

Traditional Indicators and Fleuriet Model for Liquidity Measurement in the Treasury of Non-Financial Institutions in Times of Crisis

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Abstract: Purpose: The purpose of this article is to identify the relevance of the indicators that measure the behavior of liquidity in treasury departments in times of recession.

Design/methodology/approach: As for the objective, the article is descriptive, and the technical procedures are seen as bibliographic / documentary, and with a quantitative approach. The study was based on a sample of publicly traded and non-financial companies between 2007 and 2016.

Findings: The statistical tool used was the regression with panel data, being the dependent variables: Net Working Capital, a Working Capital Requirement, and the Treasury Balance. Evidence shows that in times of economic recession, the liquidity levels of each company vary greatly. It is also shown that the variables of debt capacity and cost of debt can influence liquidity levels.

Originality: The importance of the study is related to liquidity in times of crisis as well as the real need for efficiency and control of the liquidity level in treasury management.

Keywords: Liquidity, Treasury, Financial Indicators, Crisis, Panel Data.

1. INTRODUCTION

Two crisis periods were identified in Brazil between 2008 and 2018, the first referring to the subprime crisis and the second referring to the fiscal crisis. Within the scenario of economic cycles, it is observed that companies increase their concern with the behavior and the impact of liquidity in the Treasury Departments, having as analysis criteria several types of traditional or dynamic indicators, and the reasons causing the increase or decrease in liquidity.

In this crisis scenario, business management considers Treasury Management as an issue of its main concerns. On a cloudy outlook and a clear decrease in consumption, companies face enormous difficulty in getting financing from the market and there is also the risk of poor collection. All of these factors are decisive for the Treasury Departments and emerge as a basic policy of financial risk management that impacts directly business's outcomes.

One of the organization's main pillars is financial performance, and one of the objectives is to achieve financial sustainability. Thus, institutions must constantly reexamine and improve the planning of financial resources, as a target for the liquidity balance in the short term. For, within business management, the financial cycle coordination is fundamental, since its result influences the companies' capital structure (Nascimento, Espejo, Voese and Pfitscher, 2016).

Several studies (Ferreira, Custodio and Raposo, 2005; Rogers, Rogers and Ribeiro, 2005; Han and Qiu, 2007; Frank and Goyal, 2009; Koshio and Nakamura, 2013; Loncan and Caldeira, 2014) approach the trade-off concept between the benefits and costs of excess or shortage of liquidity since, during times of crisis it is essential to focus on early estimation of their obligations and rights, to fulfill the responsibilities avoiding the risks of default, bearing in mind that, in times of recession, an excessive drop in sales strongly impacts the liquidity of companies with inadequate capital structure, and may cause the end of the activities (Fleuriet, Kehdy and Blanc, 2003).

The purpose of this article is to understand how the 2008 financial crisis and the Brazilian economic crisis of 2014 alter, in some way, the usual liquidity model adopted in the Treasury Departments of non-financial companies, as well as to determine which are the liquidity indicators that best represent the Treasury Departments status.

The article's contribution consists in providing investors and the market with information on how crises affect companies and a more assertive understanding of the decision-making process regarding liquidity levels in the Treasury Department during times of crisis.

To achieve the proposed objective and provide theoretical and practical contributions, this article is divided into an introduction, theoretical framework, methodology, and analysis of results on the proposed objective, in addition to the conclusion and suggestions for future research.

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Fig. (1). Treasury Management Main Responsibilities. Source: Adapted from Polak e Klusáček (2010).

2. LITERATURE REVIEW

2.1. Treasury Management

The Treasury Department of a company within its management way and its core activities encompasses issues related to liquidity. However, liquidity itself has its inquiries, such as the concept definition for the Treasury, and the importance of using indicators in financial analysis.

For Montigelli (2010), Treasury is the momentary control of bank account balances, either national or international and the ability in forecasting the payments and receipts flow. Thus, the evolution of cash resources, considering both, the access as well as the preservation of short, medium, and long-term funding sources, corroborates the Treasury’s essential goals (Hollein, 2010).

This scenario is proven when the Treasury refers to liquidity management when investing the surpluses in case of superavit and capturing the surpluses in case of deficit (Helliard and Dunne, 2004). Fig. (1) summarizes the Treasury’s main activities.

Because of difficulties and limitations in the market and the dizzying pattern with which businesses thrive, it is essential for companies to have consistent and efficient treasury management.

As a result, there are four basic principles (López Martínez, 2003; Torre, 1997): (i) positioning management, (ii) liquidity planning and control, (iii) management and control of banking conditions, and (iv) risk management.

There is agreement that sufficient cash generation is essential for a company’s survival. Thus, the Treasury is responsible for controlling financial information arising from all areas of the company. Treasury also shows its systemic view within

organizations, as it manages and supervises the company’s money (Zanchin, 2002).

In view of the highlights presented, it is concluded that the Treasury plays a key role in the companies’ strategic decisions, ensuring the means and mechanisms essential for the strategies’ conservation or facilitation.

Cash Management

One of the Treasury’s main features is to solve and control-cash management adversity. Cash management is the art and the science of managing a company’s short-term resources to sustain its ongoing activities, mobilize funds and optimize liquidity (Das, 2017). Since the target is to give greater flexibility to the inputs compared to disbursements, thus optimizing the financial status and current obligations (Dalbello, 1999).

The essential elements of cash management are – (a) efficient utilization of current assets and current liabilities of a firm throughout each phase of the business operating cycle; (b) the systematic planning, monitoring, and management of the company’s collections, disbursements and account balances; (c) the gathering and management of information to use available funds effectively and identify risk.

For William (2004) and Eden (2009), the objectives of efficient cash management are as follows:

- a. To ensure the availability of cash resources at all times for efficient and unconstrained implementation of the annual budget.
- b. To use available cash with the least cost and risks.
- c. Keeping to a minimum the volume of idle balances held in the banking system, and the extra costs associated with that.

- d. Reducing risk – operational, credit, and market risk.
- e. Adding flexibility to the ways in which the timing of government cash inflows and outflows can be matched.
- f. Supporting other financial policies.

From the perspective of Eden (2009), companies in developing countries generally focus initially on the first established objective. That is, the priority of cash management is to keep the company's operation running.

It is evident that costs and uncertainties, resource limitations, and market barriers are the boosters for a higher level of cash, as a means of survival in the financial market (Iturralde, Maseda and San-José, 2009; Morellec, Nikolov and Zucchi, 2013).

The optimal level of cash is one of the consequences of imperfect markets, as there is a need to balance the benefits and costs in to maximize the company's value (Teruel and Solano, 2003).

National studies present a different perspective, since, according to Forti, Peixoto and Freitas (2011), cash retention can be explained by two assumptions, with a positive relationship between a) cash maintenance and performance; and b) cash maintenance and value of the company. In the words of Fresard (2010), these two pieces of evidence corroborate the existence of a set of benefits, both operational and strategic, in which companies that retain levels of available operating cash flows higher than their competitors can use their reserves to finance their operations.

