RESTRIÇÕES AO CRÉDITO: UMA ANÁLISE COMPARATIVA ENTRE[1] EMPRESAS BRASILEIRAS DE CAPITAL ABERTO E FECHADO

CREDIT CONSTRAINTS: A COMPARATIVE ANALYSIS BETWEEN OPENED AND CLOSED CAPITAL BRAZILIAN COMPANIES

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ABSTRACT

Background: Classic finance theories argue that information asymmetry is a major cause to reinforce the barrier between investors and companies. From this, it would be plausible to assume that publicly traded companies have less difficulty in raising equity, either from their own or from third parties, given their higher level of disclosure.

Objective: the purpose of this study is to analyze the potential differences regarding credit constraints between opened and closed capital companies. To this end, financial information was collected from 291 Brazilian opened capital companies and 325 closed capital companies, from 2012 to 2016.

Method: With a panel regression, with cash as the dependent variable and cash flow as the main explanatory variable.

Results: the results show that opened capital companies are more dependent on cash and cash flow than closed capital companies. A sub-sample constructed using propensity score matching corroborated the study results. This implies a greater restriction to credit for opened capital companies than closed capital companies.

Contributions: The main causes behind the unexpected results are the particularities of the Brazilian credit market (strong performance of BNDES), associated with the fact that opened capital companies were, on average, more affected by the 2015-2016 economic recession than the companies with closed capital.

Keywords: Credit constraints. Information asymmetry. Opened and closed capital companies. BNDES.

RESUMO

Objetivo: O objetivo deste estudo é analisar as potenciais diferenças em relação à restrição ao crédito entre empresas de capital aberto e fechado e, para tanto, foram coletadas informações financeiras de 291 empresas brasileiras de capital aberto e 325 empresas de capital fechado, de 2012 a 2016.

Fundamento: As teorias clássicas de finanças defendem que a assimetria de informações é uma das principais causas para fortalecer a barreira entre investidores e empresas. A partir disso, seria plausível presumir que empresas abertas tem menor dificuldade para conseguir capital, próprio ou de terceiros, dado seu maior nível de *disclosure*.

Método: Regressão em painel, tendo caixa como a variável dependente e fluxo de caixa como a principal variável explicativa.

Resultados: Os resultados apontam que empresas de capital aberto têm maior dependência do caixa e fluxo de caixa em relação às empresas de capital fechado. Uma sub amostra construída utilizando o *propensity score matching* corroborou os resultados do estudo. Isso implica na existência de maior restrição ao crédito para empresas de capital aberto do que para as empresas de capital fechado.

Contribuições: As principais causas por trás dos resultados inesperados são as particularidades do mercado de crédito brasileiro (forte atuação do BNDES), associadas ao fato de que empresas de capital aberto foram, em média, mais afetadas pela recessão econômica de 2015-2016 do que as empresas as empresas de capital fechado.

Palavras-chave: Restrição ao crédito. Assimetria de informações. Empresas de capital aberto e fechado. BNDES.

1 INTRODUÇÃO

Every company faces the recurrent challenge of defining the way it is going to finance its assets. The well-known theory of Modigliani and Miller (1958) brought some light to the issue by showing that in perfect conditions, a firm's value is not affected by its capital structure. But considering that in the real world these conditions are not achievable, it is plausible to believe there is a clear tradeoff between issuing debt and raising equity, since higher tax benefits of a bigger debt to equity ratio are followed by higher probabilities of bankruptcy (Ross, 1977). Therefore, it can be inferred that there is an optimal leverage ratio, that at the same time generates tax benefits and signalizes a healthy financial status to capital providers, resulting in the lowest possible WACC (Weighted Average Cost of Capital).

However, seeking the optimal level of leverage, or in more practical terms, seeking the cheapest source of funding is subjected to some factors that may limit credit access. Each economic cycle, each industry, and each company has particular characteristics that may influence investors into lowering their willingness to offer both debt and equity. On top of that, Fazzari, Hubbard and Petersen's (1988) point out that credit constraints exist when creditors face asymmetric information problems, given it is harder to set the good debtors apart from the bad ones. The authors argue that internal and external resources are not perfect substitutes, given investors might charge a premium due to information asymmetry when evaluating investment opportunities. An idea that invokes principles from the pecking order theory, greatly discussed by Myers and Majluf (1984).

