason, Póvoa and Nakamura (2014) argue that such characteristics should not be ignored for understanding companies' financing decisions.

Thus, the importance of this topic is related to the impact that a more or less diversified structure can have over the firm's value. Jadiyappa et al. (2020) argue that a positive relationship can be expected between debt structure heterogeneity and the firm's value due to a possible reduction in agency costs. That is, once financed by different creditors, the company becomes the focus of more effective monitoring by creditors and other market

participants, thus generating a disciplinary impact on the firm's activities. This argument is based on Jensen's (1986) free cash flow theory. According to the theory, the threat of default created by the debt payment obligation would generate incentives to make the company more efficient, making the managers take good investment decisions. Thus, by putting the company on a financial "diet," as described by Myers (2001), the use of debt would have positive effects for the firm.

From another perspective, Kysucky and Norden (2016) argue about the possible increase in the company's bargaining power through raising funds with different creditors, which would reduce its dependence on a single source of financing and enable investments that demand a large volume of resources. All these factors would positively impact the firm's value.

On the other hand, arguments are also found in the literature that favor a more homogeneous debt structure. Lou and Otto (2020) highlight that the greater difficulty for creditors to coordinate in cases of default can increase the costs of financial distress and, consequently, the cost of financing, thus favoring debt homogeneity. The authors also indicate that creditors would be less willing to grant resources to companies with multiple creditors, given the low incentive to monitor those companies, which would presumably have a small share in their credit portfolio. Results favoring debt homogeneity are also found in studies such as those of Castro et al. (2020), Ivashina et al. (2016), John et al. (2018), and Platikanova and Soonawalla (2020).

Regarding the evidence from recent studies, Platikanova and Soonawalla (2020) identified that the level of opacity of accounting information is linked to the probability of companies being financed by only a small number of creditors. According to the authors, companies considered as opaque tend to prefer the creditors with whom they already maintain an established relationship, since they tend to reduce the high costs of collecting information and monitoring that would be subject to if they sought new creditors. Castro et al. (2020), in turn, analyzed the relationship between debt homogeneity and the occurrence of changes in the chief executive officer's (CEO) remunerating system that raises the incentive for risk-taking. With a higher incentive for risk, the probability of default is also raised and, as a result, financing costs. For the authors, a more homogeneous debt structure could signal greater empowerment of the creditor in cases of default and, for that reason, it also signals the executives' commitment to strive to avoid a financial distress situation, causing a reduction in funding costs.

Even with arguments and results that oppose and favor heterogeneity, it is noted that the channel through which the debt structure affects the firm's value involves the company's cost of capital. However, no papers were found in the Brazilian and international literature that analyzed the relationship between debt structure and cost of capital. In Brazil, authors have sought to analyze the relationship between heterogeneity and firm characteristics (Póvoa & Nakamura, 2014, 2015), as well as between debt heterogeneity and capital structure decisions (Cavalcante & Castro, 2015; Tarantin & Valle, 2015).

Regarding the determinants of the debt cost, various papers have analyzed the impacts of the level of disclosure and of the quality of the accounting information over the cost of capital. In this sense, Lima (2009) verified that the higher the level of disclosure, the lower the cost of debt of publicly-traded Brazilian companies. Within another aspect, Santos et al. (2020) identified a positive relationship between earnings management and cost of debt. The authors also verified that bigger and more profitable companies tend to have a lower fundraising cost. Regarding the relationship between corporate governance mechanisms and debt cost , Fonseca and Silveira (2016) confirmed the role of commitment to more rigorous governance practices in reducing the debt cost of Brazilian companies. Konraht et al. (2020), in turn, verified both positive and negative effects derived from the concentration of control in relation to acquiring debt in Brazil. The authors also verified a negative relationship between size and profitability and cost of debt, and a positive one between cost and indebtedness.

In the international literature, authors such as Aslan and Kumar (2012), Borisova and Megginson (2011), and Boubakri and Ghouma (2010) have also confirmed the importance of the firm's governance structure in reducing agency costs and, consequently, in reducing fundraising costs. Recent research, in turn, has verified the importance of corporate social performance and ESG practices over the debt cost, such as that of Eliwa et al. (2019) and La Rosa et al. (2018).

Just like governance mechanisms, debt covenants also seek to align interests, reducing the agency costs of debt and having impacts over financing costs. Authors such as Bradley and Roberts (2015) and Miller and Reisel (2012) have confirmed the negative relationship between the presence of covenants and spreads in the U.S. market. In Brazil, Konraht and Soares (2020) verified that covenants present a dual function in capturing debt, where, for the issuing company, they work as a complementary mechanism to the premium and, in the case of the solidary company, they constitute a substitutionary mechanism

to risk and reduce the spread of debentures. The authors also verified the negative relationship between size and cost of debt and the positive relationship between that variable and the level of companies' indebtedness.

As seen, there is a gap in the national and international literature on the effects of debt structure over firms' fundraising costs. This paper lies within that context, aiming to provide new contributions and support other papers in the area.