However, this retention deserves to be highlighted, since American companies prefer to issue shares, following the pecking order theory. Thus, the retention of operating cash flows is equivalent to only a small part of the retention (Bates, Kahle and Stulz, 2009; McLean, 2011).

For Forti, Peixoto and Freitas (2011), a high cash value was seen as a harmful practice to the profitability of organizations. However, crises and credit control policies, show that a more liquid balance sheet aims to avoid cash problems (Frésard, 2010).

In the executives' view, cash management is crucial, as there is an inevitability to seek a balance between risk and return, profitability, and liquidity, with the purpose of generating value for the company (Palombini and Nakamura, 2012). In summary, cash management brings together several functions associated with the management of short-term financial flows: liquidity management, bank management, management of cash surpluses and deficits, and financial risk management; it is a broader concept than the mere management of payments and collections (San-José, Iturralde and Maseda, 2008).

Expansion and Recession Periods

The term economic cycles, according to the literature, is a method of determination of past economic gaps, in order to forecast or develop long-term assumptions (Mello and Spolador, 2010).

According to Burns and Mitchell (1946), economic cycles can be characterized as variability in countries' global economic activities. In other words, it is an oscillation of the economic movement around the tendency for long-term growth, which is often represented by GDP (Mello and Spolador, 2010).

The economic cycle includes changes in time, regarding growth intervals, stagnation, or decline (Mello and Spolador, 2010). These are divisible into shorter periods, but they maintain a similar character and the same amplitude. The economic cycle duration, in turn, may vary from one year to ten / twelve years (Burns and Mitchell, 1946).

The recession is seen as a sequence of economic disturbances, a decline in asset values, failures of financial agents, and a rupture in foreign exchange markets at the international level (Baxter and King, 1999).

According to the National Bureau of Economic Research (NBER, 2011), a recession is a considerable decline in a country's activity which spreads quickly throughout the economy, impacting industrial production, employment, income, and retail and wholesale trade.

Within this context, some studies show the importance of understanding the countries' economic behavior and proposing scenarios regarding this behavior, and how these aspects can influence liquidity in companies' treasury and cash. Table 1 presents some studies referring to the theme and its main conclusions, considering that all these studies were carried out taking into account the level of cash or liquidity of companies.

In summary, the organizations' cash is correlated with economic indexes, either in periods of expansion or in periods of recession. This denotes that the issues related to both, the excess, and the constraint of capital, in cash management, is a thermometer that characterizes correct or incorrect liquidity management.

Liquidity

Liquidity is as important an aspect as Treasury, and these two aspects are linked together. To address liquidity, it is essential to discern it in two parts: corporate liquidity and financial assets liquidity (Famá and Grava, 2000).

Corporate liquidity is linked to management way. In short, corporate liquidity denotes the ways to settle obligations with third parties within the agreed period, in addition to providing credibility and opportunity in the market, as well as discounts on transactions (Dalbello, 1999).

This liquidity that meets the payments within the agreed deadlines is called Effective or Dynamic Liquidity, which, for Dalbello (1999, p. 15) "admitting the rotations of each of the liquidity components, that is, how much each means of payment rotates, in daily averages, and how much is required, also in daily averages, for the payment needs".

According to Keynes (1937a; 1937b), in his studies to formulate The General Theory, four fundamental reasons for demanding liquidity can be identified. They are:

Table I. Impact of Crisis on Treasury Departments.

| Authors | Year | Article | Study Period | Results |
|-------------------------------------|------|---------------------------------------------------------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Korajczyk e Levy | 2003 | Capital Structure choice: Macroeconomic Conditions and Financial Constraints | 1984 a 1998 | The result is significant, that is, for companies with limited credit and cash, the macroeconomic outlook is fundamental |
| Ferreira, Custodio e Raposo | 2005 | Cash Holdings and Business Conditions | 1996/2002 | During the period there was an increase of USD 300 billion in company cash. This increase confirms the concerns of pecking order theory and also of the cash retention |
| Almeida, Campello e Liu | 2006 | The Financial Accelerator: Evidence from International Housing Markets | 1970 a 1999 | The observed consequence showed a trend in crisis periods for a raise in the organizations' cash level |
| Elkinawy e Stater | 2007 | Cash Holdings and Firm Value during Latin American Financial Crisis | 1995/1999 | Mexican, Argentine and Brazilian companies had an increase in the cash level, as a result of the crises in Mexico and Brazil |
| Chen | 2009 | Corporate Liquidity in Emerging Markets: a Retrospect of Asian Financial Crisis | 1990 a 2006 | Companies least affected were those with higher amounts of liquid assets. Thus, companies started to use the trade-off model as a tool to maintain liquidity |
| Álvarez, Sagner e Valdivia | 2010 | Liquidity Crises and Corporate Cash Holdings in Chile | 1996 a 2009 | It was found a dramatic decrease in liquidity in the period. The hypothesis is that the incident was due to the limitations in obtaining capital |
| Alimov e Mikkelson | 2010 | Economic Conditions, Corporate Governance and the Value of Cash Holdings | 2008/2009 | During the crisis organizations prefer cash increase; cash availability is more valuable than foreign credit |
| Campello, Giambona, Graham e Harvey | 2011 | Liquidity Management and Corporate Investment during a Financial Crisis | 2008/2009 | It is indicated that credit lines soften the impacts of the crisis, but limit credit; there is a choice, that is, either cash reserves or investment |

Source: Prepared by the authors (2018).

- I. *Transaction*—the need for cash (money) for current personal or commercial transactions;
- II. *Precautionary* - certainty as to the future cash (money) equivalent of a certain amount of total resources;
- III. *Speculative* – obtaining profits through heavily liquid assets or not so strongly liquid assets, in order to predict the market and the future;
- IV. *Finance* - required liquidity between the planning of a determined expense and what it actually accomplishes.

The demand for liquidity can be justified by reasons of unpredictability in relation to economic events and in relation to the expected performance of past and present investments.

After further studies, two new motives were added to the original motives presented by Keynes. The first one is the Tax, which is defended by Foley, Hartzell, Titiman and Twite (2007); according to these authors, in countries where the tax burden on resources repatriation is high, the cash levels in companies are significantly high.

The second motive is the Agency Conflict, where executives are not willing to distribute dividends to shareholders, providing an increase in cash even if there is no investment opportunity (Jensen, 1986). A development of Jensen's study is presented by Dittmar and Mahrt-Smith (2007), showing that low levels of corporate governance decrease companies' surplus cash, destroying the value.

According to Iturralde, Maseda and San-Jose (2009), the definition of greater or lesser liquidity must be decided by executives and shareholders, through costs and benefits. Organizations need to define a position on the trade-off between liquidity and profitability.

