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DETERMINANTS OF THE WORKING CAPITAL REQUIREMENT AND THE NET OPERATING CYCLE OF BRAZILIAN COMPANIES LISTED IN B3

SABRINA ESPINELE DA SILVA
Universidade Federal de Minas Gerais. ***Address:*** *Av. Pres. Antônio Carlos, 6627, Prédio FACE | Pampulha | 31270-901 | Belo Horizonte/MG | Brazil.*
http://orcid.org/0000-0001-9451-144X
sabrinaespinele@gmail.com

MARCOS ANTÔNIO DE CAMARGOS
Universidade Federal de Minas Gerais e Faculdade Ibmec de Minas Gerais. ***Address:*** *Av. Pres. Antônio Carlos, 6627, Prédio FACE | Pampulha | 31270-901 | Belo Horizonte/MG | Brazil.*
http://orcid.org/0000-0002-3456-8249
marcosac@face.ufmg.br

SIMONE EVANGELISTA FONSECA
Universidade Federal de Minas Gerais. ***Address:*** *Av. Pres. Antônio Carlos, 6627, Prédio FACE | Pampulha | 31270-901 | Belo Horizonte/MG | Brazil.*
http://orcid.org/0000-0002-1169-8614
simone_fonseca16@hotmail.com

ROBERT ALDO IQUIAPAZA
Universidade Federal de Minas Gerais. ***Address:*** *Av. Pres. Antônio Carlos, 6627, Prédio FACE | Pampulha | 31270-901 | Belo Horizonte/MG | Brazil.*
http://orcid.org/0000-0003-1657-2823
rbali@ufmg.br

ABSTRACT

The working capital management is of great importance for the survival and profitability of the companies. Decisions of operational order can have both short-term and long-term consequences, affecting the operational performance of companies. Thus, the efficient management of working capital and the knowledge of his determinants factors has relevance for business managers since it can impact the liquidity and profitability of companies. The aim of this study was to identify and analyze the determinants of working capital requirement (WCR) and net operating cycle (CF) requirements of Brazilian publicly held non-financial corporations, covering the period from March 2010 to December 2016 (28 quarters). Methodologically, we used regression analysis with panel data and the feasible generalized least squares model that is robust to heteroscedasticity problems. The results showed that the operating cash flow has a negative relation with the net operating cycle, while the asset return and the sales growth have a positive relation. In addition, the current liquidity, the size of the company and the leverage were significant and negatively related to the companies' need for working capital.

Keywords: Working capital management. Working capital requirement. Net operating cycle. Corporate Finance.

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1 INTRODUCTION

The topic addressed in this research, working capital management, still needs studies in both national and international literature given its relevance to conducting business and due to being a determinant of business performance (Garcia-Teruel & Martinez-Solano, 2007). Although current assets represent between 30 and 40% of the total asset value, their management, however, requires greater financial area efforts than those required by fixed assets management due to their continuous changes (Assaf Neto & Silva, 2009).

Throughout the evolution of the corporate finance literature there is a greater focus on long-term financial management (Nazir & Afza, 2009; Palombini & Nakamura, 2012; Singh & Kumar, 2014; Chang, 2018). However, short-term financial management is important to companies and consumes much of financial managers' time and effort. In academic terms, it is still a little explored field in empirical research.

Managing short-term liabilities has already represented one of the main corporate financial functions, as companies were concerned with ensuring the ability to pay their daily bills. However, markets growth and development have heightened companies' competition and breadth, shifting management's focus to managing companies' funds applications and sources and thus having a broader view (Fusco, 1996).

Within short-term financial policies, companies must manage their working capital requirements. Companies' future performance may be reflected in the study of their working capital, which makes its management a topic of importance within corporate finance (Assaf Neto & Lima, 2009; Nazir & Afza, 2009). For Jalal and Khaksari (2019), short-term financial management is one of the three most important activities for corporate managers, along with capital budgeting and long-term financial management.