2.2 Development of the Hypotheses

Kysucky and Norden (2016) argue that a strong relationship between bank and company can create a greater probability of firms having their gains "captured" by the creditor. The authors explain that, in a situation of a strong relationship with the creditor, in the beginning, that creditor may offer favorable loan conditions, to attract the client. However, the following stage is marked by an increase in subsequent fundraising costs, which can considerably affect the firm's investment decisions. For that reason, through accessing different financing sources, the company is expected to increase its bargaining power, thus enabling a reduction in fundraising costs by establishing better negotiations with its creditors.

In addition, according to the argument present in the work of Jadiyappa et al. (2020), as the number of sources of debt increases, the monitoring by creditors becomes more effective, which can reduce agency costs and, consequently, fundraising costs. Thus, the first research hypothesis is the following:

> H_1: the greater the level of debt structure heterogeneity, the lower the debt cost of Brazilian companies.

Considering the first research hypothesis, it is necessary to investigate whether the proposed relationship is stronger for companies more susceptible to higher agency costs. After all, it may be that this type of company, characterized as presenting greater information asymmetry, obtains greater benefits derived from the more efficient monitoring imposed by different creditors. Therefore, the second hypothesis is the following:

> H_2: the negative relationship between the heterogeneity level and the cost of debt is more intense for companies that are more susceptible to higher agency costs.

To test the second hypothesis, the total sample was segregated into subsamples of companies with a higher and lower propensity for agency costs, considering two proxies: the level of intangibility of the assets and the level of free cash flow to equity available for the managers' discretionary use.

The second hypothesis of the paper is supported by the fact that companies that have a greater share of intangible assets in their asset structure and a higher volume of free cash flow tend to present higher agency costs. According to Rajan and Zingales (1995), companies with high intangibility present high costs of financial distress, given that these assets cannot be used as a debt guarantee, so creditors would retain a smaller value of the firm in the case of its liquidation. Thus, for the authors, the higher the degree of intangibility, the greater the agency costs of the debt.

Considering the free cash flow theory (Jensen, 1986), companies with a greater free cash flow available for the managers' discretionary use present higher agency costs. After all, a high volume of free cash flow can signal greater possibilities of expropriation by the managers, through unnecessary expenses or economically unviable investments, thus raising agency costs. Therefore, greater debt structure diversity is expected to increase the effectiveness of the monitoring of the company, reducing agency costs and making the relationship between heterogeneity and cost of debt more intense. The models for testing the theories are presented in the next chapter.

It warrants mentioning, as already presented, that the literature regarding debt heterogeneity is not consensual and, therefore, it presents favorable and unfavorable arguments concerning its effects on firms' performance. However, considering the macroeconomic and institutional factors of Brazil as an emerging country, it is believed that a higher level of heterogeneity is beneficial for Brazilian companies. Studies such as those of Ferri and Lui (2005), LiPuma et al. (2011), and Machokoto and Areneke (2020) highlight that developing countries are characterized by high information asymmetry, less protection of creditors' and shareholders' rights, weak legal enforcement, a high cost of external financing, and the presence of financial constraints.

With regard to this, Carvalho (2009) and La Porta et al. (1998) highlight that the environment companies form part of can be a determining factor for their financial decisions. Therefore, from the company's perspective, the context of financial constraint and high financing costs can constitute an additional incentive to seek to diversify sources of financing. From the creditor's perspective, information asymmetry, less protection of their rights, and weak legal enforcement would be additional incentives for imposing greater monitoring over firms. In light of the above, it follows that, in the Brazilian context, the hypothesis that debt heterogeneity is capable of reducing the debt cost is more consistent with reality.

3. METHOD

3.1 Data

The sample chosen for this study was based on all Brazilian companies present in the Capital IQ database in the period from 2010 to 2019. This database was chosen due to the availability of detailed data regarding the companies' debt structure, containing information concerning the loan amount for each one of the seven debt categories, according to the categorization made by that database, which will be detailed in the following section.

Initially, there were 59,834 (publicly and privately held companies) Brazilian companies in Capital IQ. Subsequently, we excluded from the sample companies from the utilities sector [Standard Industrial Classification (SIC) codes 4900-4949] and financial companies (SIC codes 6000-6999), as in the studies of Castro et al. (2020), Colla et al. (2013), Lou and Otto (2020), and Platikanova and Soonawalla (2020), thus leaving 29,932 companies. In addition, we eliminated all companies that presented financial expenditure equal to 0, net equity equal to or lower than 0, companies that did not present any sales revenue over the sampling period, and companies with fewer than two years of consecutive data for analysis.

In addition, as they did not enable the calculation of the main variable of this study (according to section 3.2), we eliminated the companies for which there were no details on their debt structure. With the application of all the filters mentioned, the final sample contains a total of 570 firms, of which 172 are publicly held companies and 398 are privately held companies, totally 4,025 firm-year observations. Among the 398 publicly held companies, 390 are Corporations and only eight are Limited Liability Companies.

