XXIV SEMEAD
Seminários em Administração

novembro de 2021
ISSN 2177-3866

Effect of Debt Structure Concentration on the Investment-Cash Flow Sensitivity of Brazilian Companies

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Agradecimento à orgão de fomento:
O presente trabalho foi realizado com apoio da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES)

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1. INTRODUCTION

In imperfect markets, transaction costs, agency problems, bankruptcy costs, and information asymmetry among agents can cause distortions in the credit market. These distortions unleash what Fazzari, Hubbard and Petersen (1988) called financial constraints. In other words, in the presence of less information about the risks of projects and the borrowers' payment capacity, lenders are more likely to restrict credit to borrowers (Ambrozio, Sousa, Faleiros and Sant'Anna, 2017). This financial constraint leads firms' investments to be more dependent on the internal generation of resources, i.e., more sensitive to the cash flow generated internally (Fazzari et al., 1988).

Several studies have been conducted to analyze whether specific financing sources can soften companies' financial constraints. In other words, since creditors can have, according to Lou and Otto (2020), different: i) investment horizons; ii) relationships with borrowers; and iii) rights over firms' cash flow, it is possible to conjecture that determined sources of financing can have a greater capacity to alleviate the financial constraints of some firms. This issue has been addressed in studies such as those of Behr, Norden and North (2013) Berger, Bouwman and Kim (2017), Srinivasan and Thampy (2017) and Nozawa and Managi (2019).

Broadly speaking, when focusing on a specific financing source, these authors have sought to understand whether that source would reduce the firms' financial constraints. Behr et al. (2013) found that resources from the German saving banks (i.e. local state-owned banks) reduce the firms' financial constraints. Similarly, Srinivasan and Thampy (2017) identified that an exclusive relationship with government-owned banks contributes to reducing the financial constraints of Indian firms. The results of Berger, Bouwman and Kim (2017) pointed out that credit from small banks has comparative advantages in reducing US small businesses' financial constraints. Finally, Nozawa and Managi (2019) identified evidence that credit unions are more likely to reduce the financial constraints of small and midsized Japanese firms than banks.

Despite the importance of these studies, a new approach, still little explored in the financial restrictions literature, has emerged: the analysis of the debt structure concentration/diversification effects. Unlike the earlier approach previously mentioned, the focus of the debt structure analysis is on the possible effects on financial constraints considering the simultaneous use of different debt types.

Rauh and Sufi (2010) and Colla, Ippolito and Li (2013) were the pioneers by analyzing in detail the various categories of debt that compose the debt structure of US companies. Based on these studies, other authors have investigated different aspects related to the debt structure concentration (e.g., Jadiyappa, Saikia & Parikh, 2019; Jadiyappa, Hickman, Jyothi, Vunyale & Sireesha, 2020; Castro et al., 2020; Lou & Otto, 2020; Orlova, Harper & Sun, 2020).

However, the relationship between debt structure concentration/diversification and financial constraints is still an open question in the literature. This issue is even more pertinent when considering that the literature does not present a consensus about the effects of simultaneous use of different debts on the firms.

On the one hand, greater diversification of financing sources can be a fundamental strategy for managers seeking to implement projects that demand large investments beyond the capacity of a single lender (Jadiyappa et al., 2020). On the other hand, in case of default, debt structure diversification can cause higher financing costs due to the difficulty of coordination among different lenders (Lou & Otto, 2020). Furthermore, in a more concentrated debt structure, by having lower participation in the firms' debt, the creditor tends to have less incentive to monitor, resulting in a lower financing volume.

The relationship between debt structure concentration and financial constraints is thus a question that still lacks empirical evidence. To the best of our knowledge, only the recent work of Jadiyappa et al. (2020) has dealt with this aspect in a complementary manner. Nevertheless, the study pertains to the specific context of listed companies in India.

Thus, the literature lacks empirical evidence for different contexts than the ones covered by Jadiyappa et al. (2020), specifically for different emerging countries and samples of private firms. In other words, contexts that should make financial constraints more intense, with limitation of firms' innovation capacity, growth, and performance, as argued by Sousa and Ottaviano (2017). Therefore, we aim to analyze the relationship between the degree of debt structure concentration and the financial constraint of the company's.

More specifically, this study is based on a sample of 500 Brazilian firms (337 unlisted and 163 listed) from 2010 to 2019, applying the analytic model of investment-cash flow sensitivity proposed by Fazzari et al. (1988).

The results are favorable to a more concentrated debt structure. In other words, firms with a greater concentration of debts tend to have less investment-cash flow sensitivity. In general, the results are robust to: i) variation of the debt concentration proxy and the independent variable; ii) the control of fixed effects in different dimensions; and iii) use of estimator for endogeneity treatment (2SLS and GMM-Diff).

This study contributes to the literature in different ways. In the first place, it provides empirical evidence in a context little explored in the literature. As mentioned, several studies have investigated whether specific financing sources reduce financial constraints, but there is little empirical evidence of the relationship between debt structure concentration and financial constraints.

In the second place, the study addresses the relationship of debt concentration and financial constraints based on a sample that also contains private firms. To the best of our knowledge, no previous studies have examined this relationship considering a sample of private firms. This is relevant since the effects of financial constraints tend to be more pronounced for firms with less access to the capital market, as is the case of unlisted corporations.

This study is divided into four sections besides this introduction: theoretical framework and development of hypotheses; methodological procedures; results; and final considerations.