This trade-off is structured on two pillars, in Lameira's view (2005, p. 9), the first pillar: is "the optimal amount of liquidity is an increasing function of the external financing cost, the volatility of cash flows, and the profitability of future investments". Also, according to Lameira (2005, p. 9), the second pillar: "is a decreasing function of the spread between the return of physical assets and liquid assets".

The real importance and functionality of liquidity come from the need to perform healthy liquidity management. In the opinion of Sá (2004, p. 12) "the generation of liquidity is more important than the generation of profit since what breaks a company is not the lack of profit; is the lack of liquidity".

3. METHODOLOGY

3.1. Sampling and Data Collection

The companies listed in B3 (Stock Exchange in Brazil) were the population used, as they follow a high standard of information disclosure. With this population, the companies that make up the theoretical portfolio of Ibovespa were selected. This portfolio is related to the third four-monthly of 2017. The main source of data for this collection was the quarterly

Table 2. Sample of Companies.

| Company | Code | Segment B3 | Economic Sector | Listing on B3 | Ibovespa (%) |
|-------------------|--------|----------------------------------------|--------------------------|---------------|---------------|
| Ambev S/A | ABEV3 | Beer and soft drinks | Non-cyclical consumption | Traditional | 7,382 |
| Bradespar | BRAP4 | Metallic minerals | Basic materials | Level 1 | 0,477 |
| Braskem | BRKM5 | Petrochemicals | Basic materials | Level 1 | 1,022 |
| BRF SA | BRFS3 | Meat and meat products | Non-cyclical consumption | New Market | 2,617 |
| CCR SA | CCRO3 | Highway exploration | Industrial goods | New Market | 1,503 |
| Cemig | CMIG4 | Electricity | Public utility | Level 1 | 0,542 |
| Copel | CPLE6 | Electricity | Public utility | Level 1 | 0,198 |
| CPFL Energia | CPFE3 | Electricity | Public utility | New Market | 0,095 |
| Cyrela Real | CYRE3 | Buildings | Cyclic consumption | New Market | 0,253 |
| Ecorodovias | ECOR3 | Highway exploration | Industrial goods | New Market | 0,191 |
| Eletrobras | ELET3 | Electricity | Public utility | Level 1 | 0,430 |
| Embraer | EMBR3 | Aeronautical and defense equipment | Industrial goods | New Market | 0,977 |
| Energias BR | ENBR3 | Electricity | Public utility | New Market | 0,347 |
| Engie Brasil | EGIE3 | Electricity | Public utility | New Market | 0,615 |
| Equatorial | EQTL3 | Electricity | Public utility | New Market | 1,078 |
| Gerdau | GGBR4 | Steel Mill | Basic materials | Level 1 | 0,938 |
| Gerdau Met. | GOAU4 | Steel Mill | Basic materials | Level 1 | 0,247 |
| JBS | JBSS3 | Meat and meat products | Non-cyclical consumption | New Market | 1,031 |
| Klabin S/A | KLBN11 | Paper And Cellulose | Basic materials | Level 2 | 0,781 |
| Localiza | RENT3 | Car rent | Cyclic consumption | New Market | 0,842 |
| Lojas Americanas | LAME4 | Miscellaneous Products | Cyclic consumption | Traditional | 0,845 |
| Lojas Renner | LREN3 | Fabrics, clothing and footwear | Cyclic consumption | New Market | 2,032 |
| Marfrig | MRFG3 | Meat and meat products | Non-cyclical consumption | New Market | 0,234 |
| Natura | NATU3 | Personal use products | Non-cyclical consumption | New Market | 0,427 |
| Pão de Açúcar-Cbd | PCAR4 | Food | Non-cyclical consumption | Level 1 | 0,925 |
| Petrobras | PETR3 | Exploration, refining and distribution | Oil, gas and biofuels | Traditional | 3,677 |
| Rumo S.A. | RAIL3 | Rail transport | Industrial goods | New Market | 1,236 |
| Sabesp | SBSP3 | Water and sanitation | Public utility | New Market | 0,947 |
| Sid. Nacional | CSNA3 | Steel Mill | Basic materials | Traditional | 0,377 |
| Suzano Papel | SUZB3 | Paper And Cellulose | Basic materials | New Market | 0,693 |
| Taesa | TAEE11 | Electricity | Public utility | Level 2 | 0,334 |
| Telef Brasil | VIVT4 | Telecommunications | Telecommunications | Traditional | 1,678 |
| Tim Part S/A | TIMP3 | Telecommunications | Telecommunications | New Market | 0,812 |
| Ultrapar | UGPA3 | Exploration, refining and distribution | Oil, gas and biofuels | New Market | 2,426 |
| Usiminas | USIM5 | Steel Mill | Basic materials | Level 1 | 0,372 |
| Vale | VALE3 | Metallic minerals | Basic materials | Level 1 | 8,977 |
| Total | | | | | 47,558 |

Source: Prepared by the authors (2018).

financial statements, obtained through the Economatca system and on the organization's own website.

After this first selection, a new selection was proceeded using as a basis the non-financial domestic companies, that is, excluding all financial companies. This exclusion is justified by some particularities, cash being one of them, according to Zani (2013), as its composition is also formed by deposits from customers whose function is to support their withdrawals.

Using a third filter, from 01/01/2007 to 12/31/2016, there are a total of 36 companies in the sample. This selection is mandatory since the period of analysis between 2007 and 2016 is based on covering two crises, which will be represented by dummy variables in the model. Moreover, the choice of this time period covers the changes in the new economic matrix and macroprudential media, and it is based on covering a whole period before and after the fiscal crisis. Table 2 presents the 36 companies and information about the sample.

Analyzing this table, some important characteristics are noticed: segment, economic sector, and level listing. So, these segregation criteria are established according to B3. This sample percentage of participation in the Bovespa index (Ibovespa) is approximately equivalent to 48%.

Finally, the Economic Cycles Dating Committee and the Institute of Applied Economic Research were consulted to gather pieces of information that accurately detail the economic cycles in the country and make it possible to characterize the quarters in expansion or recession over the years.

Statistical Technique

There are many different models that can be used for panel data. The basic distinction between them is the existence of fixed or random effects. According to Greene (2007), fixed effects models present the possibility that the covariates are correlated with the effects of the level of the individual, therefore any estimation in this model requires elimination or

control of the effect of the level of the individual. The random effects model, on the other hand, assumes that beta zero is purely random, that is, it is not correlated with the regressors.

The regression method chosen for this article is the panel data because there is a control of individual heterogeneity, that is, the possibility of separately measuring the effects generated due to existing differences between each observation in each cross-section.

This choice is due to the sample characteristics, that is, time series for several company observations and a large number of variables. According to Baltagi (2005), Gujarati and Porter (2017), the results found in this model provide more explanatory data, more variability, less collinearity in the samples, and more degrees of freedom and efficiency.

According to Islam (1995), the main utility of panel data modeling is its ability to allow differences to occur between the companies studied in this article, which causes the results to be significantly different from those obtained through isolated regressions for each company.