3.2 Measuring Debt Structure Heterogeneity

To measure the heterogeneity level of the debt structure, two proxies were used, aiming to give greater robustness to the results. These are the HHI and Excl90 (as an alternative proxy), both present in the studies of Castro et al. (2020), Colla et al. (2013), Lou and Otto (2020), and Platikanova and Soonawalla (2020). The subsections that follow present in more detail the procedure for calculating both proxies.

3.2.1 Herfindahl-Hirschman index (HHI)

In general terms, the HHI, calculated for each firm *i* in each year *t*, aims to measure the heterogeneity level of the companies' debt structure. The calculation involvestwo stages. First, the squares (SQ_{it}) of the ratio between the different debt categories and the total loans and financing of company *i* in time *t* should be added together, as presented in the studies of Castro et al. (2020), Colla et al. (2013), Lou and Otto (2020), and Platikanova and Soonawalla (2020) and highlighted in equation 1. Like those authors, this paper uses the categorization present in the Capital IQ database, which classifies the companies' debts among seven categories, according to equation 1,

$$SQ_{it} = \left(\frac{PN_{it}}{TD_{it}}\right)^2 + \left(\frac{RC_{it}}{TD_{it}}\right)^2 + \left(\frac{BL_{it}}{TD_{it}}\right)^2 + \left(\frac{SBN_{it}}{TD_{it}}\right)^2 + \left(\frac{SUB_{it}}{TD_{it}}\right)^2 + \left(\frac{Leas_{it}}{TD_{it}}\right)^2 + \left(\frac{Others_{it}}{TD_{it}}\right)^2 \quad (1)$$

in which SQ_{it} is the sum of the squares, *TD* is total debt, *PN* is promissory notes (issued in the internal or external market), *RC* is revolving credit (granted by national or international banks), *BL* is bank loans [e.g., loans for working capital, fixed asset financing, secured accounts, credit subsidized by the National Bank for Economic and Social Development (BNDES) and other development banks, and advances on foreign exchange contracts granted by national or international banks], *SBN* is senior bonds and notes (e.g., debentures and promissory notes issued in the country or abroad), *SUB* is subordinate bonds and notes (e.g., debentures and promissory notes issued in the country or abroad), *Leas* is leasing (covering leasing contracts), and *Others* represents the amount of debt not covered in any of the previous categories.

In the second stage, based on the calculation established in equation 1, the HHI can be obtained through the following equation:

$$HHI = \frac{SQ_{it} - 1/7}{1 - 1/7} \quad (2)$$

in which SQ_{it} is obtained as described in equation 1; as there are seven debt categories, this number is considered in equation 2.

As a result, the HHI presents values ranging from 0 to 1, where the closer to 1, the more dependent the company's financing structure is on one type of debt (i.e., greater the debt structure homogeneity). In contrast, the closer to 0, the greater the presence of different types of debt in the company's financing structure, indicating greater debt structure heterogeneity (Colla et al., 2013).

3.2.2 Excl90 economic dependence index

As in the work of Castro et al. (2020), Colla et al. (2013), Lou and Otto (2020), and Platikanova and Soonawalla (2020), an alternative proxy to the HHI was chosen: this is the Excl90 index. This proxy aims to capture the firm's economic dependence on a single type of debt.

The Excl90 metric is a dummy that takes a value equal to 1 if more than 90% of the firm's debt is concentrated in only one type of debt (that is, debt structure homogeneity) and 0 otherwise.

3.3 Econometric Models

In order to investigate the impact of debt heterogeneity over the debt cost, panel data regression models with fixed effects were estimated, in which the dependent variable is represented by the cost of debt, the explanatory variables aim to measure the level of heterogeneity (or homogeneity) of the companies' debt structure, and the control variables seek to capture firm characteristics widely used in the literature, as described in Table 1. The models for testing the research hypotheses are represented by equations 3 and 4.

$$Kd_{i,t} = \beta_0 + \beta_1 HHI_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROE_{i,t} + \beta_4 Lev_{i,t} + \beta_5 Tang_{i,t} + \beta_6 Cov\_Rat_{i,t} + \beta_7 Grow\_Op_{i,t} + e_{i,t} \quad (3)$$

$$Kd_{i,t} = \beta_0 + \beta_1 EXCL90_{i,t} + \beta_2 Size_{i,t} + \beta_3 ROE_{i,t} + \beta_4 Lev_{i,t} + \beta_5 Tang_{i,t} + \beta_6 Cov\_Rat_{i,t} + \beta_7 Grow\_Op_{i,t} + e_{i,t} \quad (4)$$

in which *Kd* is the costs of debt, *EXCL90* is the economic dependence index represented by a dummy variable equal to 1 if more than 90% of the firm's debt is concentrated in only one type of debt and 0 otherwise, *Size* is the size of the company, *ROE* is return on equity, *Lev* is leverage, *Cov_Rat* is the interest coverage ratio, and *Grow_Op* is growth opportunities.