Based on this information, one can assume that ceteris paribus, by increasing its information transparency a firm would obtain more access to credit, since investors would be able

to distinguish that particular company from potential bad borrowers. As a consequence, it can be assumed that public capital companies would face less credit constraints when compared to private ones, given they are being continuously analyzed by professional analysts in the capital market and have a higher disclosure level than their private peers. Testing this potential difference in access to credit is the main goal of this paper, with the hypothesis that opened capital companies have more credit constraints than closed capital ones.

Ghani, Martelanc and Kayo (2015) with the same aim, used a sample containing 164 public capital companies and 688 private capital companies to build a panel model, which was included data from 2007 to 2010. The study did not finddifferences related to credit constraints between public and private capital companies.

Despite of sharing the same core objective with Ghani, Martelanc and Kayo (2015), this paper used a different model in order to estimate potential differences in credit access. The main difference in this study was the adoption of a model based on the cash flow sensitivity to cash method proposed by Almeida, Campello and Weisbach (2004), instead of using the cash flow sensitivity to investment, considering the critics of this model (Kaplan & Zingales, 1997; Povel & Raith, 2001; Almeida & Campello, 2002, Cited By Almeida, Campello, & Weisbach, 2004), who point that a positive and significant relation between cash flow and investment is commonly found among both credit restricted and unrestricted firms while also questioning the robustness of Fazzari, Hubbard and Petersen's (1988) implications. In this sense, the contribution of this study is underpinned by the proposition of a more adequate model to investigate some of the supposed differences between private and public capital companies.

Additionally, in order to eliminate the selection bias once the collected public and private capital companies have different characteristics, this study used the propensity score matching procedure, taking companies' size and sector as the criteria to create pairs of closed and opened capital companies.

Econometric results pointed to public companies facing higher credit constraints than private ones, which was an interesting and unexpected finding. This controversial result was attributed to particularities of the Brazilian credit market in addition to the economic recession negatively affecting public capital companies more than private capital ones as the descriptive analysis of the sample had shown.

2 LITERATURE REVIEW

2.1 Private versus public companies

Focusing to investigate the credit sources chosen by firms, considering that their own credit rating plays a key role in credit availability, Denis and Mihov (2003) concluded, by analyzing a sample with 1,560 companies, that firms with a poor credit rating tend to seek resources from non-bank private debt, while firms with a good rating finance their assets with public debt and firms with a rating ranging between those two groups tend to raise resources from bank debt. The authors also mention that there are several studies agreeing on the fact that banks are the most efficient lenders doing business in an asymmetric information environment. There is academic evidence strengthening the fact that a solid information sharing structure across banking systems is associated with cheaper and more abundant credit (Brown, Jappelli & Pagano, 2009).

Another clear factor that impacts credit access is, according to Lambert, Leuz and Verrecchia (2007), the quality of the information disclosed by companies. Higher transparency and reporting standards would, therefore, lower the cost of capital. The authors point out that this is

directly caused by positive change in market players' perceptions of the company and indirectly caused by an impact on managers' decisions that alter expected future cash flows.

In a study analyzing the quality of non-compulsory information disclosure, Lima (2007) also found out, aligned with most of the academic research, that a higher level of disclosure can be linked to a lower cost of debt. The author studied 23 non-financial companies with stocks exchanged at B3, formerly known as BM&FBOVESPA, between 2000 and 2005, classifying their disclosure level in great, good, regular or bad.

Pagano, Panetta and Zingales (1998) while investigating the 'common wisdom' that going public capital is simply one of the stages in the growth path of a firm, analyzed a data set of Italian companies to mean the main drivers towards an IPO (Initial Public Offering). The study concluded that, for independent companies, an abnormal growth and significant investments are key factors present right before the IPO. Following the public offering, decreases in leverage and investment were noticed, thus indicating a willingness to reshape the capital structure of the firm, which, in turn implies that the firm is looking for lower costs of capital to finance its assets when going public.

The available academic findings lead to the idea that besides credit ratings, disclosure is a key factor when analyzing credit constraints. Consequently, it would be more than reasonable to affirm that, ceteris paribus, public firms would be endowed with easier credit access, since reporting is compulsory, and regulators demand a higher transparency level from these companies, compared to private ones. This leads to the hypothesis that is going to be tested on this study: public capital companies have less credit constraints than private capital ones.

From the hypothesis that public capital firms have higher access to the capital market, and therefore should be less leveraged, Brito, Batistella and Corrar (2007) investigated a sample containing the 500 biggest Brazilian companies and concluded that being public is not a determinant factor on capital structure. In addition, they argue that bigger companies tend to be more leveraged and have a higher proportion of long-term debts. The reason behind this may lie in the fact that big companies have greater access to BNDES credit lines than smaller ones.