The approach is unbalanced, that is, the number of observations is not equal for all variables, thus characterizing a long panel, in which the number of time periods (T) is greater than the number of observations (N) in the cross-section (T > N). With this characteristic, it becomes necessary to specify a model that considers the existence of serial error correlation (Fávero, 2013).

The choice of linear regression with panel data is mirrored in the possibility of explaining liquidity in Treasury Departments, considering the periods of recession. The dependent variable is the liquidity in the Treasury and the independent variables are the selected indicators, in addition to the variable binary to check the influence of the crisis.

Dependent Variable

The dependent variable, by definition, is the variable that is influenced by other variables (explanatory and binary). Accordingly, for the present study, liquidity is the dependent variable, which will be assessed in this study using three different metrics: Net Working Capital (NWC), Working Capital Requirement (WCR), or Treasury Balance (T).

Net Working Capital

The NWC can be interpreted by the disparity between current assets and current liabilities. However, there are questions and doubts regarding the liquidity information obtained through the NWC concept (Zanolla, Gartner, Silva and Scalco, 2014). For example, the interrelationships between current assets and liabilities that affect the accounts, highlight the fact that, in the opinion of Assaf Neto e Silva (2012, p. 20), "the assessment of liquidity based on the NWC value is not enough for more decisive conclusions".

Working Capital Requirement

The WCR is a model for the assessment of performance, whose objective is to separate the required investments in working capital and the means that companies use to finance these investments (Zanolla *et al.*, 2014).

Both current assets and current liabilities are reclassified in this assessment model, thus distinguishing between the financial and the operational part, showing the features of each in the Balance Sheet. Accordingly, the difference between operating current assets (OCA) and operating current liabilities (OCL) results in the WCR, which includes only operational elements. From this perspective Melo and Coutinho (2007, p. 3), state "that the WCR is a function that has the same size as the Financial Cycle".

According to Fleuriet (2005), one of the most fundamental aspects of the WCR model is the issue of liquidity and its relationship with the Operating Cash Flow (OCF), and one can reason that working capital is the soul of the business. Following this reasoning, Assaf Neto and Silva (2012) claim that working capital is paramount for companies' operational performance.

Treasury Balance

According to Araújo, Oliveira Costa and Camargos (2013), the TB calculation is made from the checking between the accounts of current financial assets (CFA) and the accounts of current financial liabilities (CFL). For Assaf Neto and Silva (2012), the Treasury Balance represents the remaining long-term resources available for financial investments, serving as a financial buffer for organizations.

Thus, this indicator is able to determine the organizations' behavior and their state of financial liquidity, serving as a support and a guide in periods of economic cycles.

Explanatory Variables

Explanatory variables can be described as those that, independently, influence the dependent variable, so that the dependent variable behavior can be explained via explanatory variables.

In view of the financial index's variety, 21 indicators frequently used for the purpose of measuring liquidity were tested. A description of the coefficients is found below in Table 3.

Dummy Variable and Exogenous Variable

Binary variables, also known as dummy variables, indicate the presence or absence of a certain characteristic. In this article, the characteristic is the crisis influence, and for the proper achievement and writing of the article dummies were built for periods of expansion as well as periods of recession (CODACE, 2009).

Table 4 describes the expansion and recession quarters during the analysis period, in which the recession periods are represented as a dummy variable equal to one, and expansion periods are represented as a dummy variable equal to zero (CODACE, 2017). The acronym "Dumc" was used to indicate the variable.

Still a recent methodology in Brazil, but according to the Dating Committee of Economic Cycles - CODACE itself (2009), "form of organization and method of work [...] follows the model adopted [...] by the National Bureau of Economic Research".

Table 3. Financial indicators.

| Código | Indicators | Formula | Autors |
|--------|--------------------------------------------|-------------------|----------------------------------|
| X1 | Current liquidity | CA / CL | Silva Brito and Assaf Neto, 2008 |
| X2 | Immediate liquidity | AVAILABILITY / CL | Silva Brito and Assaf Neto, 2008 |
| X3 | Debt coverage with cash | (CL + NCL) / OCF | Silva Brito and Assaf Neto, 2008 |
| X4 | Short-term debt coverage with cash | CL / OCF | Silva Brito and Assaf Neto, 2008 |
| X5 | Debt coverage using Ebitda | ND / EBITDA | Silva Brito and Assaf Neto, 2008 |
| X6 | Third party capital participation | TPC / SE | Silva Brito and Assaf Neto, 2008 |
| X7 | Composition of indebtedness | CL / (CL + NCL) | Silva Brito and Assaf Neto, 2008 |
| X8 | Total indebtedness | (CL + NCL) / CA | Silva Brito and Assaf Neto, 2008 |
| X9 | Return on equity | NI / ASE | Silva Brito and Assaf Neto, 2008 |
| X10 | Return on assets | NI / ATA | Silva Brito and Assaf Neto, 2008 |
| X11 | Operational margin | EBIT / NSR | Silva Brito and Assaf Neto, 2008 |
| X12 | Cost of debt | FE / LFL | Silva Brito and Assaf Neto, 2008 |
| X13 | Net working capital | CA – CL | Fleuriet, Kehdy and Blanc, 2003 |
| X14 | Working Capital Requirement | (OCA – OCL) | Fleuriet, Kehdy and Blanc, 2003 |
| X15 | Treasury balance | (CFA – CFL) | Fleuriet, Kehdy and Blanc, 2003 |
| X16 | Treasury balance on sales | (CFA – CFL) / NSR | Iudícibus, 2017 |
| X17 | Net treasury | (CFA – CFL) – OR | Iudícibus, 2017 |
| X18 | Treasury flow | FTV – ITV | Iudícibus, 2017 |
| X19 | Operating cash flow on assets | OFC / CA | Silva Brito and Assaf Neto, 2008 |
| X20 | Operating cash flow over total liabilities | OCF / (CL + NCL) | Silva Brito and Assaf Neto, 2008 |
| X21 | Operating cash flow on financial debt | OCF / (CFL + LTL) | Silva Brito and Assaf Neto, 2008 |

Notations: CA - Current Assets; CFA - Current Financial Assets; OCA - Operating Current Assets; TA - Total Assets; ATA - Average Total Assets; TPC - Third Party Capital; ND - Net Debt; FE - Financial Expense; OR - Other Receivables; AVAILABILITY - CCE - Cash and Cash Equivalent; LFL - Loans and Financing Liabilities; OCF - Operating Cash Flow; EBIT - Earnings Before Interest and Income Tax; NI - Net Income; CL - Current Liabilities; NCL - Non-current Liabilities; OCL - Operating Current Liabilities; CFL - Current Financial Liabilities; LTL - Non-current Financial Liabilities (long-term liability); SE - Shareholders Equity; ASE - Average Shareholders' Equity; NSR - Net Sales Revenue; ITV - Initial Treasury Value; FTV - Final Treasury Value.

Source: Prepared by the authors (2018).