The coefficient β_1 is the parameter of interest of both equations. According to the hypotheses developed, β_1 is expected to be positive and significant, thus indicating that the more heterogeneous the company's debt structure is, the lower the debt cost, or, otherwise, that the greater the debt structure homogeneity is, the higher the debt cost.

Equations 3 and 4 were estimated for the total sample, as well as for subsamples that aim to represent companies that are more and less susceptible to agency costs, as shown in section 4. These equations enables us to test the second research hypothesis: the relationship between heterogeneity and cost of debt is more intense for companies that are more susceptible to agency cost. To represent agency costs, two proxies were used: the degree of intangibility of the assets and the level of free cash flow to equity available for the managers' discretionary use.

Panel data regression models with fixed effects were estimated, using ordinary least squares, and dummies for controlling the firm and time (year) fixed effects. Table 1 represents in detail each variable that composes the econometric model, as well as its form of operationalization.

Table 1
Variables used in the models

Dependent variable	Abbreviation	Operationalization	Reference studies
Cost of debt	$Kd_{i,t}$	Financial expenses net of taxes on mean onerous liabilities	Cameran & Campa (2020), Costa et al. (2017), La Rosa et al. (2018)
Explanatory variables			
Herfindahl-Hirschman index	$HHI_{i,t}$	As presented in the HHI subsection	Castro et al. (2020), Colla et al. (2013), Lou & Otto (2020), Platikanova & Soonawalla (2020).
Economic dependence index	$EXCL90_{i,t}$	Dummy equals 1 for firms with more than 90% of their debt concentrated in only one type and 0 otherwise.	Castro et al. (2020), Colla et al. (2013), Lou & Otto (2020), Platikanova & Soonawalla (2020).
Control variables			
Size	$Size_{i,t}$	LN of total assets	Carmo et al. (2016), Cameran & Campa (2020), Pandey et al. (2019)
Return on equity	$ROE_{i,t}$	Net income over net equity	Costa et al. (2017)
Leverage	$Lev_{i,t}$	Total debt over total assets	Cameran & Campa (2020), Carmo et al. (2016), Pandey et al. (2019), Platikanova & Soonawalla (2020)
Tangibility	$Tang_{i,t}$	Fixed assets over total assets	Carmo et al. (2016), La Rosa et al. (2018), Pandey et al. (2019)
Interest coverage ratio	$Cov\_Rat_{i,t}$	EBITDA over financial expenses	Eliwa et al. 2019), La Rosa et al. (2018)
Growth opportunities	$Grow\_Op_{i,t}$	Variation in net revenue over total assets	Cameran & Campa (2020), La Rosa et al. (2018), Pandey et al. (2019)
Proxies for segregating the sample			
Degree of intangibility	$Intang_{i,t}$	Intangible assets over total assets	Rajan & Zingales (1995)
Free cash flow	$FCF_{i,t}$	Free cash flow to equity (IQ_Unlevered_ FCF – Code 4423 – CapitalIQ)	Jensen (1986)

Notes: *The marginal rate of tax is equal to 34%, where 25% is income tax and 9% is social contribution. Total debt is equal to the sum of short- and long-term onerous liabilities. EBITDA = earnings before interest, taxes, depreciation, and amortization; LN = natural logarithm.*
Source: *Elaborated by the authors.*

Fixed effects model was chosen for the panel data estimation to control possible specific effects that vary in time, not between the firms. Given the idiosyncrasy present in firms' financial decisions, the fixed effects model is more suitable as it better addresses endogeneity. Thus, the underlying theoretical premise of the model forms the basis for choosing it in this study, as opposed to the random effects model, which presupposes there being no correlation between unobserved heterogeneity (i.e., the random effect per firm) and the other independent variables of the model, a premise that is fairly unrealistic in studies in the area, as discussed by Angrist and Pischke (2009).

Finally, tests were conducted for multicollinearity (variance inflation factor – VIF) and heteroscedasticity (White test). Given the presence of heteroscedasticity, the models were estimated with robust and clusterized standard errors by firm, to consider the presence of heteroscedasticity, as well as the possible serial correlation of the error terms. Time (year) dummies were also included in all specifications to consider the influence of macroeconomic temporal factors that could affect the analysis. The result presented by the VIF test did not indicate multicollinearity between the variables of the model, given that the values presented were lower than 5 for all the explanatory variables. In addition, all the metric variables were winsorized in the 2.5 and 97.5 percentiles, aiming to mitigate the effect of outliers.

4. RESULTS ANALYSIS

Table 2 presents the descriptive statistic results.