2.2 Cash flow sensitivity of cash

A possible strategy to verify if a firm has credit constrained or not is by econometrically testing the relation between a firm's cash flow and investment levels (Fazzari, Hubbard, & Petersen, 1988), by using investment as the dependent variable and cash flow as the independent one. This model is named cash flow sensitivity of investment. The rationale behind this technique consists in the fact that internal and external resources have different costs mostly due to information asymmetry. As a consequence, if a firm operates in an asymmetric information environment from to higher costs on external resources, it will probably depend more on self-resources to finance its operation. Therefore, when the proposed model was estimated, the cash flow coefficient would be relevant and positive for credit constrained firms, suggesting a direct relation between investments and cash flow when a company has credit constraints. For firms without restrictions to credit, the regression would result in an irrelevant coefficient for the variable cash flow, given the companies' investment levels do not depend on their internal resources.

Generally, the cash flow sensitivity model uses the Tobin's Q as a control variable. Since this study focuses on both public and private capital companies, it will not be possible to use Tobin's Q because the market value of private capital companies is not measurable. Ghani, Martelanc and Kayo (2015) used the cash flow sensitivity of investment model and faced the same issue when comparing credit constraints among closed and opened capital companies. This study

will then follow the authors' solution to the problem which consists in including present and past revenue as control variables in place of Tobin's Q.

In their study, Ghani, Martelanc and Kayo (2015), concluded that private and public capital companies did not exhibit differences in credit access, thus suggesting that the 852 companies in their sample would have similar information asymmetry characteristics. As the authors themselves claim, the cash flow sensitivity of investment model faces some criticism, given companies in better financial conditions would tend to have a clear relation between cash flow and investment (Kaplan & Zingales, 1997; Povel & Raith, 2001; Almeida & Campello, 2002, Cited By Almeida, Campello, & Weisbach, 2004). Therefore, when analyzing the significance of the model estimators, it would not be clear which one out of the two factors is leading to the dependence of investments on cash flow, given a possible explanation for the high dependence on cash flow might be due to credit constraints or due to the company's solid cash flow generation associated with good financial result.

Considering the main criticism around Fazzari, Hubbard and Petersen's (1988) model as mentioned on the introduction section, Almeida, Campello and Weisbach (2004) propose a revision of the framework, claiming that credit-constrained firms demand higher liquidity levels, thus a strong relation between cash flow and cash would be more likely in those companies. The authors validate their model empirically and conclude that a cash flow sensitivity of cash model is more adequate than a cash flow sensitivity of investment. Hadlock and Pierce (2010) focusing to develop a new credit constraint index, concluded that firms hold cash as a measure of precaution. Acharya, Davydenko and Strebulaev (2012) also found evidence that supports the idea that firms expecting to go through financial distress are the ones who tend to accumulate more cash, it could be implied that this effect would be stronger in credit constrained firms.

Authors Denis and Sibilkov (2009) strengthened Almeida, Campello and Weisbach's (2004) model by concluding that credit constrained firms value cash more than unconstrained ones, in addition, the researchers went further to understand why some constrained companies would not have higher levels of cash and found out that these companies tended to have a decreasing cash flow in the past ten years, thus limited possibilities to hoard cash. The authors argue that these high cash levels are value increasing for constrained companies given they can seize valuable investment opportunities.

Considering these authors contribution, this paper will combine Fazzari, Hubbard and Petersen's (1988) model, replacing Tobin's Q (as private companies were included in the analysis) for current and past revenue (Ghani, Martelanc, & Kayo 2015), and considering cash, instead of investment, as the dependent variable to evaluate credit constraints differences between private and public companies. In other words, the final model used in this study, was a combination of three models proposed by the academy, with some additional variables which were considered relevant to the analysis. Table 1 summarizes the models.

Table 1 –Model construction

	Fazzari, Hubbard and Petersen (1988)	Almeida, Campello and Weisbach (2004)	Ghani, Martelanc and Kayo (2015)	Final Model
Dependent Variable	Investments	Cash Holdings	Investments	Cash Holdings
Independent Variable	Cash flow	Cash flow	Cash flow	Cash flow
Control Variable	Tobin's Q	Tobin's Q	Revenue and Revenue t-1	Revenue and Revenue t-1

Source: Author

Using the Final Model, the rationale remains the same, it is expected that private firms have a relevant and positive coefficient associated with cash flow, thus evidencing that cash levels are derived from the companies own resources generation, given these companies would have more credit constraints when compared to the public ones, and therefore would have higher demands for liquidity in their balance sheets. For public companies, it is expected a statistically irrelevant coefficient, thus evidencing these group higher access to credit and less dependence on their own resources.

