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The Effects of Financial Constraints on Cash Management: A Study with Private Firms of the Brazilian Sugarcane Industry

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ABSTRACT

Objective: The objective of this study is to analyze the effects of the financial constraints on cash management of the Brazilian sugarcane industry.
Method: Fixed-effects panel regression was employed as research method, in which the financial statements of 48 private firms between 1998 and 2016 were analyzed.
Originality/Relevance: Managing the cash holdings is one of the central activities of a manager, because it is through cash that organizations balance their current and future resource needs, and this decision-making process is challenging, especially in emerging markets and in private firms, where financial market constraints restrict the availability and credit flow to economic activities.
Results: The results indicate that, on average, in financially constrained firms, a construct captured by size and age criteria, maintain higher percentages of their assets in cash than unconstrained firms. This result is statistically significant and consistent with precautionary motives, in which financially constrained firms manage their cash holdings in order to circumvent uncertainties in the macroeconomic environment.
Theoretical contributions: This article contributes to the literature by providing evidence on the effects of financial constraints on cash management in a context of scarcity of studies with private companies and in emerging markets.

Keywords: Agribusiness; Financial crisis; Liquidity.

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1 INTRODUCTION

Considering that firms operate in a market that is far from perfect (Bigelli & Sánchez-Vidal, 2012), financial constraints play an essential role in their managerial policies and is often a recurrent topic of discussion among managers (Beck, Demirgüç-Kun, Laeven & Maksimovic, 2006; Farre-Mensa & Ljungqvist, 2016). The informational asymmetry in line with high agency costs means that the availability of resources offered is lower and, at the time of its existence, the interest rates charged may be prohibitive (Jensen & Meckling, 1976).

Moreover, when the market fails to distinguish between good and bad investment opportunities, then the problem of adverse selection arises (Akerlof, 1970). Thus, considering that the cost of obtaining external financing is higher than using internally generated cash flows, external funds cannot be considered as an ideal substitute (Myers, 1977; Myers & Majluf, 1984).

In companies operating in less developed financial markets, these constraints can be even greater (Carreira & Silva, 2010). The Brazilian market, considered as emerging and less developed, is known by the difficulty in attracting funding sources due to the high interest rates which, in turn, limit access to external financing (Crisóstomo, Iturriaga & González, 2013). Nevertheless, the financial constraints on private firms can be even greater, since, in comparison to public companies, they do not have access to all the tools for obtaining resources from the capital market (Beck, Demirguc-Kunt, & Maksimovic, 2008).

As a result, firms located in countries like Brazil, especially private firms, are expected to be more dependent on the availability of internally generated resources and self-funding (Beck *et al*., 2008). Therefore, companies with financial obstacles must manage their cash in a way that balances the profitability of current investments without rendering future investments impossible and turns their existence unfeasible (Han & Qiu, 2007). Furthermore, cash reserves can mitigate the effects of financial obstacles, allowing organizations to invest closer to the first best level (Luo, 2011).

The management of the cash balances of Brazilian privately held firms, as a relevant component of the financial structure (Acharya, Almeida & Campello, 2007), should be planned in order to minimize the effects of financial obstacles (Almeida, Campello & Weisbach, 2004). This fact occurs because the demand of financially constrained and privately held firms by cash is greater given the precautionary motives (Hall, Mateus & Mateus, 2014) and because this asset is more valuable to them (Faulkender & Wang, 2006).

Most of the existing evidence in the literature about financial constraints deals with public companies. Furthermore, private firms have important differences compared to the public ones, such as lower capital dispersion, different governance and compensation structures (Ball & Shivakumar, 2005). Consequently, the efforts made so far with public companies cannot be applied directly to privately held firms. In order to fill this gap and increase the understanding about the effects of financial constraints in cash management, this research focuses specifically on the private firms of the Brazilian sugarcane industry.

Despite the importance of the sugarcane industry, the industry is experiencing one of its worst financial crises (Manoel, Eça & Moraes, 2016). Between January and October of 2014, according to recent data from Neves, Kalaki, Trombin and Rodrigues (2014), 62 economic groups either closed down or filed for bankruptcy protection. Sant'anna, Shanoyan, Bergtold, Caldas and Granco (2016) attribute this scenario to the context of recession of the gasoline price regulation by the previous Brazilian government in order to control inflation, increasing the debt of this industry since prices were artificially low.

By analyzing the explanatory notes of the sample used, it was verified that the financial obstacles and the reflexes of the crisis were recurrent factors mentioned by them. Firms have pointed, as the main effects of the crisis context, a reduction in investment capacity and the inability to take advantage of growth opportunities. Therefore, financial constraints and the crisis represent a generalized concern for the Brazilian sugarcane industry.

Moreover, the lack of access to timely funding sources may prevent firms from taking advantage of profitable investment opportunities (Luo, 2011) or even turning into solvency problems. This means that the sugarcane industry may be below its real capacity for growth and cannot provide greater contribution to the Brazilian economy. Consequently, exploring the effects of financial constraints on the sugarcane industry could show the informational asymmetry between organizations and investors as one of the root causes of constraints on funding sources. The increase in defaults can result in greater difficulties in access to credit, such as higher risk premiums. This, in turn, can cause lenders to reduce the access to credit, especially for financially constrained companies.