Assaf Neto and Lima (2009, p. 631) highlight that "[…] All financial decisions that may be carried out by a company require careful attention to its current assets." According to Silva, Santos, Hein and Lyra (2012), good working capital management is linked to corporate liquidity and solvency. In addition to being important for maintaining companies' financial health, working capital management is also a way of addressing inherent business uncertainties (Fusco, 1996; Gill, 2011). Seidel and Kume (2003) stress that the need for working capital contributes to many companies going bankrupt.

Araújo and Machado (2007) argue that investment in current assets represents a significant portion of investments in relation to total corporate assets. Thus, short-term financial management is important for maximizing companies' value and operating performance (Chang, 2018). Nazir and Afza (2009) argue that companies can improve their overall performance as well as lower their risk if they understand working capital role and determinants. In the same line, Jalal and Khaksari (2019) argue that there is a relationship among companies' value, a country's level of development and working capital management. Additionally, they show that companies with shorter cash cycles tend to have higher market value and lower indebtedness.

Working capital, also called current working capital, is defined as the financial resources that rotate (circulate) several times within a given period. Operationally, it represents the capital required by a company to finance its operating cycle, which ranges from the need to purchase raw materials to the sale of finished products. Importance and level of this working capital change depending on each company's particular characteristics as well as the sector of activity, the economic conditions and the desired risk-return ratio (Fusco, 1996; Assaf Neto & Lima, 2009; Berk & Demarzo, 2009).

Working capital components are found in companies' current assets. Current liabilities include short-term sources of funds. And in current assets are the investments of funds. The difference between total assets and current liabilities determines companies' net working capital. A positive difference – when current assets exceed current liabilities – indicates that the company is able to meet its short-term commitments.

However, some caution should be taken regarding this indicator, as a positive value may indicate high inventory levels or many trade bills receivable, i.e., it is not necessarily indicating that the company is in a good financial situation.

As future cash flows are permeated by uncertainties, working capital management becomes relevant and represents a constant challenge for managers. According to Palombini and Nakamura (2012), good working capital management is critical to Brazilian companies' operating performance given the high costs of short-term borrowing and difficulties in obtaining financing for permanent working capital requirements.

International studies such as those by Nazir and Afza (2009), Gill (2011) and Jalal and Khaksari (2019) highlight the importance of efficient working capital requirements management. Companies can minimize risk and improve overall performance if they can understand the determinants of their working capital requirements. However, few Brazilian studies have explored the determinants of working capital requirements. It is in aiming to fill this gap in the national literature that resides the scope of this study.

In this context, the objective of this study is to identify and analyze factors that determine Brazilian companies' working capital requirements (WCR) as well as their financial cycle. WCR is determined by the companies' cash cycle and is related to average payment and payment terms and, consequently, financial cycles. When cycles are longer, WCR is larger and the reverse is also valid. WCR forecasting is facilitated by calculating the financial cycle due to some change in average term policies or sales volume. This is the approach used in this paper.

Analysis has been undertaken on a sample of 112 publicly traded companies and includes the period between March 2010 and December 2016. Results have shown that larger, with more current liquidity and more leveraged companies tend to have lower working capital requirements, while companies with higher operating cash flows tend to have shorter financial cycles.

In addition to this initial introductory section, this study is structured as follows: the second section presents a review of the literature. The third section presents the methodological procedures. The fourth section presents the results and the fifth section presents the final considerations, ending with the references consulted.

2 LITERATURE REVIEW

2.1. Short-term financial management and working capital requirements

Importance of good short-term business management is not a recent topic. Smith (1973) has already pointed out that some companies' failure could be attributed to their financial managers' inability in planning and controlling their short-term assets and liabilities. Gentry (1988) stresses that short-term financial management plays a key role in creating shareholder value. In this same vein, Lamberson (1995) also points out that efficient management of short-term accounts requires time and effort from corporate administrators.