3 METHODOLOGY

3.1 Sample

Financial data from 1,610 companies from 2012 to 2016 were collected from Capital IQ database. After excluding financial companies and companies with null data entries, the final sample was composed of 616 Brazilian companies, from which 291 are public and 325 are private capital. The financial data consisted of: total assets, total current assets, cash and equivalents, inventory, total liabilities, total current liabilities, revenue, EBITDA and interest expense. Such information as the company description and the primary sector was also collected, resulting in the sample shown in Table 1.

Table 2 – Public and private capital companies' distribution across their primary sectors.

Sector	Public Capital Companies	Private Capital Companies	Total
Consumer Discretionary	70	43	113
Consumer Staples	25	19	44
Energy	10	6	16
Healthcare	14	8	22
Industrials	50	110	160
Information Technology	15	12	27
Materials	34	34	68
Real Estate	22	18	40
Telecom	5	4	9
Utilities	46	71	117
Total	291	325	616

Source: Author

3.2 Econometric Model

The following regression was estimated in a panel data model including both public and private companies with a two-stages GLS using random effects, with a dummy (D_{it}) (that equals one for public companies) interaction with the variable cash flow. In the equation, i represents the firm, t represents the year, a_i is the firm's non-observed effect and e_{it} is the idiosyncratic error.

$$\frac{CashHoldings}{Assets}_{it} = \alpha_0 + \alpha_1 \frac{CashFlow}{Assets}_{it} + \alpha_2 D_{it} \frac{CashFlow}{Assets}_{it} + \alpha_3 \frac{Revenue}{Assets}_{it} + \alpha_4 \frac{Revenue}{Assets}_{it-1} +$$

$$\alpha_5 \, Liquidity_{it} + \alpha_6 \, IntCover_{it} + \alpha_7 \frac{CashHoldings}{Assets}_{it-1} + \alpha_8 \, lnassets_t +$$

$$\alpha_9 \, SectorDummies + a_i + b_t + e_{it}$$

The variables represent:

Cash holdings = cash and cash equivalents

Assets = total assets

Cash flow = EBITDA

D = dummy equal to one for public capital companies

Revenue = net revenue

Liquidity = (Current assets – inventory)/Current liabilities

Interest cover = Interest expense/EBIT

Ln assets = natural logarithm of total assets

Sector dummies = each primary sector was included in the model through a dummy.

The model is a combination of the cash flow sensitivity of cash model, proposed by Almeida, Campello and Weisbach (2004), with Ghani, Martelanc and Kayo's (2015) model, who substituted the Tobin's Q with revenue and past revenue, as proposed in the sales accelerator model seen in Terra's (2003). The dependent variable used in the featured model is cash holdings, pointing to companies' demand for liquidity (given credit constrained firms would have higher liquidity in their assets), which is explained by the independent variable cash flow plus the variables from the sales accelerator model (present and past revenue) and the other control variables. It is expected a significant and positive coefficient for the variable cash flow, while the interaction between the dummy and cash flow should have an insignificant coefficient, as a result of the hypothesis that public companies face less credit constraints and depend less on their own resources.

The other variables were included as control variables, as other factors besides cash generation might impact a company's liquidity demand. The expected signals for Revenue and Revenue lagged one period are undetermined, once credit constraint firms might have different impacts coming from revenue on their demand for liquidity compared with companies without credit constraints. A positive sign is expected for the variable Liquidity, as Al-Najjar (2013) has pointed out, other current assets besides cash can be accumulated by companies when they demand higher level of liquidity; therefore, companies holding cash should also be to increase their assets liquidity. IntCover was constructed as the inverse of the traditional interest cover ratio in order to avoid division by zero for companies without interest expense. Given that the more negative the ratio is, the higher the indebtedness versus operational revenue will be, it is expected a positive sign for this variable, because companies that already have a high indebtedness might face hardships in the credit market coming from higher bankruptcy probability (Ross, 1977). Finally, differences in each primary sector might result in different signs for the 9 primary sectors dummy included, as some segments need to hold more cash than others due to the nature of their businesses (Filbeck, & Krueger, 2005). In order to make variables comparable, the non-ratio variables were weighted to total assets. The lagged dependent variable was also included in the model, given liquidity level on a current period, might have resulted from lower or higher levels of liquidity in the past.