Table 4. Annual and quarterly chronology of Economic Cycles.

| Year | 1° quarter | 2° quarter | 3° quarter | 4° quarter |
|------|------------|------------|------------|------------|
| 2007 | Expansion | Expansion | Expansion | Expansion |
| 2008 | Expansion | Expansion | Expansion | Recession |
| 2009 | Recession | Expansion | Expansion | Expansion |
| 2010 | Expansion | Expansion | Expansion | Expansion |
| 2011 | Expansion | Expansion | Expansion | Expansion |
| 2012 | Expansion | Expansion | Expansion | Expansion |
| 2013 | Expansion | Expansion | Expansion | Expansion |
| 2014 | Expansion | Recession | Recession | Recession |
| 2015 | Recession | Recession | Recession | Recession |
| 2016 | Recession | Recession | Recession | Recession |

Source: CODACE (2017).

Thus, another method of analysis that assists and supports the statements on periods of expansion or recession is the analysis of the quarterly variation of Gross Domestic Product. As can be seen in Table 5, the actual values of the quarterly GDP (accumulated 12 months) of the years used in this paper, represent this new exogenous variable that indicates the growth or decline of the quarterly Gross Domestic Product, following the methodology of the Institute of Applied Economic Research.

Table 5. Actual Quarterly GDP (% a.a.).

| Year | 1° quarter | 2° quarter | 3° quarter | 4° quarter |
|------|------------|------------|------------|------------|
| 2007 | 5,2 | 6,5 | 5,9 | 6,6 |
| 2008 | 6,2 | 6,3 | 7,0 | 1,0 |
| 2009 | -2,4 | -2,2 | -1,2 | 5,3 |
| 2010 | 9,2 | 8,5 | 6,9 | 5,7 |
| 2011 | 5,1 | 4,6 | 3,5 | 2,5 |
| 2012 | 1,7 | 1,0 | 2,5 | 2,5 |
| 2013 | 2,8 | 4,1 | 2,8 | 2,4 |
| 2014 | 3,2 | -0,8 | -1,1 | -0,7 |
| 2015 | -2,0 | -3,0 | -4,5 | -5,9 |
| 2016 | -5,4 | -3,6 | -2,9 | -2,5 |

Source: IPEA (2017).

With this additional analysis, it is confirmed that the methodology used, CODACE - Economic Cycle Dating Committee, is able to validate what happened to the Brazilian economic cycles and, therefore, is an index for assessments of expansion or recession.

Given the above, it is proposed the use of six regressions with panel data. That is two regressions for each dependent variable NWC, WCR, and TB in which the crisis situations will be tested in the first moment through the dummy

Table 6. Variables Descriptive.

| Variable | Observations | Mean (Average) | Median | Standard Deviation | Minimum | Maximum |
|----------|--------------|----------------|-----------|--------------------|--------------|-------------|
| CL | 777 | 1,797664 | 1,538808 | 2,006636 | 0,176780 | 34,699153 |
| IL | 777 | 0,602984 | 0,408662 | 0,889592 | 0,000023 | 11,241021 |
| CDC | 777 | 5,394829 | 3,114995 | 64,240234 | -1823,903811 | 1262,779561 |
| STDCC | 777 | 1,996441 | 1,038621 | 11,961037 | -243,354551 | 283,903153 |
| DCE | 777 | 8,022477 | 6,753413 | 15,181024 | -213,339945 | 238,990924 |
| TPCP | 777 | 2,185923 | 1,437554 | 2,921162 | 0,025344 | 43,823803 |
| CI | 777 | 0,385957 | 0,362747 | 0,176842 | 0,017871 | 0,998743 |
| TI | 777 | 0,592579 | 0,589366 | 0,152595 | 0,024718 | 0,977690 |
| ROE | 777 | 3,552016 | 3,273513 | 7,573639 | -109,149518 | 50,228245 |
| ROA | 777 | 1,375774 | 1,338113 | 2,124900 | -20,450008 | 12,497080 |
| OP | 777 | 19,519573 | 16,706965 | 22,440431 | -266,260959 | 168,223041 |
| CD | 777 | 0,301249 | 0,212874 | 0,342566 | -0,746498 | 5,148348 |
| NWC | 777 | 0,000000 | -0,296148 | 1,000000 | -1,236993 | 8,025327 |
| WCR | 777 | 0,000000 | -0,360157 | 1,000000 | -1,140042 | 5,904177 |
| TB | 777 | 0,000000 | -0,145446 | 1,000000 | -2,503571 | 9,035034 |
| TBS | 777 | 0,023474 | 0,028055 | 0,243097 | -2,273003 | 1,888256 |
| NT | 777 | 0,000000 | 0,171979 | 1,000000 | -5,901505 | 5,569012 |
| TF | 777 | 0,000000 | -0,000614 | 1,000000 | -8,765126 | 10,675904 |
| OCFA | 777 | 0,263164 | 0,178552 | 0,279643 | -0,204778 | 2,365524 |
| OCFIL | 777 | 0,465791 | 0,299202 | 0,486726 | -0,347183 | 3,202858 |
| OCFFD | 777 | 0,914609 | 0,483141 | 1,348002 | -0,404076 | 20,050049 |
| GDP | 777 | 2,02 | 2,50 | 4,02 | -5,90 | 9,20 |

Source: Prepared by the authors (2018).

“Dumc” and in a second moment through the real quarterly GDP.

Thus, it is sought to contribute to the most appropriate determination of liquidity measurement, focused on decision-making in Treasury. In view of the variables available: dependent, explanatory, and binary, the following regressions are proposed:

- $$NWC = \alpha + \beta_1 CL + \beta_2 IL + \beta_3 CDC + \beta_4 STDCC + \beta_5 DSCE + \beta_6 TPC + \beta_7 CE + \beta_8 TI + \beta_9 ROE + \beta_{10} ROA + \beta_{11} OP + \beta_{12} CD + \beta_{13} WCR + \beta_{14} TB + \beta_{15} TBS + \beta_{16} NT + \beta_{17} TF + \beta_{18} OCFA + \beta_{19} COET + \beta_{20} OCFOL + \beta_{21} Dumc + \varepsilon_{pt}$$
- $$WCR = \alpha + \beta_1 CL + \beta_2 IL + \beta_3 CDC + \beta_4 STDCC + \beta_5 DSCE + \beta_6 TPC + \beta_7 CE + \beta_8 TI + \beta_9 ROE + \beta_{10} ROA + \beta_{11} OP + \beta_{12} CD + \beta_{13} NWC + \beta_{14} TB + \beta_{15} TBS + \beta_{16} NT + \beta_{17} TF + \beta_{18} OCFA + \beta_{19} COET + \beta_{20} OCFOL + \beta_{21} Dumc + \varepsilon_{pt}$$
- $$TB = \alpha + \beta_1 CL + \beta_2 IL + \beta_3 CDC + \beta_4 STDCC + \beta_5 DSCE + \beta_6 TPC + \beta_7 CE + \beta_8 TI + \beta_9 ROE + \beta_{10} ROA + \beta_{11} OP + \beta_{12} CD + \beta_{13} NWC + \beta_{14} WCR + \beta_{15} TBS + \beta_{16} NT + \beta_{17} TF + \beta_{18} OCFA + \beta_{19} COET + \beta_{20} OCFOL + \beta_{21} Dumc + \varepsilon_{pt}$$
- $$NWC = \alpha + \beta_1 CL + \beta_2 IL + \beta_3 CDC + \beta_4 STDCC + \beta_5 DSCE + \beta_6 TPC + \beta_7 CE + \beta_8 TI + \beta_9 ROE + \beta_{10} ROA + \beta_{11} OP + \beta_{12} CD + \beta_{13} WCR + \beta_{14} TB + \beta_{15} TBS + \beta_{16} NT + \beta_{17} TF + \beta_{18} OCFA + \beta_{19} COET + \beta_{20} OCFOL + \beta_{21} GDP + \varepsilon_{pt}$$