It is also worth noting that the mills and distilleries account for more than 60% of the supply of their main raw material, sugar cane. From the formation of sugar cane plantations, it is possible to explore them annually for more than seven years, which makes investments in agricultural areas strategic to companies in times of higher production and land costs. The productivity rate of this biological asset declines over time, which further reaffirms the continued need for new investments as a way of ensuring the sustainability of the industry (Manoel, Moraes, Santos & Neves, 2017).

Consequently, firms that do not have enough cash in a timely manner or do not have shareholders willing to invest more resources can miss valuable investment opportunities. On the other hand, this reality could be mitigated from cash management policies aimed at reducing the problems arising from market imperfections.

In this way, the research question of this article is:

What are the effects of financial constraints on cash management in the Brazilian sugarcane industry?

Seeking to answer the research question, this study has the following objective: analyze the effects of the financial constraints on cash management of the Brazilian sugarcane industry.

For this purpose, a unique hand-collected panel data of 48 privately held firms of the industry was analyzed from 1998 to 2016. The results obtained indicate that firms with financial obstacles, a construct captured by firm size and age, hold more cash than the unrestricted ones. This result is consistent with the previous literature, in which financially constrained firms save cash due to precautionary motives, see the studies of Almeida *et al*. (2004) and Opler, Pinkowitz, Stulz and Williamson (1999) and especially with the findings in the agribusiness literature, such as Manoel *et al*. (2017) and Trejo-Pech, Gunderson, Baker, Gray and Boehlje (2015).

The practical effects of the discussion about the effects of financial constraints in the cash management are of great relevance for the sugarcane industry, not only for financial managers, but also for investors, pension funds, financial institutions and suppliers. Whereas the availability of timely financing sources is a recurring factor in the sugarcane industry and in the Brazilian context itself, the cash policies of these firms should be directed to circumvent their financial constraints. Financially constrained firms grow less, have lower growth rates, and use more their cash reserves (Campello, Graham & Harvey, 2010). Hence, despite its relevance for the Brazilian economy, the industry may be short of a greater contribution to the economy.

Furthermore, only few studies, such as Bigelli and Sanchez-Vidal (2012), Hall *et al*. (2014) and Manoel *et al*. (2017), investigated cash holdings in private firms. Nevertheless, none of them analyzed the effects of financial constraints on cash management in a specific industry. In this way, this study contributes to the financial constraints and cash holdings literature by providing evidence on the effects of financial restrictions on cash management in a context of scarcity of studies with private firms and in emerging markets. Despite the economic and social importance of privately held companies, studies with them have been neglected in the literature due to the lack of comprehensive data.

Secondly, this paper also contributes to the literature by showing that mills and distilleries of the Brazilian sugarcane industry, in order to rebuild their cash reserves during the international financial crisis (subprime crisis), have increased their average level of short-term debt. This fact, however, can be considered as alarming and may have even, ceteris paribus, contributed in parts with the current scenario of recession in the industry, since short-term sources are generally costlier. Finally, this research seeks to contribute with managers to have a more accurate decision-making process and balancing the effects of financial constraints on cash management, mitigating the cases of bankruptcy that are afflicting this industry and the Brazilian economy.

The research is organized as follows: in section 2, the hypothesis is developed; in section 3, the data used are detailed, the econometric model is presented as well as explained the criteria used in the classification of firms between constrained and unconstrained; section 4 is devoted to the presentation of descriptive statistics and model assumptions; in section 5 the obtained results are discussed; finally, section 6 is dedicated to the final considerations.

2 HYPOTHESIS DEVELOPMENT

The effects of financial constraints on firms' investment decisions have received considerable attention from the literature (Lyandres, 2007). A firm can be considered as financially unconstrained if it has enough financing capacity to make the first-best investments now or in the future, regardless of the realization of the future cash flow (Han & Qiu, 2007). In other words, this construct can be understood, according to Fazzari, Hubbard and Petersen (1988) and Kaplan and Zingales (1997), as a wedge between the internal and external costs of funds, in a manner that the larger the wedge, the more restricted is a company.

This wedge may preclude firms from investing in projects that would be profitable if they were financed only with internal funds (Lyandres, 2007). Thus, due to informational asymmetry, agency and transaction costs, external funds cannot be considered an ideal substitute for resources generated internally in an imperfect market (Myers, 1977; Myers & Majluf, 1984).

If companies were in a perfect market with unrestricted access to external funds at an interest rate compatible with their opportunity cost, there would be no need for them to protect themselves against adverse market conditions, which would make the management of cash balances irrelevant. In contrast, considering that firms operate in an imperfect market, financial constraints turn the management of the cash reserves as a key issue (Almeida *et al*., 2004), since external funds cannot be obtained on fair terms (Drobetz, Grüninger & Hirschvogl, 2010). In this sense, Harford (1999) points out that the cash holdings are a tool that firms can use to circumvent the problems arising from market imperfections.

The lack of access to the stock market makes private firms more dependent on bank loans and financing (Beck *et al*., 2006; Bigelli & Sánchez-Vidal, 2012). Furthermore, the credit lines allocated to private firms are generally costlier (Campello, Giambona, Graham &

Harvey, 2011), which suggests that the level of their financial constraints should be higher and the access to external financing is more difficult compared to public companies (Bigelli & Sánchez-Vidal, 2012).