2. THEORETICAL FRAMEWORK

The financial constraints have been widely addressed in the academic literature. Fazzari et al. (1988) pointed out that these constraints are variously the result of transaction costs, agency problems, the cost of bankruptcy, and information asymmetry among market agents. In the last case, financial constraints can arise due to the difficulty faced by lenders regarding the evaluation of the loans' quality. For this reason, these creditors tend to restrict the supply of capital to determined companies, hence making them financially constrained (Fazzari & Athey, 1987).

Besides the ex-ante impact of information asymmetry, as previously described, an ex-post effect also exists, i.e., the difficulty of monitoring the borrower's actions after the loan is approved. For this reason, the higher cost of monitoring by lenders also contributes to the financial constraints of firms (Hubbard, 1998).

Hence, this financial constraint, by making access to external capital more costly, or even inaccessible, leads to a greater dependence on the internal cash generation to satisfy the investments needs (Fazzari et al., 1988). Thus, investments of firms with greater financial constraints tend to be more sensitive to the cash flow generated internally. On the other hand, firms that do not face relevant financial constraints should have less (or even none) investment-cash flow sensitivity.

In recent years, several studies have been published to verify whether these financial constraints can be attenuated by using specific sources of financing. This literature has generally shown that lenders can have different investment horizons, relationships with borrowers, and even rights over borrowers' cash flow (Lou & Otto, 2020). Hence, it is possible to assume that some financing sources can alleviate the financial constraints of companies.

In this context, Behr et al. (2013) identified that loans obtained from saving banks (more specifically, local state-owned banks) could reduce the financial constraints of German firms. A similar approach was applied by Srinivasan and Thampy (2017), Berger et al. (2017) and Nozawa and Managi (2019) in other countries.

Srinivasan and Thampy (2017) found empirical evidence that having an exclusive relationship with government-owned banks contributes to reducing the financial constraints of Indian firms. Specifically, their results showed that firms having exclusive relationships with those banks had investment-cash flow sensitivity almost 30% lower than other firms. Berger et al. (2017), focusing on credit from small banks, found that such banks had comparative advantages in reducing US small businesses' financial constraints. In the same vein, Nozawa and Managi (2019) identified that credit unions are more likely to reduce the financial constraints of small and midsized Japanese firms than banks.

However, although still little explored, a new approach has emerged in debt structure literature. In this new approach, the studies consider the effects, not of a specific source of financing on the firm, but the concomitant use of different sources.

Both Rauh and Sufi (2010) and Colla et al. (2013) presented results that shed light on the concomitant use of different types of debt by firms in the United States. In Brazil, Valle and Albanez (2012), Póvoa and Nakamura (2014) and Tarantin Jr. and Valle (2015) also made significant contributions in this respect, presenting empirical evidence of the presence of different financing sources on firms' debt structure.

From this new approach, an important question arises: is there a relationship between the degree of debt structure concentration and the companies´ financial constraints?

In general, the literature describes different reasons why firms seek not to concentrate but diversify their debt structure. As argued by Jadiyappa et al. (2020), the effort to diversify the sources of financing is an important strategy for managers who want to implement projects that require a high volume of resources, which a single creditor would not finance. In other words, it is through diversification of their financing sources that firms manage to implement economically attractive projects that demand huge outlays.

Besides that, a more diversified debt structure could also reduce agency costs (Jadiyappa et al., 2020). More specifically, when seeking financing from different lenders, firms are examined by multiple agents with different perspectives. Thus, this greater scrutiny has a disciplinary impact on firms' activity, leading to lower agency costs (Jadiyappa et al., 2020).

Finally, a more diversified debt structure can increase companies' bargaining power. According to Kysucky and Norden (2016), it is possible for firms with a certain dependence on a particular bank to have their earnings "captured" by that bank. In other words, at the start of the relationship between bank and borrower, loans can be offered with favorable conditions to attract clients. However, at a later moment, the loan costs can be increased, because this close bank-borrower relationship can create a lock-in effect if the borrower does not have an alternative banking relationship or if the costs of switching to a new lender are high.

Therefore, it is possible that: i) by allowing access to a greater volume of resources; ii) by reducing agency costs; and iii) by increasing the borrower bargaining power, the less concentrated debt structure mitigates the effects of financial constraints on firms.

Nevertheless, on the other hand, some authors have presented empirical evidence that supports a positive effect of debt concentration on firms. For example, Lou and Otto (2020) argue about the difficulty of coordination among different types of creditors in case of default.

According to them, this coordination becomes difficult because creditors can have different objectives, which can cause an increase in the cost of distress, thus increasing the cost of financing. In addition, when the company has a more diversified debt structure, each creditor tends to hold a small portion of the debt, reducing the incentive to monitor the borrower.

Platikanova and Soonawalla (2019) identified that companies with a higher level of accounting information opacity tend to be financed by only a small number of creditors. According to the authors, companies considered opaque tend to prefer creditors with whom they already have a relationship, reducing the high costs of information collection and monitoring they would be subjected to if they sought new creditors.

Castro et al. (2020) found that companies in which the CEO's compensation system generates incentives for risk-taking tend to seek greater debt structure concentration. According to Castro et al. (2020), with a greater incentive to risk, the probability of default is high and, as a consequence, lenders impose higher financing costs. For the authors, a more concentrated debt structure could signal greater creditor empowerment in bankruptcy cases and, therefore, also signal executives' commitment to avoiding a situation of financial difficulty, leading to a reduction in funding costs.