- $$WCR = \alpha + \beta_1 CL + \beta_2 IL + \beta_3 CDC + \beta_4 STDCC + \beta_5 DSCE + \beta_6 TPC + \beta_7 CE + \beta_8 TI + \beta_9 ROE + \beta_{10} ROA + \beta_{11} OP + \beta_{12} CD + \beta_{13} NWC + \beta_{14} TB + \beta_{15} TBS + \beta_{16} NT + \beta_{17} TF + \beta_{18} OCFA + \beta_{19} COET + \beta_{20} OCFOL + \beta_{21} GDP + \varepsilon_{pt}$$
- $$TB = \alpha + \beta_1 CL + \beta_2 IL + \beta_3 CDC + \beta_4 STDCC + \beta_5 DSCE + \beta_6 TPC + \beta_7 CE + \beta_8 TI + \beta_9 ROE + \beta_{10} ROA + \beta_{11} OP + \beta_{12} CD + \beta_{13} NWC + \beta_{14} WCR + \beta_{15} TBS + \beta_{16} NT + \beta_{17} TF + \beta_{18} OCFA + \beta_{19} COET + \beta_{20} OCFOL + \beta_{21} GDP + \varepsilon_{pt}$$

Being,

α = intercept;

ε_{pt} = error term.

4. RESULTS AND DISCUSSION

It is noteworthy that, for all models and tests, the significance level (α) is 5%. A descriptive statistic on the variables was prepared, using 777 observations for the years 2007 to 2016, showing the mean (average), median, standard deviation, minimum, and maximum of the data.

The information in Table 6 provides the sample characteristic. The three variables (Net Working Capital, Working Capital Requirement, and Treasury Balance) have undergone standardization, which means that they have become standard. This standardization was necessary to achieve comparability between variables measured in different units, the

Table 7. Regression Methods

| | $\alpha = 5\% (0,05)$ | | | Regression Methods |
|---------------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------|
| | Chow Test | Breusch-Pagan Test | Hausman Test | |
| | <i>Pooled</i> vs Fixed Effects | <i>Pooled</i> vs Random Effect | Random Effect vs Fixed Effects | |
| Equation 1 (NWC and CODACE) | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 0,0417 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 9,74E-15 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 < 0,254401 | Random Effect |
| Equation 2 (WCR and CODACE) | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 < 0,0750 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 1,96E-15 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 0,003080 | Pooled Effect |
| Equation 3 (TB and CODACE) | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 0,0252 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 9,77E-24 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 8,77E-13 | Fixed Effect |
| Equation 4 (NWC and GDP) | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 0,0382 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 2,08E-14 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 < 0,164581 | Random Effect |
| Equation 5 (WCR and GDP) | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 < 0,0718 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 3,65E-15 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 0,001343 | Pooled Effect |
| Equation 6 (TB and GDP) | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 0,0242 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 3,03E-23 | H0 = $\alpha < p$ -value H1 = $\alpha > p$ -value 0,05 > 1,46E-13 | Fixed Effect |

Source: Prepared by the authors (2018).

liquid treasury (net cash) and the cash flow were also standardized.

The standardization used was the normalization, $X_{norm(i,j)} = \frac{X_{(i,j)} - \bar{X}_j}{S(X_j)}$, which causes the variables to have a

mean (average) of zero and a standard deviation equal to one. Therefore, it can be concluded that the standard elements enable comparability since they have no size and are highlighted in uniformity of standard deviation.

Table 7 shows the results of the statistical tests used for each of the equations. The tests used were: the Chow test (checks the model stability estimated by structural changes over the estimation period); the Breusch-Pagan test (checks whether the random effects model is more suited to the panel analysis than the pooled least squares model) and the Hausman test (checks whether, with respect to the panel under study, the random effects model is more appropriate than the fixed effects model).

In Equations 1 and 4 the random effect method is applied, where the intercept varies for each individual, but not over time (Fávero, 2013). In Equations 2 and 5, the *pooled* effect method is used, in which behavior is uniform for all individuals and over time, and the observations are homogeneous (Gujarati and Porter, 2017). And finally, in Equations 3 and 6 the assertive method is the fixed effect, which aims to control the effects of omitted variables that vary between individuals and remain constant over time (Fávero, 2013).

Regressions for Net Working Capital

Table 8 shows a comparison between the significant variables of the regressions. It was adopted at 5% for the significance level.

The variable Debt Composition (DC) shows negative coefficients in the two regressions, being statistically significant at 1%, 5%, or 10%. The result found makes sense since the increases in Current Liabilities (CL) are greater than the increases in Non-Current Liabilities (NCL) since the value of CL directly impacts the result arising from the Net Working Capital.

The positive coefficient found in Regression 4 for the Cost of Debt (CD) is consistent with the expected since one of the ways to obtain liquidity in treasury is got through loans, financing, or investments. This borrowing, financing, or investment entails an increase in financial expenses (installment payments, interest, fees, or service charges) for companies.

In turn, the variables Working Capital Requirement and Treasury Balance showed positive coefficients and were statistically significant for all three levels. This result shows that the higher the WCR and/or the TB of a company, the higher the NWC value will be. The result was expected, as the NWC analyzes the difference between Current Assets and Current Liabilities. This indicator can be defined as a sum between the WCR and the TB since the WCR assesses the operational part of the current assets and liabilities, and the TB analyzes the financial part of the current assets and liabilities.