Table 2
Descriptive statistics

Variable	n	Mean	Standard deviation	Min	Max
Kd	3,405	0.105	0.099	0.014	0.546
HHI	4,025	0.657	0.280	0.131	1.000
Size	4,025	7.259	1.679	3.851	10.846
ROE	4,025	0.013	0.389	-1.613	0.759
Lev	4,025	0.344	0.203	0.008	0.780
Tang	4,025	0.302	0.231	0.001	0.829
Cov_Rat	4,025	5.553	10.407	-3.620	53.664
Grow_Op	3,405	0.076	0.175	-0.300	0.630

Cov_Rat = interest coverage ratio; Grow_Op = growth opportunities; HHI = Herfindahl-Hirschman index, a proxy for financing structure heterogeneity; Kd = cost of debt; Lev = leverage; ROE = return on equity; Size = Company size; Tang = tangibility.
Source: *Elaborated by the authors.*

From analyzing the results presented in Table 2, it is perceived that, in average terms, the cost of debt of the companies in the sample is 10.5% a year. Another variable that warrants mentioning is the HHI, which presented a mean of 65.7%. Póvoa and Nakamura (2014) believe that HHI values lower than 0.7 are indicative of debt heterogeneity., Therefore, on average, the companies in the sample tend to present greater debt heterogeneity. However, the maximum and minimum values reveal the presence of firms with different debt concentration levels, varying between those that have total dependence on a single type of debt (HHI = 1), to those that have a more diversified structure, with different types of debt (HHI = 0.13).

To verify whether the debt heterogeneity level affects the debt cost, regressions were estimated, whose results for the total sample are shown in Table 3. Column 1 shows the results of the estimations whose explanatory variable is the HHI and column 2 shows the results of the estimations whose explanatory variable is the EXCL90.

Table 3
Panel data regressions with fixed effects (total sample)

Variables	1	2
	Coef.	Coef.
HHI	0.0230***	
	(0.0080)	
EXCL90		0.0100**
		(0.0040)
Size	0.0003	1.70e-05
	(0.006)	(0.0065)
ROE	-0.0058	-0.0060
	(0.0047)	(0.0047)
Tang	-0.0312	-0.0315
	(0.0242)	(0.0243)
Lev	-0.1720***	-0.1740***
	(0.0201)	(0.0203)
Cov_Rat	-0.0020***	-0.0020***
	(0.0004)	(0.0004)

Table 3
Cont.

Variables	1	2
	Coef.	**Coef.**
Grow_Op	0.0078	0.0078
	(0.0114)	(0.0114)
Constant	0.1670***	0.1810***
	(0.0444)	(0.0438)
Observations	3.405	3.405
R^2	0.120	0.119
Adjusted R^2	0.116	0.115
Firm fixed effects	Yes	Yes
Time fixed effects	Yes	Yes

Note: *Cluster-robust standard error in parentheses below each coefficient.*
Cov_Rat = interest coverage ratio; EXCL90 = dummy equal to 1 for firms with more than 90% of their debt concentrated in only one type and 0 otherwise; Grow_Op = growth opportunities; HHI = Herfindahl-Hirschman index, a proxy for financing structure heterogeneity, where the closer the value is to 1, the lower the heterogeneity; Lev = leverage; ROE = return on equity; Size = Company size; Tang = tangibility.
, **, * = significance levels of 10%, 5%, and 1%, respectively.*
Source: *Elaborated by the authors.*

In Table 3, the variables of interest in the study (HHI and EXCL90) presented a positive and significant relationship with the cost of debt. Therefore, there is a relationship between reduced homogeneity, that is, increased heterogeneity, and a reduced debt cost. More specifically, a 0.10 increase in the HHI index, on average, is related with a 0.23 percentage point increase in Kd. Furthermore, in an extreme situation, a company with an HHI equal to 1, that is, with a totally homogeneous debt structure, would have a 2.3 percentage point higher cost of capital in relation to a totally heterogeneous company (HHI equal to 0).

Also according to the EXCL90 indicator, by becoming highly dependent on a particular type of debt (EXCL90 = 1), a company increases its debt costby 1 percentage point, on average. This analysis indicates the economic relevance attributed to the relationship between debt heterogeneity and debt cost.

Considering the control variables, the leverage (Lev) and interest coverage ratio (Cov_Rat) metrics presented a negative and significant sign, consistently with the studies of Cameran and Campa (2020), Carmo et al. (2016), Eliwa et al. (2019), La Rosa et al. (2018), and Pandey et al. (2019). Considering that the coverage ratio measures the firm's capacity to pay interest, the higher its value is, the lower the risk for the creditor, which explains the result presented in the estimations.

Concerning leverage, the results indicate a reduction in debt cost based on a higher leverage level. Given that any risk of default is controlled by the interest coverage ratio variable, the leverage would be capturing the effects of firms' financing capacity. Put it differently, by showing the ability to obtain external resources, there may be a positive signal to the creditor, which, consequently, reduces the cost of debt. It is also possible to infer that the most leveraged companies in the sample have obtained resources with more attractive interest rates, causing this result. The size, ROE, tangibility, and growth opportunities variables, in turn, did not present statistical significance.