Therefore, it is possible that: i) by reducing the effect of the difficulty of coordination between creditors in case of default; ii) by increasing the incentive to monitor based on greater participation of the creditor in the debt structure; and iii) by taking advantage of the lesser asymmetry of information derived from a closer relationship with the creditor, a greater degree of debt concentration mitigates the financial constraint of companies.

Given the lack of consensus in the literature, this study aims to verify whether, in Brazil, empirical evidence points to a positive or negative relationship between the degree of debt concentration and the financial constraints of companies.

3. METHODS

3.1 Data and selection of the sample

This study is based on data from the Capital IQ database. In line with the works of Colla et al. (2013), Castro et al. (2020) and Lou and Otto (2020), we excluded firms from the utilities industry [Standard Industrial Classification (SIC) codes 4900–4949] and financial institutions (SIC codes 6000–6999).

We also excluded firms with negative or zero net equity, those not reporting revenue and EBITDA during the sample interval and had observations for only one year. We also excluded firms without founding year data. Finally, we excluded firms that did not present details of their debt structure. All these exclusions were necessary so that the variables could be appropriately calculated. The final sample consisted of 500 firms (337 unlisted and 163 listed), with 3,239 observations, in the period between 2010 and 2019.

3.2 Measuring the debt structure heterogeneity

As a proxy for the degree of debt structure concentration, we used the Herfindahl-Hirschman Index (HHI) for each firm *j* in each year *t*, as also done by Colla et al. (2013), Lou and Otto (2020) and Jadiyappa et al. (2020). This index is calculated by the sum of the squares (SS) of the debt categories divided by the total of loans and financing reported on the balance sheet of firm *i* in year *t*, as indicated in equation 1:

$$SS_{it} = \left(\frac{CP_{it}}{DT_{it}}\right)^2 + \left(\frac{DC_{it}}{DT_{it}}\right)^2 + \left(\frac{TL_{it}}{DT_{it}}\right)^2 + \left(\frac{SBN_{it}}{DT_{it}}\right)^2 + \left(\frac{SUB_{it}}{DT_{it}}\right)^2 + \left(\frac{CL_{it}}{DT_{it}}\right)^2 + \left(\frac{Others_{it}}{DT_{it}}\right)^2$$

(1)

Where *DT* is the total debt, *CP* is the value of commercial papers, *TL* is the value of term loans, *SBN* denotes senior bonds and notes, *SUB* stands for subordinated bonds and notes, *CL* is capital leases, and *Others* denotes the value of debt not included in any of the previous categories. Finally, the HHI is calculated according to equation 2:

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

Where "n" is the number of debt categories considered (seven here). The HHI ranges from 0 to 1. According to Colla et al. (2013), the HHI is 1 when a determined firm only obtains one type of debt (indicative of debt homogeneity), while it is zero if the firm simultaneously relies on all available debt categories (indicative of debt heterogeneity).

3.3. Econometric model and technique of analysis

We chose the econometric model based on investment-cash flow sensitivity, which has been widely used in studies of financial constraints, such as Fazzari et al. (1988), Almeida et al. (2004), Behr et al. (2013) and Srinivasan and Thampy (2017). It is denoted by equation 3.

$$Invest_{i,t} = f(X)_{i,t} + g(CF)_{i,t} + e_{it} \quad (3)$$

In this model, I represents investment; X is a vector of variables indicated in the literature as determinants of firms' investments; and the function g depends on the firm's internal cash flow (CF). In other words, it denotes the potential sensitivity of a particular investment to fluctuations in the cash flow generated internally (after controlling for the variables contained in the vector X). Given their limited access to external financing sources, we expect constrained firms to have greater dependence of investment (I) on the cash flow generated internally (CF) (i.e. investment-cash flow sensitivity).

An empirical strategy of the financial constraints studies is to classify companies in groups that, a priori, tend to face different financial constraints levels and then compare the investment-cash flow sensitivity between these groups. Some proxies usually used for classifying firms into groups of financial constraints are the firm's dividend payment status, credit rating and the Kaplan-Zingales, Hadlock-Pierce and Whited-Wu indices. Nevertheless, there is evidence that none of these measures precisely identify firms that behave as financially constrained (Farre-Mensa & Ljungqvist, 2015). Furthermore, most financial restriction indexes were developed considering the U.S. market. This factor can be problematic since, according to Fisman and Love (2003), even the most financially restricted companies in the United States face much less financial restriction than companies from other countries

Thus, in the main analyzes of this study, we applied the model of the investment-cash flow sensitivity without a priori classification of the companies in different groups. In other words, we analyze the investment-cash flow sensitivity considering the sample as a whole. The motivation for this procedure, in addition to the possible inefficiency of financial constraints indexes, is related to the fact that the macroeconomic and institutional environment in which such companies operate is, predominantly, an environment that generates financial restrictions. Therefore, these companies, in general, face non-negligible levels of financial constraints.

More specifically, some studies point to the predominant characteristics in emerging countries that lead to greater financial constraints on companies. As LiPuma, Newbert and Doh

(2011) and Machokotoa and Areneke (2020) argue, for example, emerging markets suffer from problems such as a high degree of information asymmetry and agency costs, less protection for creditors' and shareholders' rights, weak legal enforcement, which, consequently, tends to increase the companies' debt cost. Specifically about Brazil, we highlight that the low level of capital market development, featured by low trading volume and low long-term credit supply, leaves Brazilian companies in a financial constraints scenario (Castro, Kalatzis and Martins-Filho, 2015).