The main objective of short-term financial management is to individually manage components of current assets and current liabilities with a view to achieving a balance between profitability and risk that shall increase companies' value. From this perspective, the importance of good working capital management, which is capable of improving companies' competitive position, as well as their profitability, is important (Gill, 2011). This is why, in working capital management research, its impact on companies' profitability has been widely studied (Archavli, Siriopoulos & Arvanitis, 2012).

In this direction, studies of the international literature on the subject, among which those by Shin and Soenen (1998) and Afza and Nazir (2007), emphasize that the components and the way companies manage their short-term resources (working capital) can have a significant impact on their liquidity, profitability, market value and shareholder value creation.

Various accounts that involve working capital analysis must be managed in order to strike a balance: companies should have neither too little nor too much liquidity and this provides a balance between risk and efficiency (Fusco, 1996; Nazir & Afza, 2009; Gill, 2011). According to Baños-Caballero, García-Teruel and Martínez-Solano (2014, pg. 6, our translation) "There exists an optimal level of investment in working capital that balances costs and benefits and maximizes a firm's performance." Deloof (2003) supports this idea and underlines that companies must have an optimal level of working capital in order to maximize their value.

In this context, Eljelly (2004) also argues that efficient working capital management is central to planning and controlling current assets and liabilities. The idea is to invest the least in asset items in order to minimize the risk of the company not being able to meet its future obligations. Companies must strive to find an "optimal combination" of reducing inventory and customer levels and increasing lead times with their suppliers (Kargar & Blumenthal, 1994). Ganesan (2007) stresses that efficient working capital management increases companies' growth opportunities and shareholder returns.

Gill (2011) points out that achieving an optimal level of working capital investment requires constant monitoring of its components, such as accounts receivable, accounts payable, inventories, cash, among others. In addition, the author points out that efficient working capital management is of great importance to business organizations, as it influences liquidity and profitability. Berk and Demarzo (2009, p. 847) highlight that "Any working capital reduction requirements generate positive free cash flow that companies can immediately distribute to shareholders."

Seidel and Kume (2003) point out that the need for working capital and its variations drives many companies into bankruptcy. The authors argue that, as important as decisions on investments in permanent assets, are decisions to grant customers and maintain inventories, accounts that are accounted for in current assets, given that these decisions also have lasting effects on companies' financial positions. Deloof (2003) points out that a reduction in customer and inventory lead times can increase companies' profitability.

Companies' operating and financial activities are concerns of short-term financial management. These activities range from the purchase of raw materials, payment terms to suppliers, manufacture and sale of products as well as credit policies that shall be used. The mismatch between payment terms to suppliers and the time term for customers represents companies' financial cycles as the operating cycle represents the time period from the purchase of raw materials to the actual receipt of sales carried out over time.

The difference between applications and sources of operating accounts represents companies' working capital requirement (WCR). In other words, the difference between accounts that make up Operating Current Assets (OCA), such as customers and inventories, and accounts that make up Operating Current Liabilities (OCL), such as suppliers, provides the WCR value (Seidel & Kume, 2003). WCR is a function of companies' cash cycles. The longer the cash cycle the longer they shall be and vice versa. One of the goals of financial management is to receive in advance (reducing the time to receive from customers) and pay as soon as possible (increasing suppliers' term), which would consequently reduce cash flow and WCR.

However, to reduce cash flow, companies must adopt operational measures such as shortening production lead times, stocking and sales. In this way, calculation of WCR is facilitated by calculation of the financial cycle due to a change in sales volume. Seidel and Kume (2003) highlight the various reasons that may cause changes in WCR, including changes in inventory prices, increases or decreases in economic activity levels, changes in suppliers' payment terms and receiving from customers.

Guimarães and Nossa (2010) point out that liquidity is also a variable related to working capital and it's financing. Liquidity represents companies' ability to meet their obligations. Lack of liquidity implies delays in paying service providers. According to the authors, current liquidity

is the appropriate indicator for verifying the relationship between liquidity and working capital as it is the most commonly used indicator.