Nonetheless, financial constraints in agribusiness can be even greater, since that the agroindustry is capital-intensive, investments occur much before sales can happen (due to the time taken to harvest some crops after planting) and, not infrequently, organizations cannot invest in projects that are considered profitable only with their own resources (Hartarska & Nadolnyak, 2012). The evidence obtained by Beck *et al*. (2006) corroborates this fact, since their results indicate that, on average, agricultural companies report larger financing constraints.

Denis and Sibilkov (2010) and Luo (2011) highlighted the management of cash balances to mitigate the adverse effects of financial constraints, so that in the absence and/or insufficiency of the cash flows and external funds in a timely manner, the cash reserves can be of great value to companies. According to this view, financially constrained organizations are more likely to accumulate higher percentage of total assets in cash, as a buffer against possible adverse conditions (Almeida *et al*., 2004; Campello *et al*., 2010; Harford, 1999; Keynes, 1936; Opler *et al*., 1999).

This article has the following research hypothesis:

H1: Financially constrained mills and distilleries maintain a higher percentage of their total assets in cash in comparison to unconstrained ones.

3 RESEARCH METHODOLOGY

3.1 Sample

The annual financial statements of 48 privately held firms from the Brazilian sugarcane industry over the 1998 to 2016 period was employed. The choice of this period occurred according to availability of data and sought to analyze the longest possible period. The data are nominal and were hand-collected from the websites of the firms and their publications in the Official Journal of Brazilian Government.

When analyzing Table 1, it was verified that initially 912 observations were expected, given the use of a panel data with 48 firms over a period of 19 years. However, 266 observations presented missing data and some firms did not disclose their financial statements over the whole period. Finally, the observations (53) that presented negative equity were also removed, following Bigelli and Sánchez-Vidal (2012) recommendations.

Table 1
Research Sample

1998-2016	Firms	Observations
Total	48	912
(-) Companies with missing values		-266
(-) Companies with negative Equity		-53
(=) Final sample	48	593

Thus, the final sample was composed of 48 firms in a total of 593 observations.

3.2 Description of the Variables

3.2.1 Dependent Variable

The dependent variable of this study, following Manoel, Moraes, Nagano and Sobreiro (2018) and Opler *et al*. (1999), was obtained by the natural logarithm of the sum of the cash and cash equivalents scaled by the net assets (total assets minus cash and cash equivalents), that is, Natural log of (Cash/Net Assets).

3.2.2 Financial Constraints Criteria

One of the central points of the studies about financial constraints is the search for proxies that can actually capture this construct, since the degree of financial constraint that a firm faces is not directly observable. Furthermore, there is no consensus in the literature on which proxy is the best (Denis & Sibilkov, 2010). Therefore, to answer if a firm is financially constrained or not require reasonable ways of classifying it, so that if it is not possible to ask managers directly about this fact, as in Campello *et al*. (2010), studies depend on indirect proxies, such as credit rating and dividend payment, or a combination of indicators based, for example, on size, age and leverage that try to capture this construct (Farre-Mensa & Ljungqvist, 2016).

Beck *et al*. (2006) obtained evidence that firm size and age are robust proxies to test the effects of financial obstacles. Their results indicated that, on average, larger and older firms are less financially constrained since larger and older firms are generally better known in the market and have more information available to stakeholders (Beck *et al*., 2006; Denis & Sibilkov, 2010). In the same way, Hadlock and Pierce (2010) assert that firm size and age seem to be closely related to this construct. Nevertheless, the authors still mention that both are less endogenous than the other proxies used in the literature. Hadlock and Pierce (2010) suggested that the researchers depend solely on these two criteria in the identification of restricted firms. Finally, Hartarska and Nadolnyak (2012) state that newer firms from farming have limited ability to undertake profitable investment with only their own funds.

For that reason, given the theoretical assumptions presented, this study used firm size and age to identify the financially constrained firms. To that end, the firms classified in the first quartile of the year-to-year distribution of the variables size and age, measured respectively by the natural logarithm of total assets and the firm's years of life, were classified as financially constrained and, if they were in the last quartile, as financially unconstrained. The use of the 1st (restricted) and 4th (unrestricted) quartile for size and age followed the articles of Han and Qiu (2007) and Manoel and Moraes (2018), respectively.

3.2.3 Control Variables

The following control variables were used in this study: Net Working Capital (NWC), Short-Term Debt (STD), Current Liquidity (CL), Size, Leverage (Lev), Return on Equity (ROE), Subprime and Brazilian Crises.

The change in the Net Working Capital was controlled because the NWC is easily converted into cash and because it is considered as a substitute for cash reserves (Opler *et al*., 1999), both in public and private companies (Bigelli & Sánchez-Vidal, 2012). Like NWC, the theoretical assumptions presented by Almeida *et al*. (2004) suggested that changes in short-term debt can replace the cash balances, since firms can increase their short-term debt as a way of constructing cash reserves. Furthermore, Al-Najjar (2013) argues that the costs of converting liquid assets into cash are lower. Therefore, we also included the variable Current Liquidity.