4 RESULTS
4.1 Descriptive analysis

The descriptive analysis of the sample, summarized on Table 3, shows the differences between the two groups. In the course of the period, both groups have decreases in cash holdings as a proportion of total assets, with the biggest drop happening from 2015 to 2016 for public capital companies and from 2013 to 2014 for private capital ones. Public capital companies were the ones that suffered more in terms of cash flow generation during the recession, with an 11.5% average drop in 2016, while private capital companies' cash flow dropped by 3.7%, on average, in the same period. It is interesting to notice that private capital companies seem asset-lighter, given the proportion of cash flow against total assets mean remains above 0.10 during the whole period analyzed, while public companies have that proportion starting at 0.084 and dropping to 0.058 in 2016, half of the private group. Revenue as a proportion of total assets remained more stable for public than for private companies during the 5 years, probably showing public companies concern with keeping a consistency in their balance sheet according to fluctuations in revenues.

The financial ratios are also different between the two groups, with the public capital companies having higher liquidity levels than the private group, while interest cover means along the period show higher financial expenses in the public group than the private one. The positive results in interest cover averages in 2015 and 2016 result from companies with negative EBIT having some impact on the sample.

It is also interesting to notice, that when standard deviation was analyzed, the private capital companies' group had a greater dispersion on cash holdings/total assets, cash flow/total assets and revenue/total assets, but regarding the financial ratios, public capital companies are more heterogeneous and had a greater standard deviation in the majority of years.

Table 3 – Mean, median, standard deviation and t test for private (325 firms) and public (291 firms) capital companies' variables.

		Public Capital			Private Capital			
	Year	Mean	Median	SD	Mean	Median	SD	t test
Cash Holdings/Total Assets	2012	0.083	0.053	0.095	0.075	0.044	0.095	0.205
	2013	0.083	0.057	0.093	0.073	0.040	0.102	0.212
	2014	0.082	0.054	0.097	0.063	0.043	0.083	0.000
	2015	0.079	0.050	0.095	0.064	0.040	0.066	0.000
	2016	0.074	0.044	0.087	0.057	0.038	0.080	0.000
Cash Flow/Total Assets	2012	0.084	0.088	0.170	0.104	0.098	0.225	0.333
	2013	0.086	0.089	0.116	0.105	0.098	0.270	0.171
	2014	0.085	0.085	0.101	0.121	0.101	0.147	0.007
	2015	0.066	0.073	0.106	0.112	0.100	0.208	0.045
	2016	0.059	0.076	0.143	0.107	0.099	0.146	0.008
Revenue/Total Assets	2012	0.697	0.591	0.623	0.713	0.535	0.717	0.776
	2013	0.684	0.569	0.565	0.678	0.497	0.773	0.902
	2014	0.671	0.570	0.526	0.693	0.549	0.736	0.652
	2015	0.633	0.552	0.480	0.622	0.489	0.625	0.804
	2016	0.624	0.552	0.467	0.643	0.497	0.719	0.695
Liquidity	2012	1.880	1.177	3.840	1.445	0.907	1.871	0.090
	2013	1.825	1.224	3.051	1.299	0.952	1.835	0.006
	2014	2.133	1.196	8.334	1.238	0.931	1.136	0.071
	2015	2.198	1.167	9.077	1.072	0.896	0.999	0.036
	2016	1.648	1.124	2.569	1.131	0.934	0.963	0.002
IntCover	2012	-2.116	-0.208	22.857	-1.492	-0.336	17.365	0.700
	2013	-9.489	-0.252	152.586	-0.358	-0.338	12.490	0.309
	To be continued							

			Continuation				
2014	-7.272	-0.280	99.353	-0.449	-0.404	2.973	0.243
2015	0.342	-0.252	8.417	-1.029	-0.340	22.827	0.292
2016	0.226	-0.252	13.952	-0.622	-0.392	3.505	0.327

Source: Author

The correlation between the dependent variable cash holdings and the independent variables is shown in Table 4 and Table 5, separately for private and public capital companies. Public capital companies presented a higher positive correlation between cash flow and cash holdings. Revenue and cash flow, as expected, presented expressive correlations, with a 0.9 correlation between the two variables for the public capital companies. This high correlation is expected, once what separates revenues from cash flow are costs and expenses excluding interest, depreciation, amortization and taxes.