2.2. Previous Studies

In the international literature, Chiou, Cheng and Wu (2006) have studied Thai companies between 1996 and 2004. The authors have found that leverage and operating cash flow negatively affect working capital and that companies' size has a positive relationship to working capital requirements.

Nazir and Afza (2009) have studied the determinants of working capital in Pakistani non-financial corporations. Results have indicated a positive relationship between working capital, dummy companies, operating cycle, Tobin's Q (market performance) and return on assets. In addition, they have pointed to a negative relationship between working capital and company leverage, demonstrating that companies with a higher debt-to-total assets ratio tend to pay more attention to efficient working capital management to prevent considerable capital from being linked to accounts receivable and inventories. The variables operating cash flow, economic activity, sales growth and size were not statistically significant.

Hill, Kelly and Highfield (2010) have investigated factors that influence net investment in operating working capital (OWC). Results have shown a significant negative relationship between OWC, sales growth, sales volatility, market value over book value index and financial distress index. The survey has also indicated a positive and significant relationship between OWC, operating cash flow and company's size.

The study by Gill (2011) has aimed to find the factors that influence the working capital demand in Canadian companies. For this, it has analyzed 166 companies listed on the Toronto Stock Exchange for a period of three years (2008-2010). Results have shown a positive relationship for the operating cycle, return on assets, company's internationalization and the dummy for industry and a negative relationship for companies' growth and size. Nonsignificant relationships have been found for operating cash flow, Tobin's Q and leverage.

Wasiuzzaman and Arumugam (2013) have investigated working capital investment determinants in Malaysian companies. Results have shown that in periods of economic expansion there is a positive relationship among sales growth, operating cash flow and working capital investment. In addition, this relationship is negative for company's age, sales volatility, company's size and leverage level.

Baños-Caballero, García-Teruel and Martínez-Solano (2014) focus the relationship between working capital investment and business performance. They have analyzed nonfinancial companies in the United Kingdom. Results have shown that there is an inverted U-shaped relationship between working capital investment and companies' performance. Thus, when a company maintains a low level of working capital investment, the relationship between working capital investment and corporate performance is positive. However, the relationship is reversed for companies with high investments in working capital.

Singh and Kumar (2014) have conducted a literature review on working capital management studies. The authors have concluded that studies in this area have focused more attention on the relationship between working capital management and companies' profitability, considering that there is a theoretical gap in studies in this field.

Azeem and Marsap (2015) have investigated working capital requirements determinants factors in Pakistan. The authors have analyzed nonfinancial companies for a period of six years. Results have shown that there is a negative and statistically significant relationship between returns on assets, leverage and companies' size on working capital demand. On the other hand, operating cash flow has been positively related. Nonsignificant results have been found for operating cycle, economic activity level and sales growth.

In the national literature, Palombini and Nakamura (2012) have analyzed the determining factors of working capital management in Brazilian companies. Results have shown that the level

of indebtedness, free cash flow, companies' size (measured by sales logarithm) and sales growth have a negative and significant relationship with companies' working capital level. These results have indicated that companies with smaller growth and smaller size invest more in working capital.

In summary, evidence presented in the empirical literature on the subject shows that the variables returns on assets, level of financial leverage, operating cash flow, sales growth and companies' size are relevant in determining working capital requirements and companies' financial cycles. Additionally, a dummy variable that specifies the sector is also relevant.