In general, the results presented indicate that greater diversity in the firms' debt structure is related to a reduction in the debt cost, and so the first hypothesis of the study cannot be rejected. This result corroborates the argument present in the study of Kysucky and Norden (2016) about the importance of diversifying sources of financing. That is, by increasing the borrower's bargaining power as dependence on a single creditor is reduced, debt heterogeneity can contribute to reducing fundraising costs.

Having identified the positive relationship between the debt cost debt and the HHI for the general sample, we proceeded with other investigations in order to analyze whether this relationship is even more intense for companies that are more susceptible to agency costs. After all, greater debt heterogeneity tends to cause an increase in the number of creditors willing to monitor the firm. That increase in creditors would result in more efficient monitoring of the firm and could reduce fundraising costs due to the lower perceived risk (Jadiyappa et al., 2020). Therefore, due to the greater degree of information asymmetry, companies with a higher agency cost are expected to benefit more in terms of a reduced debt cost compared to others.

Thus, the sample was segregated into two groups, characterized by companies that tend to present a higher agency cost and another group composed of companies that tend to present a lower agency cost. Two proxies were chosen for agency cost, namely: (i) intangibility level; and (ii) free cash flow.

Table 4 presents the results of the models estimated for the subsamples of companies that are more and less susceptible to agency costs. Columns 1 and 2 show the results considering the separation by intangibility level (Intang), while columns 3 and 4 show the results considering the separation by free cash flow. In both cases, the segregation was based on the median of the variable. The intangibility variable was calculated by the ratio between total intangible assets and total assets. Free cash flow to equity, in turn, was obtained from the Capital IQ database.

Table 4
Panel data regressions with fixed effects (segregated sample)

Variables	1	2	3	4
	> Intangibility	< Intangibility	> FCF	< FCF
	Coef.	Coef.	Coef.	Coef.
HHI	0.0288***	0.0264*	0.0224**	0.0210*
	(0.0098)	(0.0135)	(0.0104)	(0.012)
Size	0.0023	-0.0115	0.0059	-0.0040
	(0.0098)	(0.0141)	(0.0103)	(0.0092)
ROE	-0.0057	-0.0057	-0.0096	0.0007
	(0.0069)	(0.0067)	(0.0089)	(0.0092)
Tang	-0.0089	-0.0591	-0.0367	-0.0482
	(0.0399)	(0.0367)	(0.0407)	(0.0367)
Lev	-0.1640***	-0.1930***	-0.1760***	-0.1610***
	(0.0250)	(0.0395)	(0.0270)	(0.0271)
Cov_Rat	-0.0026***	-0.0018**	-0.0018***	-0.0025***
	(0.0004)	(0.0008)	(0.0006)	(0.0005)
Grow_Op	0.0193	-0.0059	0.0089	0.0061
	(0.0136)	(0.0208)	(0.0175)	(0.0203)
Constant	0.1470**	0.2530***	0.1390*	0.1980***
	(0.0699)	(0.0923)	(0.0741)	(0.0627)
Observations	1.726	1.679	1.746	1.659
R^2	0.180	0.108	0.121	0.133
Adjusted R^2	0.172	0.099	0.112	0.124
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes

Note: *Cluster-robust standard error in parentheses below each coefficient.*
Cov_Rat = interest coverage ratio; FCF = free cash flow to equity; Grow_Op = growth opportunities; HHI = Herfindahl-Hirschman index, a proxy for financing structure heterogeneity, where the closer the value is to 1, the lower the heterogeneity; Intang = intangibility; Lev = leverage; ROE = return on equity; Size = Company size; Tang = tangibility.
, **, * = significance levels of 10%, 5%, and 1%, respectively.*
Source: *Elaborated by the authors.*

Based on the results presented in Table 4, the HHI variable continues to show statistical significance for each estimation. Comparing the estimations of columns 1 and 2, it is noted that the companies with a higher intangibility level (above the median), that is, those that are more susceptible to higher agency costs, have a slightly higher coefficient of the HHI variable than that of the group of companies with a lower intangibility level. The same occurs when comparing the results of the estimations whose sample was segregated by free cash flow (columns 3 and 4). These results may indicate that the relationship between increased debt heterogeneity and reduced debt cost is more intense for companies with a higher agency cost.

Therefore, based on the results presented, a reduction in the debt cost of based on greater debt heterogeneity is an effect that is present, on average, in the whole sample, independently of the separation criterion. This effect may

be derived from the increase in the bargaining power of the borrower, which given the possibility of accessing different types of debt, can negotiate a better rate with its creditors.

However, when segregating the sample according to susceptibility to agency cost, an additional benefit is perceived for the companies with a higher agency cost. The results indicate the possibility of these companies reducing their cost of capital even more based on greater debt diversification. This result, besides not rejecting hypothesis 2 of the study, finds support in the arguments presented by Jadiyappa et al. (2020); that is, when it finances itself through different creditors, there may be more efficient monitoring of the firm, which contributes to a reduction in its agency cost.