Table 4 – Public capital companies' variables correlation (n = 291)

	Cash holdings	Cash flow	Revenue	Liquidity	Interest Cover
Cash holdings	1	0.798	0.666	-0.022	-0.024
Cash flow		1	0.904	-0.029	0.009
Revenue			1	-0.031	0.005
Liquidity				1	0.008
Interest Cover					1

Source: Author

Table 5 – Private capital companies' variables correlation (n = 325)

	Cash holdings	Cash flow	Revenue	Liquidity	Interest Cover
Cash holdings	1	0.544	0.619	0.043	0.001
Cash flow		1	0.602	-0.017	0.004
Revenue			1	-0.035	0.001
Liquidity				1	-0.170
Interest Cover					1

Source: Author

4.2 Econometric Results

The degree of multicollinearity was evaluated using the variance inflation factor (VIF), and we can conclude that multicollinearity is not large enough to bring consequences to the models, according to Gujarati (2006), since all values are less than 10 (see Table 6). Residual analysis tests were performed for homoscedasticity (White test) and for serial correlation (Breusch-Godfrey test). As heteroskedasticity was detected, all models have robust standard errors. There is no serial correlation in the errors, which was expected by the presence of the past variable response in the model.

Table 6 – Variance Inflation Factor (VIF) for public and private capital companies

Variables	Total	Public Capital	Private Capital
Revenue/Assets	4.24	5.66	3.65
Revenue t-1/Assets	4.08	5.33	3.49
Cash holdings t-1/Assets	1.07	1.26	1.10
Cash flow/Assets	1.04	1.11	1.10
Liquidity	1.03	1.05	1.06
Interest Cover	1.02	1.03	1.03
Ln Total assets	1.00	1.00	1.00
Number of observations	616	291	325

Results from the two-stages GLS using random effects and robust errors estimation are shown on Table 7. With 5% of significance, results diverged from the expected, with cash flow being significant for both private and public capital companies. Revenues lagged one period, interest cover and some dummies for each primary sector were also relevant.

The results are different than the ones found by Ghani, Martelanc and Kayo (2015). The authors used a sales accelerator model, with investments as the dependent variable, and found no significance for neither private nor public capital companies regarding cash flow, concluding there is no difference in credit constraints between private and public capital Brazilian companies.

Looking at the coefficients, it is econometrically correct to state that cash holdings are more relevant for public companies than for the private ones, given the companies dummy coefficient is higher than the cash holdings coefficient, and both are positive. In practical terms, this means that the higher cash flow is the higher cash holdings will be for both groups, but for the same amount of cash flow, public capital companies would retain a greater amount of cash than private capital companies. Following the literature review, it could be argued that public capital companies are the ones with higher credit restrictions.

Table 7 – Econometric Results.

Variables	Coefficient		Std. Err.	Coefficient		Std. Err.
Cash flow/Assets	0.024	**	0.010	0.029	***	0.007
Dummy Public Cash Flow/Assets	0.043	**	0.020	0.050	**	0.028
Revenue/Assets	-0.016	*	0.008	-0.008	**	0.004
Revenue t-1/Assets	0.018	**	0.008	0.014	***	0.004
Liquidity	0.001		0.001	0.001	***	0.000
Interest Cover	-0.00002	**	0.00001	-0.00002	*	0.000
Ln Total assets	-0.0001		0.001	0.001		0.001
Cash holdings t-1/Assets	0.810	***	0.052	0.697	***	0.013
Company	Yes			Yes		
Year	No			Yes		
Sector	Yes			Yes		
R²	0.644			0.684		
Number of companies	616			616		
Number of observations	2464			2464		

Note: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard erros.

Source: author

In order to strengthen the findings, two new models were estimated, this time separating public and private capital companies, having cash holdings/assets as the dependent variable and cash flow/assets as the independent one added all the control variables. The results are shown on Table 8. They are aligned with the findings coming from Table 7. The variable cash flow coefficient is higher for public capital companies and statistically significant at 1% only for this group.

Table 8 – Econometric Result Segregating Public and Private Capital Companies.