Therefore, to estimate the investment-cash flow sensitivity of the sample, we estimated the following econometric model.

$$Invest_{i,t} = \beta_0 + \beta_1 * CF_{i,t} + \beta_2 * HHI_{i,t} + \beta_3 * (HHI * CF)_{i,t} + \beta_4 * Sales\ grow + \beta_5 * Sales\ grow_{i,t-1} + \beta_6 * Lev_{i,t} + \sum_i \beta_i * firm + \sum_t \beta_t * year + \sum_j \beta_j\ Industry + \sum_{tj} \beta_{tj}\ (Industry * year) + e_{i,t} \quad (4)$$

Where: *I* is investment, measured by capex divided by total assets measured at the beginning of the period; HHI is the Herfindahl-Hirschman Index (proxy for debt concentration); *CF* is cash flow, measured by EBITDA over total assets measured at the beginning of the period; *Sales_grow* is the opportunity for growth, measured by the variation of revenue divided by total assets at the beginning of the period; *Lev* is total leverage, obtained from interest-bearing liabilities over total assets; *CL* is current liquidity (proxy for financial slack), measured by current assets over current liabilities; and *Size* is measured by the log of total assets. Finally, we included dummies to control for the fixed effects of firm, industry and time. Table 1 presents the details of each variable composing the econometric model.

Table 1. Variables of the model

Variable	Code	Description	Literature Support
Dependent Variable			
Investment	$Invest_{i,t}$	Capex (capital expenditure) divided by total assets measured at the beginning of the period.	Almeida and Campello (2007); Behr et al. (2013)
Independent Variables			
Cash Flow	$CF_{i,t}$	EBITDA over total assets measured at the beginning of the period.	Almeida and Campello (2007); Behr et al. (2013)
Herfindahl-Hirschman Index	$HHI_{i,t}$	As presented in section 3.2	Colla et al. (2013); Castro et al. (2020); Lou and Otto (2020), Platikanova and Soonawalla (2019).
Control Variables			
Sales Growth	$Sg_{i,t}$	Variation of sales revenues	Behr et al. (2013); Srinivasan and Thampy (2017).
Leverage	$Lev_{i,t}$	Interest-bearing liabilities over total assets	Behr et al. (2013); Srinivasan and Thampy (2017).
Current Liquidity	$CL_{i,t}$	Current assets over current liabilities	Hovakimian (2009)
Size	$Size_{i,t}$	Log of total assets	Srinivasan and Thampy (2017)

Source: Own elaboration.

We chose the panel data model with fixed effects since this model can capture the differences between the companies in the sample. In other words, because of the idiosyncrasy present in financial decisions, the model with fixed effects is more suitable for this study.

Finally, we performed multicollinearity tests (variance inflation factor - VIF) and heteroscedasticity (White). Due to the presence of heteroscedasticity (p-value ≤ 0.000), we estimated the regression models by applying the robust regression technique (Huber-White standard errors). The VIF test result did not indicate multicollinearity of the variables (values lower than 5). The variables were winsorized to the 1st and 99th percentiles of the original variable.

4. RESULTS

Table 2 presents the descriptive statistics of the sample.

Table 2. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Invest	3,174	0.055	0.078	- 0.000	0.492
CF	3,174	0.117	0.112	- 0.146	0.526
HHI	3,174	0.653	0.279	0.131	1.000
Sg	3,123	0.132	0.404	- 0.724	2.709
Sg_lag	2,581	0.142	0.407	- 0.724	2.709
Lev	3,174	0.348	0.205	0.001	0.834
CL	3,174	1.686	1.324	0.083	9.053
Size	3,174	7.305	1.756	0.759	13.739

Notes: I: Investment, equal to capex divided by total assets measured at the beginning of the period; HHI: Herfindahl-Hirschman Index, proxy for heterogeneity of the financial structure; CF: cash flow, equal to EBITDA over total assets measured at the beginning of the period; Sg: sales growth, equal to the variation of sales revenues; Sg_lag: lagged sales growth, equal to sales growth lagged by one period; Lev: leverage, equal to interest-bearing liabilities over total assets; CL: current liquidity, equal to current assets over current liabilities; Size equal log of total assets.

According to descriptive statistics, the average of the main variable of this study, HHI, is 65.3%, close to the averages presented in samples from other countries such as the United States (70%), Spain (64%) and Germany (68%) (Giannetti, 2019; Castro et al., 2020). The average of sales growth (Sg) is 13.2%. However, there is considerable variation, with observations ranging from 72% negative to 271% positive. The Size variable also presents significant variations. Although the firms' average size is 7.30, there are substantially smaller ones (0.76) and others substantially larger (13.74). This result highlights the heterogeneity of the companies in the sample, an important characteristic to ensure the external validity of the results. Finally, the average of Investment is 5.5%, while the cash flow is 11.7%. The results also showed that, on average, the companies have leverage of 34.8% and a current liquidity ratio of 1.67.

Table 3 reports the results of the Panel Data regressions. The first three equations test the existence of investment-cash flow sensitivity for the companies, controlling for different fixed effects (firm, year, industry and industry-year) in each one of them. In equations IV, V and VI, the central focus is on analyzing the degree of debt concentration and its relationship with the investment-cash flow sensitivity, also controlling for different fixed effects (firm, year, industry and industry-year).