Table 1
Summary of the main studies on the theme

Author	Period	Country	Results
Chiou, Cheng e Wu (2006)	1996 - 2004	Thailand	The authors have found that leverage and operating cash flow negatively affect working capital and that companies' size has a positive relationship to working capital requirements.
Nazir and Afza (2009)	2004 - 2007	Pakistan	They have found a positive relationship between working capital, dummy companies, the operating cycle, Tobin's Q (market performance) and return on assets. In addition, a negative relationship between working capital and companies' leverage has been pointed out.
Hill, Kelly and Highfield (2010)	1991 - 2006	United States	They have found a negative and significant relationship between operating working capital (OWC), sales growth, sales volatility, market value over book value index and financial distress index. The survey has also indicated a positive and significant relationship between OWC, operating cash flow and company's size.
Gill (2011)	2008 - 2010	Canada	A positive relationship has been found for the operating cycle, return on assets, company's internationalization and the dummy for industry and a negative relationship for companies' growth and size. Nonsignificant relationships have been found for operating cash flow, Tobin's Q and leverage.
Palombini and Nakamura (2012)	2001 - 2008	Brazil	It has been found that the level of indebtedness, free cash flow, companies' size (measured by sales logarithm) and sales growth have a negative and significant relationship with companies' working capital level.
Wasiuzzaman and Arumugam (2013)	2000 - 2007	Malaysia	It has been found that in periods of economic expansion there is a positive relationship among sales growth, operating cash flow and working capital investment. In addition, this relationship is negative for company's age, sales volatility, company's size and leverage level.
Baños-Caballero, García-Teruel and Martínez-Solano (2014)	2001 - 2007	United Kingdom	It has been found that there is an inverted U-shaped relationship between working capital investment and companies' performance. Thus, when a company maintains a low level of working capital investment, the relationship between working capital investment and corporate performance is

			positive. However, the relationship is reversed for companies with high investments in working capital.
Azeem and Marsap (2015)	2004 - 2009	Pakistan	It has been found that there is a negative and statistically significant relationship between returns on assets, leverage and companies' size on working capital demand. On the other hand, operating cash flow has been positively related. Nonsignificant results have been found for operating cycle, economic activity level and sales growth.

Source: Prepared by the authors.

3 METHODOLOGY

Analysis of working capital requirements (WCR) determinants and financial cycles of publicly traded Brazilian companies has been performed by quantitative data approach research using panel data regression. Regarding objectives, this is a descriptive, *ex-post-facto* research using secondary data.

3.1. Data and Sample

Data used have been collected from the *Quantum Axis* database and comprise financial information from all publicly traded companies available at Brazilian Stock Exchange B3 [(in full, B3 – Brasil Bolsa Balcão S.A. (B3) Brazil, Stock Exchange and Over-the-Counter Market), formerly BM&FBOVESPA]. It should be noted that financial sector companies have been excluded from the sample due to their financial statements specificities and standardization.

The period analyzed was from March 2010 to December 2016. Justification for choosing this period is due to the fact of implementation of international accounting standards (IFRS – *International Financial Reporting Standards*) in 2010. Using data prior to this deployment could skew the results. Quarterly information has been collected on financial cycles, current liquidity, profit/loss for the period, net revenue, total assets, leverage (gross debt over total assets), net cash flow from operating activities and shareholders' equity.

As a way to make more robust the estimation results, information from companies with negative equity, missing financial data, negative sales values and non-positive total assets has been excluded from the sample, similar to that performed by Hill, Kelly and Highfield (2010). In addition, companies that presented extreme information in relation to the others have also been excluded from the sample in order to avoid problems from estimation *outliers*, a procedure similar to that performed by Palombini and Nakamura (2012).

Given this, the final sample consisted of 112 publicly traded nonfinancial companies that operate in nine market sectors. In total, 2,997 quarterly observations were considered.

3.2 Variables and Econometric Model

Companies' working capital requirement (WCR) has been calculated through financial cycles and daily sales. Because sales data have been collected on a quarterly basis, they have been divided over 90 (3 months x 30 days) to turn them into daily data. Therefore, WCR was calculated according to Equation 1.

$$\boldsymbol{WCR_t} = Financial\_Cycle_t \boldsymbol{x} \frac{Quarterly\ Sales}{90} \qquad \text{Equation (1)}$$

In order to control the effect of companies' size, WCR was calculated in terms of total assets, that is, each company's WCR in each quarter was divided by the respective value of total assets in the previous quarter, a procedure similar to that adopted by Nazir and Afza (2009).