The justification for size, in turn, is due to the economy of scale in cash management (Almeida *et al*., 2004). To control firm size, therefore, the natural logarithm of total sales was employed (Acharya *et al*., 2007). It was also controlled by leverage, since more leveraged firms need to save larger percentages of their cash holdings as a way of paying off their debt in the future due to the greater likelihood of financial distress (Han & Qiu, 2007; Ozkan & Ozkan, 2004). In terms of profitability, Al-Najjar (2013) pointed out that the most profitable firms are more likely to pay their debts and stock cash. Consequently, it is expected that organizations with higher Return on Equity maintain higher cash balances.

Finally, two dummies in the econometric model were included to control the effects of the subprime financial crisis (2008 and 2009) and the recent crisis in the Brazilian economy and sugarcane industry itself (2014 and 2015). In periods of recession, financially constrained firms should save a larger portion of their cash flows and should be more affected than the unconstrained ones, which, in turn, should not show systematic changes (Almeida *et al*., 2004). Therefore, it was decided to control the effects of the two crises using two binary variables.

3.3 Econometric Model

To analyze the collected data, the regression model with panel data was used, through an unbalanced panel. The proposed econometric model follows:

$$CASH_{it} = \beta_i + \beta_1 NWC_{i,t} + \beta_2 STD_{i,t} + \beta_3 CL_{i,t} + \beta_4 Size_{i,t} + \beta_5 Lev_{i,t} + \beta_6 ROE_{i,t} + \beta_7 Subprime\ Crisis_{i,t} + \beta_8 Brazilian\ Crisis_{i,t} + \epsilon_{i,t} \quad (1)$$

$Cash$ = Cash and Cash Equivalents, obtained by the Natural Logarithm of the sum of Cash and Cash Equivalents, divided by Net Assets (Total Assets minus Cash and Cash Equivalents), that is, Natural log of (Cash/Net Assets);

NWC = Net Working Capital, obtained by subtracting Current Assets by Current Liabilities, and the resulted value divided by Net Assets;

STD = Short-Term Debt, obtained by the division of Total Short-Term Debts, so that the resulting value was divided by the sum of Equity and Liabilities;

CL = Current Liquidity, obtained by the division of Current Assets by Current Liabilities;

$Size$ = Size, obtained by the natural logarithm of Total Sales;

Lev = Leverage, obtained by the sum of Total Short-Term Debts with Total Long-Term Debt, and the resulting value was divided by Net Assets;

ROE = Return on Equity, obtained by the division of Net Income by Equity;

$Subprime\ Crisis$ = Subprime Crisis, binary variable that assumes the value 1 for the years 2008 and 2009 and 0 otherwise;

$Brazilian\ Crisis$ = Brazilian Crisis, binary variable that assumes the value 1 for the years 2014 and 2015 and 0 otherwise;

ϵ = Forecast error.

4 RESULTS

4.1 Descriptive Statistics

Table 2 presents the descriptive statistics of the sample used. The average (median) cash level of the firms classified as financially constrained, for both criteria, is higher than the unconstrained ones, with this level of 11.1% (3.7%) and 10.5% (3.6%) respectively for firm size and age. On the other hand, financially unconstrained organizations presented an average (median) cash level of 9.5% (6.3%) and 7% (4.1%) for size and age criteria, respectively. Furthermore, as in the paper of Denis and Sibilkov (2010), the standard deviation of the cash holdings of financially constrained firms is higher than for unconstrained ones.

Table 2
Summary Statistics of Constrained and Unconstrained firms

		Size		Age	
		Constrained	Unconstrained	Constrained	Unconstrained
Cash/Assets	Mean	0.111	0.095	0.105	0.070
	Median	0.037	0.063	0.036	0.041
	Standard Deviation	0.169	0.093	0.146	0.094
	Minimum	0.000	0.001	0.000	0.000
	Maximum	0.736	0.442	0.736	0.478
Net Working Capital	Mean	0.193	0.096	0.100	0.000
	Median	0.042	0.090	0.030	-0.041
	Standard Deviation	0.542	0.223	0.460	0.255
	Minimum	-0.562	-0.499	-0.937	-0.499
	Maximum	2.858	1.092	2.858	1.092
Short Term Debt	Mean	0.136	0.125	0.158	0.153
	Median	0.112	0.117	0.133	0.154
	Standard Deviation	0.116	0.085	0.126	0.099
	Minimum	0.000	0.000	0.000	0.000
	Maximum	0.529	0.592	0.838	0.592
Current Liquidity	Mean	2.076	1.699	1.407	1.237
	Median	1.116	1.399	1.095	0.825
	Standard Deviation	3.257	1.506	1.255	1.588
	Minimum	0.119	0.099	0.041	0.071
	Maximum	26.214	14.516	8.771	14.516
Leverage	Mean	0.361	0.396	0.420	0.386
	Median	0.344	0.374	0.412	0.381
	Standard Deviation	0.212	0.167	0.214	0.194
	Minimum	0.001	0.051	0.001	0.010
	Maximum	0.948	0.775	0.891	0.802
ROE	Mean	-0.325	-0.039	-0.184	-0.226
	Median	0.063	0.097	0.056	0.052
	Standard Deviation	2.339	1.697	1.740	2.213
	Minimum	-25.898	-20.660	-20.660	-25.898
	Maximum	0.892	3.437	0.875	3.437

Unreported results also indicated that there is a statistically significant difference between the means (t-tests) at the 5% level of financially constrained and unconstrained groups, either by size or age criteria. The larger mills and distilleries, therefore, can take advantage of economies of scale in the management of cash balances due to the transactional motive, as pointed out by Harford (1999) and Opler *et al*. (1999), and consequently, have lower levels. Older firms, in the same way, are better able to manage their cash balances over

time or even to be more recognized on market and have easier access to funding sources, which, in turn, allows them to keep lower cash levels over the years.