Variables	Public		Private	
	Coefficient	Std. Err.	Coefficient	Std. Err.
Cash flow/Assets	0.064 ***	0.014	0.016	0.009
Revenue/Assets	-0.017 *	0.007	0.001	0.004
Revenue t-1/Assets	0.019 **	0.006	0.011 ***	0.004
Liquidity	0.0002	0.0002	0.019 ***	0.001
Interest Cover	-0.00002 **	0.00002	0.0001	0.0001
Ln Total assets	0.0001	0.001	0.001	0.001
Cash holdings t-1/Assets	0.812 ***	0.016	0.535 ***	0.018
R²	0.740		0.618	
Number of companies	291		325	
Number of observations	1164		1300	

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard erros.

Control variables: Company, year and sector

Source: author

In addition to the explicit findings shown above, Almeida, Campello and Weisbach (2004) point that in a period of recession, financially unconstrained firms should see no systematic changes in their cash levels. Considering that the models use data from 2012 to 2016, but due to lagged instruments most of the 2012 and 2013 information was not considered, it would be statistically coherent to say that public capital companies are more credit constrained than private capital ones, given the estimation summarized in Table 7 resulted in a higher coefficient for public capital companies' cash flow, while the second estimation resulted in their cash level depending on cash flow during a period of recession (years 2015 and 2016), while private capital companies' cash level did not. Nevertheless, it is important to consider the particularities of the Brazilian capital market that might have contributed to these unexpected results.

The results diverged from expected not simply because the cash flow variable was relevant for public capital companies, but mostly because in the estimation with separated samples this variable was not relevant for private capital companies, suggesting they would have higher access to financing sources, either as equity or debt.

Regarding the differences in each one of the groups, the public capital companies are bigger, on average, than the private capital ones, therefore, two heterogeneous groups where compared. Nevertheless, the regression generated results with control variables were equally significant for private and public capital companies, indicating that despite being different, the groups are still under several similarities.

As discussed in Heckman et al. (1998) and Zhao (2004), one of the ways to eliminate the selection bias is by matching the firms; i.e. for each public capital company we select a private capital company with similar characteristics to construct the control group. This is done with the use of the propensity score matching procedure, using size (ln total assets) and sector to perform the pairs. It was not possible to pair all the public and private capital companies because the distance between the pair is too high (more than 10% below or above the propensity score of the public capital company), then it was necessary to discard 29 public capital companies and 63 private capital companies, resulting in a sample of 524 paired companies (262 of each type). Evaluating the matching, a t-test was used to compare the means of size for public and private capital paired companies, and it indicates the similarity of the size groups (p-value is 0.29). The sector criteria was perfectly matched.

Table 9 – Econometric Result Using Propensity Score Matching.

Variables	All			Public Capital			Private Capital		
	Coefficient		Std. Err.	Coefficient		Std. Err.	Coefficient		Std. Err.
Cash flow/Assets	0.044	***	0.009	0.055	***	0.012	0.039	*	0.023
Dummy Public Cash Flow/Assets	0.023	**	0.012						
Revenue/Assets	-0.008	*	0.004	-0.004		0.005	-0.015	*	0.007
Revenue t-1/Assets	0.017	***	0.004	0.016	***	0.005	0.023	***	0.007
Liquidity	0.009	***	0.001	0.019	***	0.002	0.005	***	0.001
Interest Cover	-0.00002		0.00002	0.0001		0.0001	-0.00002		0.00002
Ln Total assets	0.002		0.001	0.001		0.001	0.002	*	0.001
Cash holdings t-1/Assets	0.675	***	0.015	0.543	***	0.023	0.765	***	0.020
R^2	0.621			0.504			0.738		
Number of companies	524			262			262		
Number of observations	2096			1048			1048		

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard erros.

Control variables: Company, year and sector

Source: author

Lastly, the same model applied previously was used in the new sample built through the propensity score matching procedure. As evidenced in Table 9, similar results were observed. When using a dummy to discriminate public capital companies from the private capital ones, cash flow was statistically significant for both groups, with a positive coefficient for the public capital companies dummy suggesting their cash levels tend to be more sensitive to cash flow than private capital companies' cash levels. In addition, when applying the model to separated samples, public capital companies presented a significant and higher coefficient for cash flow than the private capital ones, a result also in line with what was shown in Table 7 and Table 8.

Although all, different methods generated convergent results, nevertheless, these estimates are not enough to conclude that in, general terms, Brazilian public capital companies face more credit constraints than private capital ones. Two important points might be behind the findings: economic recession hitting harder on public capital companies and credit distortions coming from BNDES.

The descriptive analysis shows that during the 2016 economic recession, public capital companies' revenues went back to levels below 2012 results, while private capital companies also faced a decrease, but not big enough to generate a negative growth between 2012 and 2016. This might have led to private capital companies having access to a broader pool of financing options as opposed to the public company group.