For the sample and in both regressions, the variable Treasury Balance on Sales (TBS) shows a negative coefficient. The result was in line with the Fleuriet Model, as the Treasury Balance will become increasingly negative with the rapid growth in sales, which is characterized as the “Scissors Effect”. This effect shows a mismatch between the evolution of available long-term sources and the investments that need to be financed, showing an increasing dependence on short-

Table 8. Comparative Regression 1 versus Regression 4.

| Regression 1: NWC - CODACE | | | | Regression 4: NWC - GDP | | | |
|----------------------------|------------------|----------|-----------|-------------------------|------------------|----------|-----------|
| Variable | Coefficient Beta | P-Value | Sig.Level | Variable | Coefficient Beta | P-Value | Sig.Level |
| Const | 0,116254 | 5,73E-92 | *** | Const | 0,108875 | 4,73E-87 | *** |
| CI | -0,056789 | 1,44E-05 | *** | CI | -0,060641 | 2,95E-06 | *** |
| WCR | 0,750752 | 0,0000 | *** | CD | 0,015050 | 0,0296 | ** |
| TB | 0,547795 | 0,0000 | *** | WCR | 0,751350 | 0,0000 | *** |
| TBS | -0,015839 | 0,0384 | ** | TB | 0,547751 | 0,0000 | *** |
| CODACE | -0,010324 | 0,0004 | *** | TBS | -0,016018 | 0,0355 | ** |
| | | | | GDP | 0,001226 | 0,0065 | *** |
| R ² | | 0,998753 | | R ² | | 0,998763 | |
| Sig. of the Model | | 0,000000 | | Sig. of the Model | | 0,000000 | |
| Stat. F | | 3,535660 | | Stat. F | | 1,237110 | |
| P-value | | 0,060440 | | P-value | | 0,266375 | |

Significance Level: * indicates 10%, ** indicates 5%, *** indicates 1%.

Source: Prepared by the authors (2018).

Table 9. Comparative Regression 2 versus Regression 5.

| Regression 2: WCR - CODACE | | | | Regression 5: WCR - GDP | | | |
|----------------------------|------------------|----------|-----------|-------------------------|------------------|----------|-----------|
| Variable | Coefficient Beta | P-Value | Sig.Level | Variable | Coefficient Beta | P-Value | Sig.Level |
| Const | -0,162678 | 1,65E-12 | *** | Const | -0,138206 | 3,72E-21 | *** |
| CL | 0,007697 | 0,0315 | ** | CI | 0,071568 | 0,0243 | ** |
| CI | 0,066120 | 0,0321 | ** | CD | -0,028825 | 0,0376 | ** |
| NWC | 1,320740 | 3,69E-54 | *** | NWC | 1,319790 | 7,97E-54 | *** |
| TB | -0,719634 | 3,18E-43 | *** | TB | -0,717702 | 3,89E-42 | *** |
| CODACE | 0,013795 | 0,0309 | ** | GDP | -0,001642 | 0,0488 | ** |
| R ² | | 0,996883 | | R ² | | 0,996890 | |
| Sig. of the Model | | 0,000000 | | Sig. of the Model | | 0,000000 | |
| Stat. F | | 3,888880 | | Stat. F | | 3,885600 | |
| P-value | | 0,056786 | | P-value | | 0,056885 | |
| Durbin-Watson | | 1,516706 | | Durbin-Watson | | 1,522717 | |

Significance Level: * indicates 10%, ** indicates 5%, *** indicates 1%.

Source: Prepared by the authors (2018).

term resources to finance the company's activities (Fleuriet, Kehdy and Blanc, 2003).

The exogenous variable, GDP, showed a positive coefficient and had an expected response, being statistically significant at 1%, 5%, and 10%. This positive relationship must be connected to the fact that the variable is linked to some aspects, including consumption and investment. In other words, increased consumption provides greater revenue for companies and the investment by companies is elastic in relation to sales revenues.

The dummy used to capture the crisis effect has a negative result. This variable has significance at the three levels. According to the coefficient obtained, downturns in the economy would have resulted in a reduction of liquidity in the treasury, exposing one of the crisis impacts that, at first, may cause a decrease in liquidity in the treasury resulting from a fall in economic activity.

Regressions for Working Capital Requirement

The comparison between regressions can be seen in Table 9, where WCR is shown as a dependent variable. With a significance level of 5%.

The variable Current Liquidity (CL) has a positive coefficient for Regression 2, showing significance only for 5% and 10%. The result depicts that in the short term, companies' rights are higher than obligations, which highlights a financial clearance possible after the settlement of liabilities.

In Regression 5, the Cost of Debt (CD) has a negative value, which confirms the expected from the variable in the liquidity studies, since the temporary increase in liquidity in treasury, through loans and financing to meet the obligations due, also provides an increase in liabilities. This type of liquidity brings with it an increase in financial expenses, which may cause a decrease in the liquidity itself and an increase in corporate insolvency. The variable Composition of Indebtedness (CI) showed positive values for the two regression estimates, showing relevance only for 5% and 10%.

The result shows that the companies' indebtedness is directed to an operational need so that increased liquidity in Working Capital Requirement is a fact generated by the operational investments, raising the percentage of the non-current liabilities (NCL) compared to current liabilities (CL).

The analysis of the variables Net Working Capital and Treasury Balance presented results expected by the Fleuriet

Table 10. Comparative Regressions 3 versus Regressions 6.

| Regression 3: TB - CODACE | | | | Regression 6: TB - GDP | | | |
|---------------------------|------------------|-----------|---------------|------------------------|------------------|-----------|---------------|
| Variable | Coefficient Beta | P-Value | Signif. Level | Variable | Coefficient Beta | P-Value | Signif. Level |
| Const | -0,201274 | 5,73E-48 | *** | Const | -0,191660 | 2,17E-45 | *** |
| CI | 0,131982 | 4,89E-05 | *** | CI | 0,132499 | 4,91E-05 | *** |
| NWC | 1,516080 | 2,57E-279 | *** | NWC | 1,516460 | 2,19E-278 | *** |
| WCR | -1,061080 | 8,67E-186 | *** | WCR | -1,060730 | 6,70E-185 | *** |
| TBS | 0,042984 | 0,0024 | *** | TBS | 0,042012 | 0,0031 | *** |
| NT | 0,143731 | 1,11E-26 | *** | NT | 0,143663 | 1,91E-26 | *** |
| TF | 0,006023 | 0,0354 | ** | TF | 0,006124 | 0,0331 | ** |
| CODACE | 0,020089 | 5,41E-05 | *** | GDP | -0,002531 | 0,0010 | *** |
| R ² | | 0,996037 | | R ² | | 0,996007 | |
| Model Sig. | | 0,000000 | | Model Sig. | | 0,000000 | |
| F Statistic | | 0,685389 | | F Statistic | | 1,63938 | |
| P-value | | 0,408006 | | P-value | | 0,200816 | |
| Durbin-Watson | | 1,610598 | | Durbin-Watson | | 1,599044 | |

Significance Level: * indicates 10%, ** indicates 5%, *** indicates 1%.

Source: Prepared by the authors (2018).

Model. In both results, the variables showed a significant value for the three levels addressed. Since the WCR is a part that makes up the variable NWC, that is, a positive correlation, this only confirms the fact that the higher the NWC index, the higher the WCR, and the inverse also applies. In relation to the TB, there is a negative correlation, whose value resulting from the financial part of the current assets and current liabilities impacts the WCR in reverse, corroborating the scissors effect fact.