Table 3. Panel Data regressions

VARIABLES	I	II	III	IV	V	VI
	Invest.	Invest.	Invest.	Invest.	Invest.	Invest.
CF	**0.174*** **	**0.159*** **	**0.152*** **	**0.311*** **	**0.319*** **	**0.297*** **
	(0.0354)	**(0.0256)**	**(0.0273)**	**(0.0850)**	**(0.0722)**	**(0.0755)**
HHI				**0.0231** **	0.0125	0.0109
				(0.0110)	(0.0102)	(0.0112)
CFxHHI				**-0.198** **	**-0.230*** **	**-0.210** **
				(0.0866)	**(0.0806)**	**(0.0842)**
Sg	0.0090	**0.0291*** **	**0.0316*** **	**0.0088***	**0.0282*** **	**0.0307*** **
	(0.0056)	**(0.0079)**	**(0.0086)**	**(0.0053)**	**(0.0076)**	**(0.0084)**
Sg_lag	0.0054	**0.0121** **	**0.0121** **	0.0053	**0.0121** **	**0.0121** **
	(0.0039)	**(0.0052)**	**(0.0060)**	(0.0039)	**(0.0052)**	**(0.0061)**
Lev	0.0271	**0.0320*** **	**0.0296** **	0.0271	**0.0265** **	**0.0245***
	(0.0192)	**(0.0107)**	**(0.0118)**	(0.0195)	**(0.0113)**	**(0.0127)**
CL	**-0.0042** **	**-0.0032*** **	**-0.0031** **	**-0.0041** **	**-0.0030** **	**-0.0030** **
	(0.0019)	**(0.0012)**	**(0.0013)**	**(0.0018)**	**(0.0011)**	**(0.0012)**
Size	0.0086	0.0003	0.0003	0.0075	-1.63e-05	1.81e-06
	(0.0066)	(0.0011)	(0.0012)	(0.0067)	(0.0011)	(0.0012)
Constant	-0.0164	0.0211	**0.0372***	-0.0246	0.0143	0.0285
	(0.0470)	(0.0163)	**(0.0204)**	(0.0481)	(0.0194)	(0.0232)
Observations	2,576	2,576	2,576	2,576	2,576	2,576
R-squared	0.144	0.280	0.388	0.153	0.291	0.397
Firm FE	YES	NO	NO	YES	NO	NO
Industry FE	NO	YES	YES	NO	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry-Year FE	NO	NO	YES	NO	NO	YES

Notes: Dependent variable - I: Investment, equal to capex divided by total assets measured at the beginning of the period; HHI: Herfindahl-Hirschman Index, proxy for heterogeneity of the financial structure; CF: cash flow, equal to EBITDA over total assets measured at the beginning of the period; Sg: sales growth, equal to the variation of sales revenues over total assets measured at the beginning of the period; Sg_lag: lagged sales growth, equal to sales growth lagged by one period; Lev: leverage, equal to interest-bearing liabilities over total assets; CL: current liquidity, equal to current assets over current liabilities; Size equal log of total assets. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

Estimates I, II and III indicate investment-cash flow sensitivity for all companies in the sample. More specifically, on average, there is a dependence of companies' investment on internally generated cash flow. This result is consistent with previous Brazilian studies such as Terra (2003), Lazzarini et al. (2015) and Ambrozio et al. (2016). In addition, the results show that cash flow has significant economic importance on investment, presenting a coefficient substantially higher than all other variables.

The interaction variable shows that an increase in the debt concentration reduces the investment-cash flow sensitivity. This result is consistent with those found in Platikanova and Soonawalla (2019), Castro et al. (2020), Jadiyappa et al. (2020) and Lou and Otto (2020). The reduction of financial constraints from a greater debt concentration can occur through different channels.

First, few financing sources can increase the firm's incentive to build a closer relationship with the creditor, increasing the monitoring, reducing information asymmetry, and thus reducing the financial constraints. Second, the more concentrated debt structure avoids the difficulties related to coordination between different types of creditors in the case of firms' default, thus providing greater protection to the creditor (Castro et al., 2020; Lou & Otto, 2020). This protection can facilitate firms' access to a greater volume of finance, reducing the financial constraint. Thirdly, with greater participation in the company's debt structure, there is a greater

incentive for creditors to monitor (Lou & Otto, 2020). As a benefit of more robust monitoring, companies can obtain a greater financing volume, thus reducing the investment-cash flow sensitivity.

The control variable Sales growth is statistically significant for almost all estimations. This result shows that investment opportunities are an important factor to explain firms' investment, as also found in Behr et al. (2013), Srinivasan and Thampy (2017) and Nozawa and Managi (2019). The Current Liquidity is negatively associate with investments, *ceteris paribus*. An increase in liquidity may represent a firm's desire to maintain greater financial slack to avoid future financial problems, affecting the current investment. Finally, the variable Leverage has a positive effect on investment in most estimates, keeping the other variables constant. An increase in leverage can signal more indebtedness ability, leading to a greater capacity to meet investment demands.

4.1 Robustness tests

To examine the consistency of the results presented so far, we performed new estimations. Table 4 presents the estimation results with changes in the cash flow proxy and the debt concentration proxy. In estimations I, II and III, we change the debt concentration proxy. The Excl90 proxy, used in the studies by Colla et al. (2013), Platikanova and Soonawalla (2019), Castro et al. (2020) and Lou and Otto (2020) aim to capture the firm's economic dependence on a single type of debt. Therefore, the Excl90 proxy is a dummy that assumes a value equal to 1 (one) if the firm has more than 90% of its debt concentrated in only one type of debt, and 0 (zero) otherwise.