In this way, the results obtained are consistent with the precautionary motives playing an important role in the understanding of the cash management of companies (Almeida *et al*., 2004; Hadlock & Pierce, 2010; Opler *et al*., 1999), especially for those of the agroindustry (Manoel *et al*., 2017; Trejo-Pech *et al*., 2015), in which financially constrained firms hold more cash than the unconstrained ones.

Other results also indicated that the overall average cash and cash equivalents in relation to total assets is 9.01%, representing 13.23% of Net Assets. This percentage is higher than the 10% found by Bigelli and Sánchez-Vidal (2012) in their study with privately held Italian firms, in the same way as the one obtained in the Agriculture, Hunting and Forestry industry subdivision, which had a net average level of 8.8%. It is also observed that the average cash level for firms classified as financially constrained by size, through Table 3, in the year prior to the Subprime Crisis (2007) was 14.22%. However, in the following year, there was a reduction of 42%.

The firms classified in the same group by age criteria presented a reduction of 45.16% in average cash levels in 2006 (12.09%) in relation to 2007 (5.46%), and maintained similar percentages during the years of crisis, returning to increase significantly only in 2010. Therefore, the cash holdings of the financially constrained fell significantly. The financially unconstrained organizations, in turn, did not show a reduction in their cash levels, even reaching the point of unconstrained by age criteria to increase their cash levels in the year 2007 (3.82%) in relation to 2008 (9.44%).

Table 3 shows that firms, especially those classified as financially constrained, increased their short-term debt in the years of the subprime crisis compared to the previous years. This result is consistent with the assumptions presented by Almeida *et al*. (2004), that firms can increase their short-term debt levels to raise or rebuild its cash reserves.

The agribusiness firms did not have cash reserves in a timely manner, the profitability was negative and the only way to maintain their level of activity was by contracting short-term debt, given the restriction of long-term debt lines in the Brazilian market. This fact can be considered as alarming, since that the short-term debt is usually costlier, and organizations turn to this source when cash reserves and cash flows are insufficient to honor their commitments.

Thus, the first evidence obtained by the descriptive statistics indicates that the subprime crisis seems to have affected the cash management of the industry. Hence, it is suggested that financially constrained firms had to use their cash reserves to maintain their operation, while those classified as financially unconstrained by age criteria increased their cash levels as a precaution to the context of uncertainty.

In the case of the most current crisis in the Brazilian sugarcane industry and in the Brazilian economy itself, pointed out by Neves *et al*. (2014) as one of the worst crises in industry history, the results of the descriptive statistics for the four groups indicate that the cash levels were approximately similar in the year prior to the crisis. Nevertheless, Table 3 shows that there was a lower increase in short-term debt of financially unconstrained firms by size criteria when compared to the subprime crisis to maintain percentages similar to previous years. Therefore, these initial results indicate that the effects of the entire context of uncertainty of the crisis does not seem to have affected the cash management of these firms.

Table 3
Average values over the period

Size

	Constrained							Unconstrained					
Year	CASH	NWC	STD	CL	LEV	ROE	Year	CASH	NWC	STD	CL	LEV	ROE
1998	0.12	0.17	0.20	1.20	0.36	-4.34	1998	0.06	0.07	0.26	1.18	0.44	-0.19
1999	0.12	0.20	0.17	1.37	0.42	-0.15	1999	0.02	0.00	0.20	1.02	0.40	-0.03
2000	0.09	0.11	0.15	1.28	0.32	0.06	2000	0.03	0.01	0.12	1.63	0.35	0.53
2001	0.11	0.21	0.06	1.78	0.26	-0.36	2001	0.09	-0.01	0.16	0.92	0.38	0.05
2002	0.15	0.32	0.04	1.93	0.21	-0.07	2002	0.11	0.06	0.15	1.27	0.41	0.25
2003	0.13	0.41	0.04	2.09	0.18	0.21	2003	0.12	0.21	0.14	2.87	0.34	0.08
2004	0.17	0.52	0.09	5.25	0.30	0.09	2004	0.12	0.27	0.10	2.68	0.35	0.02
2005	0.19	0.58	0.05	5.03	0.33	-0.03	2005	0.07	0.08	0.08	1.55	0.30	0.18
2006	0.20	0.40	0.08	3.31	0.31	0.12	2006	0.09	0.12	0.05	1.85	0.26	0.17
2007	0.14	0.25	0.15	2.50	0.45	-0.03	2007	0.08	0.12	0.09	1.82	0.44	0.04
2008	0.08	0.11	0.20	1.51	0.41	-0.09	2008	0.08	0.04	0.13	1.30	0.45	-0.06
2009	0.06	0.03	0.20	1.16	0.46	0.04	2009	0.07	0.05	0.10	1.36	0.40	0.15
2010	0.13	0.04	0.15	1.49	0.40	0.07	2010	0.12	0.10	0.11	1.84	0.38	0.19
2011	0.09	0.04	0.15	1.57	0.38	-0.09	2011	0.11	0.07	0.11	1.60	0.39	0.11
2012	0.07	0.00	0.16	1.42	0.31	-0.13	2012	0.09	0.07	0.10	1.79	0.43	0.04
2013	0.05	0.14	0.17	1.69	0.43	-0.46	2013	0.13	0.08	0.13	1.64	0.47	-0.04
2014	0.05	-0.03	0.19	1.40	0.45	-0.19	2014	0.12	0.08	0.13	1.71	0.49	-2.59
2015	0.05	-0.04	0.20	1.18	0.46	-1.33	2015	0.14	0.13	0.13	1.81	0.45	0.08
2016	0.09	0.16	0.15	1.77	0.42	0.28	2016	0.17	0.32	0.11	2.44	0.44	0.24