The variable GDP in Regression 4 presented a negative coefficient with significance at 5%. This result proved to be as expected since the increase in GDP is caused by an increase in economic activity in the country, that is, when there is more capital circulating in the economy, in order to make it easier for companies to obtain capital from third parties.

This result may occur because there is a capital shortage in the economy, leading to periods of decline in GDP, that is, an economic recession. This event brings many difficulties for organizations. One of these difficulties is the smaller possibility of borrowing and financing through the market. When this alternative is discontinued, solutions for organizations become scarcer. One of the solutions is to interrupt investments and new projects, in such a way that capital can return to the treasury cash to reinforce liquidity in times of crisis.

The variable CODACE - Dating Committee of Economic Cycles, proved to have a positive coefficient with respect to Regression 2, having a 5% significance. This finding is a second reflex provided by the crises, as increased liquidity in the treasury is fostered by investment postponement which had been already authorized before the crisis, so that, in not making these investments, such funds are held in cash for future opportunities.

Another point highlighted to support the liquidity increase in times of crisis is the rise in interest rates, an action practiced by the government as a possible measure, depending on the type of crisis. For companies, the interest rates increase may

be an opportunity to reap gains from debt securities, in order to mitigate operating losses.

Regressions to Treasury Balance

Table 10 performs a collation, where the significant variables of each regression are found. For a 5% level of significance.

The coefficient of Composition of Indebtedness (CI) presented positive coefficients for the two regressions, demonstrating relevance to the three levels of significance. The result makes it evident that the companies' Composition of Indebtedness is for an operational need, and therefore the increase in the Treasury Balance (TB) liquidity is brought on by financial investments. Thus, an explanation for this behavior would be an increase in the values of Operating Current Liabilities (OCL) in relation to Financial Current Liabilities (FCL), so that a decrease in FCL provides TB growth.

The indicators of Net Working Capital and Working Capital Requirements were statistically significant for all three levels, and for the Fleuriet Model and for the Liquidity Theory, the results are in line with expectations. Considering that TB is a part of the NWC index, it can be said that this fact confirms that the higher the NWC, the greater the TB, and the reverse situation is also valid. In the relationship involving WCR, there is a negative correlation, the value of which is a result of the operating part of current assets and liabilities. Such a result affects TB in an opposite way, reaffirming the status of the WCR coefficient being negative.

For both regressions, the Treasury Balance on Sales (TBS) indicator had a positive and significant coefficient for the three levels. The result was expected as this variable is a TB derivation which is the variable dependent on the model. So, the higher the TB value, the greater the Treasury's financial liquidity.

The variable Net Treasury (NT) shows a positive coefficient for the three levels of significance in both regressions. This result is within the expected, as the indicator measures the

organizations' gap or financial exposure, so, the identification of financial slack in companies is a sign of increased liquidity in the treasury.

The analysis of the Treasury Flow (TF) identifies relevance for the three levels of significance and positive coefficients, as predicted by the Fleuriet Model. This positive index correlation can be explained by the basic function of the TF, which is the verification of changes in the TB from one period to the next.

Regarding GDP and the CODACE index, the explanations developed for regressions 2 and 5 are also accepted in the case of regressions 3 and 6. In other words, GDP had a negative coefficient and CODACE had a positive value, and the existence of a difference was evident, that is, for regressions 3 and 6 the two variables were statistically relevant for the values of 1%, 5%, and 10%.

5. CONCLUSIONS

This paper sought to analyze the behavior of treasury liquidity in times of crisis, and this liquidity measurement through indicators. Periods of recession lead to the reduction of capital circulating in the market, limiting the funds raised by organizations. During the economic cycles, an increase in treasury liquidity (operational and financial) was statistically verified by the three dependent variables NWC, WCR, and TB.

Thus, with this evidence, it can be said that periods of crisis impact negatively or positively the cash level in organizations. This statement is confirmed by the study carried out by Álvarez, Sagner and Valdivia (2012), in the sense that in times of recession, organizations do not reach the ideal level of cash in the treasury, that is, there is always an oscillation between a fall and a rise in the cash, and a rise and fall in the cash.

Liquidity concepts indicate the importance of having the ability to pay the obligations in due time, where the equity resources supply the payment needs. Based on statistical data, Regressions 1 and 4 are more in line with operational and financial liquidity as they present elements that may indicate current and/or future liquidity situations. In other words, the variables Composition of Indebtedness (CI) and Cost of Debt (CD) are determinants in the liquidity level, as there is a negative association between short and long-term debts (CI) and cash liquidity (NWC); In addition, the market capitalization reflected by the cost of debt at first may be positive indicating increased liquidity, but at some point, its increase will impact the reduction of cash liquidity (NWC), that is, an inverted U curve (Locan and Caldeira, 2014). The variable Treasury Balance on Sales (TBS), being negative, corroborates in identifying that there is a scissors effect, possibly due to the increase in indebtedness; this effect represents a high need for working capital and a decrease in the treasury balance (Assaf Neto and Silva, 2012).

The 2008/09 period is marked by a reliability crisis between organizations and the financial market, and this scenario has resulted in a need for liquidity in terms of transactions, that is, the evidence shows an increase in leverage and indebtedness/financing ratios and a drop in liquidity ratios. As elucidated by Almeida and Campello (2007) companies leveraged

themselves with third-party capital (banks or governments) to support their operational transactions, using assets as collateral for financing, thereby reducing the need for cash retention.

With regards to the fiscal crisis period from 2014 to 2016, the precautionary aspect found in the liquidity reasons is present in the findings, the prolonged effects of the crisis on the economy creating an adverse scenario, where there is an urgent short-term cash need. What, according to Bates, Kahle and Stulz (2009), has conditioned the companies to maintain a high level of cash to hedge against financial and economic storms, and to honor payments.

The limitations of this study refer first to the use of the CODACE index for periods of recession/expansion, without applying the difference between the periods. As a solution to this issue, it is necessary to use time series to highlight the impact and differences between periods of expansion and recession. Still, regarding the limitations of this study, there was a sample of only 36 companies on the Ibovespa, which could be mitigated by an increase in the sample within the B3 list itself or even conducting a study to other countries, would have the probability of evidencing new information.

As a suggestion for future work, the inclusion of other exogenous variables is recommended, such as the exchange rate, taxes, US T-bond, interest rate, reserves, inflation, and public debt, moreover other endogenous aspects of companies, such as mergers and acquisitions, investments, and hedge. It is also suggested to apply it in other emerging and developed countries, which in a way is fundamental for a comparative analysis between the results obtained, as well as the testing of other more refined econometric methods to measure treasury liquidity in economic cycles.

Finally, this work concluded that the treasury balance (cash balance) in periods of fluctuations (crisis) decreases and increases depending on the company's liquidity policy and that the treasury liquidity must be checked, taking into account operational and financial aspects.

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