In estimations IV, V and VI, we also change another important proxy for this study: cash flow. For these new estimates, we considered as the cash flow the Net Income plus Amortization and Depreciation as in Ding et al. (2013), Sousa and Ottaviano (2017) and Silva, Caixe and Krauter (2019).

Table 4. Panel data regressions with alternative proxies

VARIABLES	I	II	III	IV	V	VI
	Invest.	Invest.	Invest.	Invest.	Invest.	Invest.
CF	**0.212*** **	**0.208*** **	**0.193*** **			
	(0.0464)	**(0.0362)**	**(0.0377)**			
Excl90	**0.0112** **	**0.0081***	0.0061			
	(0.0051)	**(0.0048)**	(0.0055)			
CFxExcl90	**-0.0826** **	**-0.110*** **	**-0.0936** **			
	(0.0356)	**(0.0355)**	**(0.0373)**			
CF2				**0.298*** **	**0.338*** **	**0.345*** **
				(0.0816)	**(0.0660)**	**(0.0696)**
IHH				0.0104	-0.0004	0.0013
				(0.00873)	(0.0075)	(0.0086)
CF2xIHH				**-0.156***	**-0.221*** **	**-0.238*** **
				(0.0847)	**(0.0724)**	**(0.0783)**
Sg	**0.0090***	**0.0288*** **	**0.0314*** **	**0.0112***	**0.0294*** **	**0.0313*** **
	(0.0054)	**(0.0078)**	**(0.0085)**	**(0.0057)**	**(0.0079)**	**(0.0088)**
Sg_lag	0.0054	**0.0124** **	**0.0124** **	0.0050	**0.0121** **	**0.0125** **
	(0.0039)	**(0.0052)**	**(0.0061)**	(0.0037)	**(0.0051)**	**(0.0061)**
Lev	0.0270	**0.0286** **	**0.0264** **	**0.0413** **	**0.0430*** **	**0.0409*** **
	(0.0193)	**(0.0112)**	**(0.0125)**	**(0.0204)**	**(0.0117)**	**(0.0131)**
CL	**-0.0042** **	**-0.0031*** **	**-0.0030** **	**-0.0052*** **	**-0.0041*** **	**-0.0041*** **
	(0.0018)	**(0.0011)**	**(0.0012)**	**(0.0019)**	**(0.0012)**	**(0.0013)**
Size	0.0082	0.0001	0.0001	0.0055	-0.0005	-0.0005
	(0.0067)	(0.0011)	(0.0012)	(0.0069)	(0.0011)	(0.0012)

Constant	-0.0186	0.0186	0.0346	0.0031	0.0286	0.0362
	(0.0476)	(0.0173)	(0.0219)	(0.0494)	(0.0191)	(0.0226)
Firm FE	YES	NO	NO	YES	NO	NO
Industry FE	NO	YES	YES	NO	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry-Year FE	NO	NO	YES	NO	NO	YES
Observations	2,576	2,576	2,576	2,576	2,576	2,576
R-squared	0.150	0.288	0.393	0.151	0.292	0.401

Notes: Dependent variable - I: Investment, equal to capex divided by total assets measured at the beginning of the period; HHI: Herfindahl-Hirschman Index, *proxy* for heterogeneity of the financial structure; Excl90: dummy that assumes a value equal to 1 (one) if the firm has more than 90% of its debt concentrated in only one type of debt, and 0 (zero) otherwise; CF: cash flow, equal to EBITDA over total assets measured at the beginning of the period; CF2: cash flow, equal to Net Income plus Amortization and Depreciation over total assets measured at the beginning of the period; Sg: sales growth, equal to the variation of sales revenues over total assets measured at the beginning of the period; Sg_lag: lagged sales growth, equal to sales growth lagged by one period; Lev: leverage, equal to interest-bearing liabilities over total assets; CL: current liquidity, equal to current assets over current liabilities; Size equal log of total assets. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5 shows that there is no change in the main results even with the proxies' alteration. In other words, companies continue presenting investment-cash flow sensitivity, which is reduced given a positive variation in debt structure concentration.

Nevertheless, one might suspect the validity of these results by questioning a possible endogeneity in the model or, more specifically, reverse causality between debt concentration proxy and financial constraints. In other words, one could argue that companies that face difficulties in raising funds would not have many options regarding the type and degree of diversification of debt structure, being limited to a more concentrated debt structure. Thus, the model would present a simultaneity problem in which the effect of debt structure on financial constraints may occur simultaneously with the effect of financial constraints on debt structure. Therefore, this reverse causality could significantly influence the betas estimation, compromising the results found.

We account for this potential problem using two econometric strategies. Firstly, estimating a Two-Stage Least Squares (2SLS) model. Secondly, estimating a generalized method of moments in first difference (GMM-Diff),

For the 2SLS estimation, it is necessary to find a suitable instrumental variable. More specifically, a variable with a strong relationship with debt concentration (HHI) but without correlation with the error term. Following Lou and Otto (2020), we propose the amount of long-term debt that matures during the year as an instrument. According to the authors, when a larger portion of long-term debt matures, companies issue new debt instruments and, therefore, tend to change their degree of debt concentration.

Since the maturity of the company's long-term debt is determined many years in advance, it is unlikely that the portion of long-term debt that is maturing will correlate with other omitted variables in the model and affect the company's current investment (i.e. uncorrelated with the error term), which makes it a genuinely exogenous variable. Based on Lou and Otto (2020), we constructed an indicator for this variable, called Long-Term Debt Maturing, a dummy that assumes value 1 when more than 5% of the total long-term debt matures the year and 0 otherwise.