Age

	Constrained							Unconstrained					
Year	CASH	NWC	STD	CL	LEV	ROE	Year	CASH	NWC	STD	CL	LEV	ROE
1998	0.11	0.15	0.18	1.14	0.34	-0.18	1998	0.12	0.13	0.25	1.35	0.39	-3.34
1999	0.09	0.14	0.14	1.26	0.31	-0.13	1999	0.07	0.08	0.18	1.28	0.32	0.04
2000	0.10	0.10	0.11	1.32	0.25	0.08	2000	0.07	0.03	0.15	1.65	0.33	0.48
2001	0.15	0.15	0.10	1.51	0.25	-0.14	2001	0.10	0.05	0.16	1.17	0.34	-0.04
2002	0.17	0.29	0.08	1.74	0.28	0.10	2002	0.14	0.20	0.11	1.54	0.29	0.20
2003	0.15	0.34	0.09	1.77	0.28	0.16	2003	0.07	0.08	0.13	2.41	0.27	-0.18
2004	0.13	0.37	0.09	2.27	0.28	0.21	2004	0.07	0.07	0.13	1.88	0.25	-0.19
2005	0.15	0.42	0.08	2.18	0.29	0.05	2005	0.05	0.02	0.11	2.05	0.27	-0.08
2006	0.12	0.21	0.10	2.26	0.30	0.15	2006	0.03	-0.04	0.09	1.03	0.23	0.04
2007	0.05	-0.02	0.18	1.11	0.49	-0.01	2007	0.04	0.01	0.12	1.21	0.44	-1.02
2008	0.05	-0.12	0.26	0.85	0.62	-0.41	2008	0.09	-0.01	0.15	0.98	0.45	0.11
2009	0.06	-0.18	0.28	0.65	0.61	-0.09	2009	0.06	-0.09	0.16	0.76	0.45	0.06
2010	0.10	0.04	0.13	1.27	0.50	-0.15	2010	0.08	-0.09	0.17	0.72	0.43	0.27
2011	0.08	-0.10	0.21	1.06	0.49	-0.17	2011	0.07	-0.07	0.15	0.83	0.45	0.01
2012	0.07	-0.08	0.20	1.09	0.48	0.10	2012	0.04	-0.08	0.15	0.91	0.47	-0.33
2013	0.09	-0.02	0.20	1.05	0.56	-0.06	2013	0.07	-0.09	0.17	0.74	0.51	-0.43
2014	0.09	-0.03	0.21	1.02	0.59	-2.38	2014	0.07	-0.09	0.19	0.83	0.52	-0.09
2015	0.11	-0.01	0.22	1.17	0.62	-1.15	2015	0.04	-0.07	0.19	1.04	0.41	0.04
2016	0.12	0.22	0.17	1.82	0.54	0.24	2016	0.08	0.01	0.17	1.24	0.50	0.31

Notes: CASH (Cash and Cash Equivalents / Total Assets), NWC (Net Working Capital), STD (Short Term Debt), CL (Current Liquidity), Lev (Leverage) and ROE (Return on Equity).

4.2 Model's Assumptions

After presenting the initial analysis, the theoretical assumptions of the econometric model by panel data are explained. Non-tabulated results of the test of normality of the residuals indicate that residues did not present normal distribution, implying in the impossibility of generalization of the obtained results. The White Test for heteroskedasticity, indicates that the sample restricted by size and the unrestricted for age showed great dispersion around the line of the proposed model.

According to this, to analyze the two regressions more appropriately, a robust standard error technique was employed to control the heteroskedasticity problems. For those classified as unrestricted by size and restricted by age, the null hypothesis was rejected. Therefore, there was no need for correction. In sequence, the Variance Inflation Factor (VIF) test was performed. The maximum VIF found was 5.60 (with an average VIF of 2.56), indicating that multicollinearity is not a serious concern in this study.