To analyze the sensitivity of the results to different proxies for measuring the level of heterogeneity of the debt structure and seek to provide further robustness to the results presented in Table 4, in the next estimations, the alternative proxy for heterogeneity - the EXCL90 indicator, is used.

Table 5
Panel data regressions with fixed effects (segregated sample)

Variable	1	2	3	4
	> Intangibility	< Intangibility	> FCF	< FCF
	Coef.	Coef.	Coef.	Coef.
EXCL90	0.0160***	0.0097	0.0126**	0.0088
	(0.0052)	(0.0072)	(0.0058)	(0.0063)
Size	0.0024	-0.0113	0.0060	-0.0045
	(0.0099)	(0.0142)	(0.0104)	(0.0091)
ROE	-0.0057	-0.0061	-0.0099	0.0007
	(0.0068)	(0.0068)	(0.0089)	(0.0092)
Tang	-0.0111	-0.0597	-0.0368	-0.0485
	(0.0399)	(0.0372)	(0.0409)	(0.0368)
Lev	-0.1640***	-0.1990***	-0.1760***	-0.1640***
	(0.0251)	(0.0398)	(0.0272)	(0.0275)
Cov_Rat	-0.0026***	-0.0018**	-0.0018***	-0.0025***
	(0.0003)	(0.0008)	(0.0006)	(0.0005)
Grow_Op	0.0198	-0.0063	0.0097	0.0056
	(0.0135)	(0.0208)	(0.0174)	(0.0202)
Constant	0.1590**	0.2680***	0.1480**	0.2130***
	(0.0703)	(0.0918)	(0.0746)	(0.0598)
Observations	1.726	1.679	1.746	1.659
R^2	0.181	0.107	0.121	0.132
Adjusted R^2	0.173	0.098	0.112	0.123
Firm fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes

Note: *Cluster-robust standard error in parentheses below each coefficient.*
Cov_Rat = interest coverage ratio; EXCL90 = dummy equal to 1 for firms with more than 90% of their debt concentrated in only one type and 0 otherwise; FCF = free cash flow to equity; Grow_Op = growth opportunities; Intang = intangibility; Lev = leverage; ROE = return on equity; Size = Company size; Tang = tangibility.
, **, * = significance levels of 10%, 5%, and 1%, respectively.*

Source: *Elaborated by the authors.*

Consistently with the results presented in Table 4, estimations 1 and 3, present in Table 5, show that for companies with higher agency costs, the greater the debt heterogeneity is, the lower the debt cost . Both coefficients of the EXCL90 indicator of the estimations in columns 1 and 3 are slightly higher than those presented for the estimations in columns 2 and 4, although it is recognized that, for the latter, there was no statistical significance.

The lack of statistical significance for the estimations with the groups that are less susceptible to agency costs does not contradict the results found for that group in the previous estimations using the HHI variable. This result

may be due to a possible limitation of the EXCL90 proxy, which, as it is a dummy variable, does not offer a variation that can capture the effect of different heterogeneity levels of the firm. That is, the relationship between debt cost and debt heterogeneity may be better captured based on a greater variation in the HHI.

Nonetheless, the results presented using the EXCL90 indicator are important in indicating that, even though it does not offer a variation between the different debt heterogeneity levels, for the groups with a higher agency cost (above the median), the debt cost is negatively related to the level of diversification of the company's debt, which gives greater consistency to the results presented.

In a final analysis, we sought to insert a second-order polynomial of the HHI variable into the estimations made. The aim is to identify whether there is a non-linear relationship between debt cost and debt heterogeneity. Table 6 shows the results obtained.

Table 6
Panel data regressions with fixed effects (segregated sample) with squared HHI variable

Variables	1	2	3	4	5
	Total sample	**> Intangibility**	**< Intangibility**	**> FCF**	**< FCF**
	Coef.	**Coef.**	**Coef.**	**Coef.**	**Coef.**
HHI	-0.0331	-0.0464	-0.0263	-0.1040*	-0.0209
	(0.0362)	(0.0422)	(0.0619)	(0.0536)	(0.0504)
HHI^2	0.0431	0.0585*	0.0403	0.0980**	0.0323
	(0.0297)	(0.0339)	(0.0515)	(0.0439)	(0.0421)
Size	0.0006	0.00271	-0.0114	0.0065	-0.0039
	(0.0066)	(0.0098)	(0.0141)	(0.0103)	(0.0092)
ROE	-0.0059	-0.0057	-0.0059	-0.0099	0.0007
	(0.0048)	(0.0069)	(0.0067)	(0.0089)	(0.0092)
Tang	-0.0311	-0.0111	-0.0590	-0.0377	-0.0477
	(0.0241)	(0.0395)	(0.0368)	(0.0407)	(0.0367)
Lev	-0.1710***	-0.1630***	-0.1920***	-0.1720***	-0.1610***
	(0.0200)	(0.0247)	(0.0393)	(0.0271)	(0.0271)
Cov_Rat	-0.0020***	-0.0026***	-0.0018**	-0.0018***	-0.0025***
	(0.0004)	(0.0004)	(0.0007)	(0.0006)	(0.0005)
Grow_Op	0.0076	0.0192	-0.0064	0.0084	0.0059
	(0.0114)	(0.0135)	(0.0208)	(0.0175)	(0.0203)
Constant	0.1790***	0.1630**	0.2660***	0.1660**	0.2070***
	(0.0445)	(0.0700)	(0.0939)	(0.0739)	(0.0622)
Observations	3.405	1.726	1.679	1.746	1.659
R^2	0.121	0.182	0.109	0.125	0.133
Adjusted R^2	0.116	0.173	0.099	0.115	0.124
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes

Note: *Cluster-robust standard error in parentheses below each coefficient.*
Cov_Rat = interest coverage ratio; FCF = free cash flow to equity; Grow_Op = growth opportunities; HHI = Herfindahl-Hirschman index, a proxy for financing structure heterogeneity, where the closer the value is to 1, the lower the heterogeneity; HHI^2 = HHI indicator squared; Intang = intangibility; Lev = leverage; ROE = return on equity; Size = Company size; Tang = tangibility.
, **, * = significance levels of 10%, 5%, and 1%, respectively.*
Source: *Elaborated by the authors.*

According to Table 6, the squared HHI present in the models in columns 2 and 4, for groups with greater intangibility and free cash flow, respectively, presented a significant coefficient and a positive sign, therefore indicating the presence of an upward curving parabola. The results highlight that the companies most susceptible to agency cost reduce their debt cost as their heterogeneity increases. However, there is an optimal level of heterogeneity where, once exceeded, the companies tend to see an increase in their cost of capital.

This means that, for companies that are more susceptible to agency cost, both high levels of debt homogeneity (HHI close to 1) and high levels of heterogeneity (HHI close to 0) imply a higher cost of capital. High homogeneity levels can lead to a loss of bargaining power for the borrower, who by becoming dependent on one or a few sources of financing, comes to present less negotiating capacity, and most of its gains are "captured" by the creditor when the latter raises the cost of financing (Kysucky & Norden, 2016; Platikanova & Soonawalla, 2020). High heterogeneity levels, in turn, can indicate greater difficulty for creditors to coordinate in cases of company default and liquidation. In default situations, the divergence between different types of creditors can increase the risk of financial distress, which tends to be priced by the creditor in the spreads charged (Lou & Otto, 2020).

5. CONCLUDING REMARKS

This study aimed to investigate the relationship between the level of debt structure heterogeneity and the debt cost. By increasing the borrower's bargaining power and reducing agency costs, through more efficient monitoring, debt heterogeneity is expected to present a negative relationship with the debt cost, constituting the first research hypothesis. This negative relationship is also expected to be more intense for companies more susceptible to higher agency costs, constituting the second research hypothesis.

To test the proposed hypotheses, the study used a total sample of 570 publicly and privately held Brazilian companies available in the Capital IQ database in the period from 2010 to 2019. Panel data regression models were estimated in different subsamples in which the dependent variable was represented by the cost of debt and the explanatory variables were represented by the heterogeneity level of the companies' debt structure, as well as firm characteristic control variables.

The main results indicate that an increase in debt heterogeneity is related to a lower cost of debt for Brazilian companies. In addition, the study presented indications that this relationship is even more intense for companies that are more susceptible to high agency costs (i.e., with more intangible assets and a greater free cash flow), thus not rejecting the two research hypotheses.

Additional tests sought to identify if there is a non-linear relationship between debt cost and debt heterogeneity. The results indicated that there might be an optimal level of debt heterogeneity. In other words, high levels of debt homogeneity and heterogeneity are associated with a higher cost of fundraising.

In general, these results underline the role of the debt structure in reducing the debt cost. Besides filling a gap in the financial literature, the results elicit important reflections for corporate finance decisions. By presenting empirical evidence regarding the relationship between debt structure and debt cost, this study contributes to optimizing the decision-making process to increase company value.

The main limitations of the research are related to the proxies used for measuring the debt heterogeneity level. To operationalize the HHI, debts were grouped into seven categories, according to the information contained in the Capital IQ database. Thus, the "others" category may have relevant information not reflected in the proxy. Regarding the EXCL90 proxy, as discussed, since it is a dummy variable, it may not capture the effect of different firm heterogeneity levels. The proxy for debt cost, widely used in the literature, also presents limitations and aims to represent an average cost of fundraising per company. In addition, as expected, the models may have failed to incorporate other important variables for determining the cost of debt. However, we sought to mitigate that effect by using the panel data regression model with firm and time fixed effects.

As a suggestion for future papers, we believe that investigating the determinant factors of the debt heterogeneity level could provide interesting results and contribute to the literature in the area, even deepening the discussion on aspects related to our debt market.

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