The second strategy used to deal with the possible endogeneity problem was the estimation by GMM-Diff proposed by Arellano and Bond (1991). All lags of the explanatory variable are used as an instrument in this estimation, assuming that these instruments are uncorrelated with the error term but correlated with the endogenous regressor.

Table 5 presents the results of the regressions estimated by GMM-Diff and 2SLS.

Table 5. GMM-Diff and 2SLS Estimation

VARIABLES	GMM-Diff	2SLS	
		First Stage of 2SLS	Second Stage of 2SLS
	Invest.	HHI	Invest.
LT_Debt_Maturing		**-0.186*** **	
		(0.0184)	
CF	**0.423*** **	-0.0048	**0.889*** **
	(0.120)	(0.0502)	**(0.287)**
HHI	0.0120		**0.150** **
	(0.0166)		**(0.0643)**
CFxHHI	**-0.279** **		**-1.035** **
	(0.123)		**(0.406)**
Sg	0.0072	-0.0149	**0.0281*** **
	(0.0073)	(0.0166)	**(0.0070)**
Sg_def	0.0053	-0.0011	**0.0142*** **
	(0.0039)	(0.0130)	**(0.0052)**
Lev	**0.0713***	**-0.307*** **	0.0132
	(0.0384)	**(0.0270)**	(0.0120)
CL	**-0.0087*** **	**0.0119*** **	**-0.0042*** **
	(0.0029)	**(0.0039)**	**(0.0011)**
Size	-0.0022	**-0.0352*** **	**0.0032** **
	(0.0154)	**(0.0029)**	**(0.0014)**
Constant		**1.157*** **	**-0.108** **
		(0.0341)	**(0.0522)**
Year FE	YES	YES	YES
Observations	2,071	2,576	2,576
R-squared		0.161	0.027

Notes: Dependent variable - I: Investment, equal to capex divided by total assets measured at the beginning of the period; HHI: Herfindahl-Hirschman Index, proxy for heterogeneity of the financial structure; CF: cash flow, equal to EBITDA over total assets measured at the beginning of the period; Sg: sales growth, equal to the variation of sales revenues over total assets measured at the beginning of the period; Sg_lag: lagged sales growth, equal to sales growth lagged by one period; Lev: leverage, equal to interest-bearing liabilities over total assets; CL: current liquidity, equal to current assets over current liabilities; Size equal log of total assets; LT_Debt_Maturing: a dummy that assumes value 1 when more than 5% of the total long-term debt matures the year. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

The estimates presented in table 5 are in line with the previous results. In the estimation by GMM-Diff, the interaction is negative and significant, showing a reduction in the investment-cash flow sensitivity given a greater debt concentration.

The first- and second-order autocorrelation (p-value of 0.00 and 0.06, respectively) pointed to the estimation's adequacy considering a limit of 5% of significance. Furthermore, there is no evidence of pairwise correlation between the instruments and the error term of the models according to the Hansen-Sargan test (p-value of 0.276).

Regarding the 2SLS estimation, we first analyzed the results of 2SLS First Stage to verify if the instrumental variable - LT_Debt_Maturing - is correlated with HHI. The variable LT_Debt_Maturing presents statistical significance at the level of 1%, which corroborates the assumption that it is a relevant instrument. This assumption is further reinforced by the F test (41.00) result, which exceeds the limit of 10 established by Stock et al. (2002) to avoid the use of weak instruments.

Finally, the Second Stage of 2SLS, using LT_Debt_Maturing as an instrument for HHI, presents results in line with previous estimates. Therefore, the GMM-Diff and 2SLS estimations indicate that the results found so far are robust to possible endogeneity problems.

4.3 Additional tests

Finally, we also verified whether the proxies used in the literature to measure financial constraints allow for better refinement of the previous results. So, we provide new estimations using two financial constraints proxies: i) Size Age (SA) Index; and ii) financial constraints (FCP) index.

The SA index was developed by Hadlock and Pierce (2010, p.1939) based on two variables that, according to the authors, "have a long tradition in corporate finance research", namely size and age. Hadlock and Pierce (2010, p. 1939) suggested that although the index is based on only two factors, it can be considered as a "reasonable choice for measuring financial constraints in many contexts".

The FCP index was recently developed by Schauer, Elsas and Breitkopf (2019). The authors were motivated to develop a new financial constraints index given the high misclassification rates they found when using existing measures on their sample of private firms. Therefore, Schauer, Elsas and Breitkopf (2019) aimed to create an index applicable to samples that also contain private companies. The index is calculated from a combination of factors: i) size; ii) interest coverage ratio; iii) Return on Asset; and iv) Cash Holding. As Schauer et al. (2019), we use one period lagged for each factor. The smaller the FCP index, the smaller the financial constraints

We aimed to investigate whether the effect of debt concentration on the investment-cash flow sensitivity is stronger in companies considered more financially constrained by the indexes used in the literature. Table 6 shows the result of the estimations based on the application of the financial constraints indexes.