The Chow tests were performed for the firms that did not obtain problems of heteroskedasticity and the Welch test for those who had, as well as the Breusch-Pagan and Hausman tests to see which model fits better to the data used. Non-tabulated results indicate that, among the models of Pooled Ordinary Least Squares (POLS), Fixed-Effects and Random-Effects, the best fit is the Fixed-Effects. The Fixed-Effects Model is also theoretically the most appropriate, since it is the only capable of recognizing the differences between companies, given that there is a high dispersion of results that reflect differences in corporate financial management.

5 DISCUSSION OF RESULTS

It can be seen at Table 4 that the group classified as financially unconstrained by age criteria obtained statistical significance with a positive sign at the 5% level. Thus, to the extent that the financial crisis is an exogenous shock to the cost and supply of funding, precautionary motives foresee that firms should react to this shock by increasing their percentages of assets in cash (Bliss, Cheng & Denis, 2015).

Therefore, older firms were able to avoid the effects of the subprime crisis better than the others. This result is consistent with the fact that over time, organizations manage the cash balance more efficiently. Thus, older firms responded to the increase in financial constraints and uncertainty by increasing their cash levels. The increase in uncertainty can raise firms' demand for cash as a precaution, causing them to hold more cash for future investments.

For those classified as restricted by age criteria, although the results were not statistically significant, the coefficient obtained was negative. In this sense, Bliss *et al*. (2015) affirm that a reduction in cash levels is also likely to occur in a period of restricted credit supply.

Financially constrained and unconstrained firms based on size criteria had a negative association with cash levels, at the level of 1% and 10%, respectively. Therefore, the industry crisis scenario render it impossible for these firms to recompose their cash balances to pre-crisis levels. As a result, companies cannot create adequate cash reserves and their investment expenses become dependent on the current cash flows and, when they are insufficient, cause them to increase their short-term debt, as shown in Table 3, and since these are generally costlier, the scenario of these firms gets even worse if they fail to adequately plan their cash balances.

Table 4
Model of Fixed Effect Regression

	Size		Age	
	Constrained	**Unconstrained**	**Constrained**	**Unconstrained**
Variables	**Coefficients (*p-value*)**	**Coefficients (*p-value*)**	**Coefficients (*p-value*)**	**Coefficients (*p-value*)**
Constant	3.893 (0.085 *)	-7.223 (0.001 ***)	-3.609 (0.2123)	-10.229 (0.000 ***)
NWC	1.191 (0.002 ***)	1.55314 (0.141)	2.033 (0.001 ***)	4.531 (0.000 ***)
STD	-2.585 (0.12)	-0.176 (0.921)	-1.895 (0.351)	2.841 (0.053 *)
CL	0.010 (0.877)	0.167 (0.241)	0.173 (0.236)	-0.105 (0.2117)
Size	-0.643 (0.001 ***)	0.278 (0.082 *)	-0.038 (0.883)	0.529 (0.000 ***)
Lev	1.300 (0.168)	1.104 (0.233)	1.780 (0.342)	-0.078 (0.920)
ROE	0.026 (0.521)	0.116 (0.000 ***)	0.067 (0.049 **)	-0.017 (0.647)
Subprime Crisis	-1.260 (0.000 ***)	-0.602 (0.068 *)	-1.094 (0.136)	0.643 (0.020 **)
Brazilian Crisis	-0.388 (0.2646)	-0.000 (0.996)	-0.230 (0.188)	0.085 (0.781)
R^2	0.265	0.272	0.414	0.320
P-value (F)	0.000	0.000	0.000	0.000
Observations (*n*)	156	156	177	177
Durbin-Watson	1.717	1.103	1.290	1.405
Robust Standard Errors	No	Yes	Yes	No

Notes: * statistically significant at 10%; ** statistically significant at 5%; *** statistically significant at 1%. Cash is the dependent variable of this study, it was obtained by Natural log of (Cash/Net Assets); Net Working Capital (NWC) was obtained by subtracting Current Assets by Current Liabilities, and the resulted value divided by Net Assets; Short-Term Debt (STD) was obtained by the division of Total Short-Term Debts, so that the resulting value was divided by the sum of Equity and Liabilities; Current Liquidity (CL) was obtained by the division of Current Assets by Current Liabilities; Size = Size, obtained by the natural logarithm of Total Sales; Leverage (Lev) was obtained by the sum of Total Short-Term Debts with Total Long-Term Debt, and the resulting value was divided by Net Assets; Return on Equity (ROE) was obtained by the division of Net Income by Equity; Subprime Crisis is a binary variable that assumes the value 1 for the years 2008 and 2009 and 0 for the remaining sample period; Brazilian Crisis is a binary variable that assumes the value 1 for the years 2014 and 2015 and 0 for the remaining sample period;

The results of the binary variable used to represent the latest crisis in the industry and the Brazilian economy itself, on the other hand, were not significant in any subgroup. Although not significant, the results showed the same signs in each group compared to the subprime crisis dummy. It should be noted, however, that the number of observations fell because of the firms analyzed filed for bankruptcy protection or closed. Consequently, the sample fell from 33 firms in 2013 to 23 in 2016. This reduction may affect the capacity of the binary variable used in 2014 and 2015 to capture the effects of the crisis on cash management.