The second point addresses a particularity of the Brazilian credit market. According to Lazzarini et. al (2014) the Brazilian National Development Bank (BNDES) is one of the largest development banks in the world. Studying the impacts of the bank's loans and equity investments, the authors concluded that BNDES tends to lend resources to well politically connected firms, who for their part, do not show enhancements in performance. Thus, we can not rule out the possibility that distortions coming from BNDES's operation might have contributed to the findings in this paper. One could assume that if it were not for BNDES`s effects, both private and public capital companies would have faced credit constraints. However, it is important to highlight that credit offer has continuously decelerated in the period analyzed in this study as data from the Brazilian central bank summarized in Figure 1 shows.

Figure 1 – Private and Public credit growth month over month
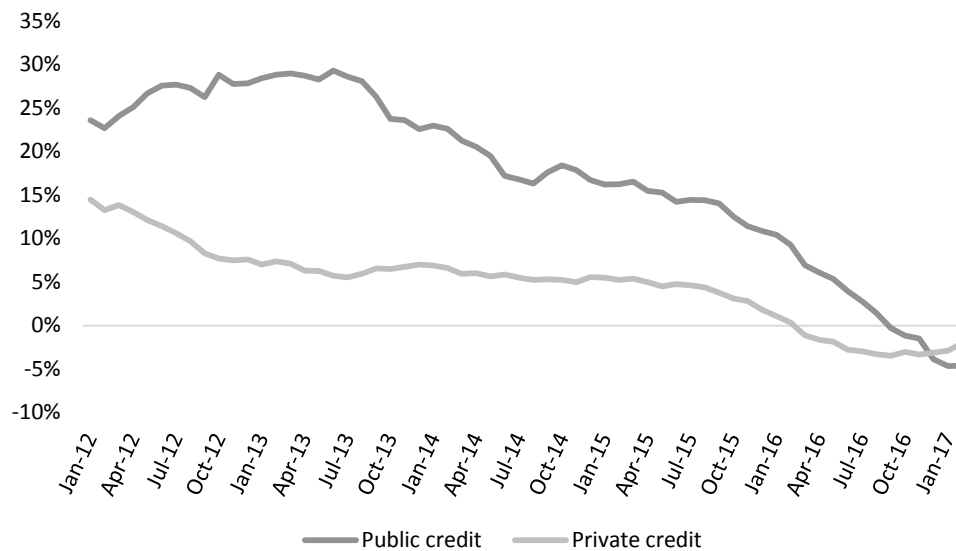
Source: BACEN

With a simple preliminary analysis over BNDES`s database available on its website, it is possible to verify that 1,437 companies received some kind of non-pre-approved credit line between 2012 and 2016. Considering the number of public Brazilian capital companies, around three quarters of these BNDES credit operations were directed to private capital firms. Combining BNDES's information with this study's results, it is reasonable to point that the development bank's behavior might be behind the distortions found in the Brazilian credit market between 2012 and 2016, when comparing public and private capital companies.

5   CONCLUSION

This study aimed to investigate whether Brazilian private capital companies face more credit constraints than public capital ones, using a sample of 616 Brazilian companies, with financial data from 2012 to 2016. Using a cash flow sensitivity of cash model combined with a propensity score matching procedure in order to avoid selection bias in the study's sample, econometric results opposed to initial assumptions. The study generated evidence that public capital companies face more credit constraints than private capital ones, which might refute several academic theories, as the idea that higher levels of disclosure lead to lower costs of capital. The credit constraint factor took as a proxy the dependency between cash holdings and cash flow.

The reasons behind results might be due to two reasons: public capital companies facing higher levels of financial distress during the 2015-2016 economic recession plus BNDES funding creating distortions in the Brazilian credit market. Nevertheless, this paper represents a contribution in the sense that the belief that public capital companies have higher access to both equity and debt as their private counterparts might not be true under certain conditions.

One potential limitation, as Ghani, Martelanc and Kayo (2015) have pointed out, is that private equity groups may be blurring the analysis, injecting liquidity into Brazilian private companies; this possibility was not contemplated by this study.

Differences in credit access between private and public capital companies is still an insufficiently studied subject in Brazil, and as this work has shown, interesting particularities of the country might be generating unexpected results. Therefore, future studies should focus on

including such variables as BNDES loans, in order to control the impact the development bank might have.

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