Table 6. Panel data regressions (segregated according to the SA and FCP indexes)

VARIABLES	(I) Constraints SA Index	(II) Not Constraints SA Index	(III) Constraints FCP Index	(IV) Not Constraints FCP Index
	Invest.	Invest.	Invest.	Invest.
CF	**0.412*** **	**0.172*** **	**0.282***	**0.466*** **
	(0.133)	**(0.0484)**	**(0.154)**	**(0.169)**
HHI	**0.0375** **	0.0056	**0.0354***	**0.0638** **
	(0.0188)	(0.0086)	**(0.0198)**	**(0.0267)**
CFxHHI	**-0.307** **	-0.0574	-0.220	**-0.351** **
	(0.131)	(0.0686)	(0.173)	**(0.162)**
Sg	**0.0172***	0.0001	0.0057	0.0224
	(0.00902)	(0.0038)	(0.0075)	(0.0180)
Sg_def	0.0076	0.0006	**0.0185*** **	-0.0139
	(0.0055)	(0.0042)	**(0.0069)**	(0.0090)
Lev	0.0349	0.0077	0.0333	**0.0989** **
	(0.0285)	(0.0244)	(0.0438)	**(0.0384)**
CL	**-0.0077*** **	0.0003	-0.0060	-0.0024
	(0.0027)	(0.0017)	(0.0041)	(0.0042)
Size	0.0049	**0.0162** **	**0.0330** **	-0.0009
	(0.0082)	**(0.0079)**	**(0.0140)**	(0.0115)
Constant	-0.0199	-0.0728	**-0.167***	-0.0252
	(0.0588)	(0.0604)	**(0.0975)**	(0.0860)
Firm FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	1,234	1,342	770	770
R-squared	0.167	0.170	0.171	0.271

Notes: Dependent variable - I: Investment, equal to capex divided by total assets measured at the beginning of the period; HHI: Herfindahl-Hirschman Index, proxy for heterogeneity of the financial structure; CF: cash flow, equal to EBITDA over total assets measured at the beginning of the period; Sg: sales growth, equal to the variation of sales revenues over total assets measured at the beginning of the period; Sg_lag: lagged sales growth, equal to sales growth lagged by one period; Lev: leverage, equal to interest-bearing liabilities over total assets; CL: current

liquidity, equal to current assets over current liabilities; Size equal log of total assets. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10.

In line with previous results, the new estimates pointed to the presence of investment-cash flow sensitivity in both groups (more and less financially constrained). This reinforces our argument that, in Brazil, there is a broad context of financial constraints that encompasses all companies in the sample.

About the relationship between HHI and the investment-cash flow sensitivity, there are different results between the financial constraints proxies. While for the SA index the reduction of investment-cash flow sensitivity occurs in the more financial constraints' group, for the FCP index, on the other hand, occurs in the lower constraints'.

These conflicting results may point to a limitation of these indexes in measuring financial constraints degree in contexts different from those in which they were developed. Thus, the result sheds light on the need to develop financial constraints indexes for the Brazilian context.

Nonetheless, a negative relationship between debt concentration and investment-cash flow sensitivity was present in all estimates of this study. We found strong evidence that an increase in debt concentration can reduce the financial constraint suffered by companies. These results are in line with the studies of Platikanova and Soonawalla (2019), Castro et al. (2020), Lou and Otto (2020).

In short, the financial restriction is very harmful to companies, limiting their capacity for innovation, growth, performance and compromising their survival. For this reason, reducing financial constraints tends to be an essential task for companies' survival. Our study showed that the concentration of the debt structure could be an essential strategy for managers seeking to reduce financial constraints. Therefore, in addition to making an important contribution to the literature, our study can contribute to improving the company's financing decision-making.

5. FINAL REMARKS

We aimed to analyze whether a relationship exists between the debt structure concentration and financial constraints of a sample of Brazilian firms. We find in the literature arguments that favor both a positive and negative effect of debt concentration on firms' financial constraints. On the one hand, the greater debt concentration could reduce the financial constraint by increasing the incentive to monitor and reduce information asymmetry with creditors. On the other hand, a lower debt concentration (i.e. greater diversification) could reduce the financial constraint due to the firm's increased bargaining power among the lenders.

To address this research problem, we analyzed a sample of 500 Brazilian companies (337 unlisted and 163 listed) from 2010 to 2019. We applied the model of investment-cash flow sensitivity proposed by Fazzari et al. (1988).

The results favored a more concentrated debt structure, suggesting that a high degree of debt structure concentration was related to lower financial constraints in our firms' sample. Therefore, few sources of financing can be a reflection of a closer relationship between lender and borrower, which in turn tends to cause increased monitoring, reducing the information asymmetry and consequently lowering the financial constraints of firms. The concentration of the debt structure also avoids the difficulty of coordination among creditors in a firm's default situation, providing greater protection to the creditor and, consequently, contributing to the reduction of financial constraints. In addition, with greater participation in the company's debt structure, there is a greater incentive for creditors to monitor. As a benefit of stronger monitoring, companies can obtain a greater volume of financing, contributing to reducing the financial constraint.

Comprehension of the factors that can help reduce firms' financial constraints is pertinent, especially in emerging countries, where financial constraints tend to be stronger. Thus, the financial restriction is very harmful to companies, and may even compromise their continuity in the market. Our study offers evidence that the concentration of debt in a few sources can be a strategy to reduce the financial constraints of companies.

The main limitation of this study is related to the proxies for financial constraint employed in the additional analysis. Although these proxies have been widely used in previous empirical studies, the subsamples' characteristics are noticeably different. This casts doubt on proxies' ability to identify financially constrained firms, and at the same time, opens avenues for future studies to develop improved proxies for financial constraints, especially considering the specific contexts such as those of emerging economies. Finally, the study focuses on analyzing only one country, making room for studies to investigate this problem in other contexts.

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