The results found for the profitability variable (ROE) were consistent with the theoretical assumptions presented by Bigelli and Sanchez-Vidal (2012), that the most profitable companies generally generate more cash than the less profitable ones. Therefore, the significant result for the unconstrained group by size criteria and for the constrained by age, which are statistically significant at the 1% and 5% levels respectively, suggest, according to Hall *et al*. (2014), that they accumulate more cash by preventing the volatility or illiquidity of the earnings.

Larger firms are generally more diversified and probably have easier access to bank financing (Opler *et al*., 1999). The results obtained for financially unconstrained firms by size and age criteria were consistent with these arguments, statistically significant and positive. However, the evidence obtained for size for the constrained group by size criteria points to a

negative and significant association at the 5% level. In this way, Ozkan and Ozkan (2004) suggest that other factors may influence how firms' size can influence cash management.

Contrary to the theoretical assumptions presented by Opler *et al*. (1999), it was found that Net Working Capital obtained a positive association instead of the expected negative sign, being significant even at the level of 1% for three of the four subgroups used, except for financially unconstrained firms by size criteria. This result is also contrary to that found by Manoel *et al*. (2017) in a previous study with private firms from the Brazilian sugarcane industry. Therefore, Net Working Capital cannot be considered as a valid cash substitute in the industry.

The variables Current Liquidity and Leverage did not obtain statistical significance. In general, the model presented a good R-squared with the minimum value of 26.5% and reaching 41.5% by the constrained groups for size and age criteria, respectively. Finally, when an alternative measure of firms' cash (cash and cash equivalents/total assets) was used, the results were similar to those reported in Table 4.

6 CONCLUSIONS

This research analyzes the effects of financial constraints on cash management of the Brazilian sugarcane industry. The results obtained indicated that smaller and younger organizations maintain higher levels of their total assets allocated in cash than those of larger size and older as financial constrain. Hence, the evidence obtained indicate that age and size criteria are effective, given the limitations of this research, in classifying financially constrained firms in the Brazilian sugarcane industry. Furthermore, it was observed that only financially unconstrained firms by age criteria increased their cash levels during the years of 2008 and 2009. This evidence is consistent with the precautionary motives, playing a relevant role for the older firms that use their cash in order to overcome the adversities of the macroeconomic environment.

In addition to the limited sample and the reduction of this number in recent years, the lack of access to the explanatory notes of most firms is also one of the limitations of this research. This, in turn, made it impossible to add new variables to the model, such as a possible dummy if the firm has access to foreign capital markets, dividend payout ratio and growth opportunities.

Moreover, in order to verify if the results obtained in this study would be limited to privately held firms from the Brazilian sugarcane industry, it was also considered to analyze the same econometric model proposed for a sample of publicly listed companies from the industry in Brazil. However, only three organizations of the industry (Biosev, Raizen Energia and São Martinho) were listed in "Brasil, Bolsa, Balcão" (B3) based on information from November 2018. Nevertheless, only one firm (São Martinho) presented data prior to 2010. Thus, a possible comparison of the results obtained in this study between publicly listed and private companies in the industry is another limitation of this article.

As a suggestion for new studies, researchers may seek to analyze whether the presence of public fund for investment, for example, by the National Bank for Economic and Social Development (BNDES, Brazilian federal investment bank) affect the levels of financial constraint and their impacts on the total percentages of assets held in cash. Finally, Shin and Park (1999) pointed out that companies belonging to business groups may suffer less from the effects of financial constraints, since these firms have access to the internal cash flows of the group. Therefore, new studies can also analyze this factor within the Brazilian sugarcane industry, given the recurrent existence of firms belonging to diversified business groups.

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Os Efeitos das Restrições Financeiras na Gestão do Caixa: um Estudo com Empresas de Capital Fechado do Setor Sucroenergético Brasileiro

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RESUMO

Objetivo: *O objetivo deste estudo é analisar os efeitos das restrições financeiras sobre a gestão do caixa das indústrias sucroenergéticas do Brasil.*

Método: *O modelo de efeitos fixos foi utilizado como método de pesquisa, em que se analisou as demonstrações financeiras de 48 empresas privadas entre 1998 e 2016.*

Originalidade/Relevância: *O gerenciamento do saldo de caixa é uma das atividades centrais do gestor, pois é por meio do caixa que as organizações equilibram suas necessidades de recursos correntes e futuros, sendo este processo decisório desafiador, especialmente nos mercados emergentes e em empresas de capital fechado, onde as limitações do mercado financeiro restringem a disponibilidade e o fluxo de crédito para as atividades econômicas.*

Resultados: *Os resultados obtidos indicaram que, na média, as empresas financeiramente restritas, constructo capturado pelas proxies Tamanho e Idade, mantêm percentuais mais altos de seus ativos em caixa do que as irrestritas. Este resultado é estatisticamente significativo e consistente com o motivo precaucional, em que as firmas financeiramente restritas gerenciam o seu caixa visando contornar as incertezas do ambiente macroeconômico.*

Contribuições Teóricas: *Nosso artigo contribui para a literatura ao providenciar evidências sobre os efeitos das restrições financeiras no gerenciamento do saldo de caixa, em um contexto de escassez de estudos com empresas privadas e em mercados emergentes.*

Palavras-chave*: Agronegócio; Crise Financeira; Liquidez.*

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