The *proxy* for companies' size consisted of the natural logarithm (NL) of net revenue, as proposed by Palombini and Nakamura (2012). Alternatively, size has also been measured by the NL of total assets according to procedure by Gill (2011) and Azeem and Marsap (2015). There was a choice for two measurements because the first size measurement would not be adequate for the equation that has the WCR as a dependent variable. Thus, dependent variables that represent the size [SIZE and SIZE (2)] have been calculated according to Equations 2 and 3.

$$Size = ln(Net\_Revenue) \qquad \text{Equation (2)}$$

$$Size\_2 = ln(Total\_Assets) \qquad \text{Equation (3)}$$

The financial leverage measure was calculated by dividing the company's gross debt in each quarter by total assets in the same period. Calculation of corporate leverage (LEV) has been performed according to Equation 4.

$$Leverage = \frac{Gross\_debt}{Total\_Assets} \qquad \text{Equation (4)}$$

Sales growth (Growth) has been calculated by differentiating the series, i.e., sales in period t subtracted from sales in period t-1. This procedure can be seen in equation 5.

$$Growth = Sales_t - Sales_{t-1} \qquad \text{Equation (5)}$$

In order to capture the difference between WCR in the different market segments, a *dummy* variable has been included in the regression in order to differentiate companies from the industrial segment. The other variables: current liquidity (CL) and net operating cash flow (OCF) have been directly obtained from the database.

Thus, two multiple regression models with panel data have been estimated since the data consist of several companies over a period of time, that is, there are variations between units and variations in time. The models have been estimated according to Equations 6 and 7.

$$FC_{i,t} = OCF_{i,t-1} + ROA_{i,t-1} + CL_{i,t-1} + Size_{i,t-1} + ALAV_{i,t-1} + Growth_{i,t} + IND + \varepsilon_{i,t}$$
Equation (6)

$$WCR_{i,t} = OCF_{i,t-1} + ROA_{i,t-1} + CL_{i,t-1} + Size(2)_{i,t-1} + ALAV_{i,t-1} + Growth_{i,t} + IND + \varepsilon_{i,t}$$
Equation (7)

Where: FC represents companies' financial cycles, WCR represents working capital weighted by total assets, OCF represents operating cash flow weighted by total assets, ROA represents return on assets, CL represents current liquidity, SIZE represents the natural logarithm of net income, SIZE (2) represents the natural logarithm of total assets, LEV represents gross debt weighted by total assets, Growth represents the variation in sales, all variables in relation to company i in periods t-1 or t. IND is a *dummy* that takes on value 1 for companies in the industrial sector and 0 for companies in the commercial and service sectors.

To validate the proposed econometric model, multicollinearity (VIF; Variance Inflation Factor), normality (Shapiro-Wilk) and homoscedasticity (Breusch-Pagan) tests were performed. The Hausman specification test has also been performed to verify the suitability between a panel data model with fixed effects versus random effects.

However, because heteroscedasticity tests have pointed to rejection of the null hypothesis, that is, they have pointed to heteroscedasticity problems in the data, the models of Equations 6 and 7 have also been estimated by the feasible generalized least squares method, since this method is robust to heteroscedasticity problems. Table 2 presents a summary of the variables used, their respective operationalization as well as their theoretical/empirical sources.

Table 2
Operationalization of the variables of the proposed model

Dependent variables				
No.	**Variable**	**Acronym**	**Calculation**	**Theoretical Source**
1	Operating Cash Flow	OCF	Net cash operational activities/Total assets	Wasiuzzaman and Arumugam (2013)
2	Asset Profitability	ROA	Net profit/Total assets	Nazir and Afza (2009); Azeem and Marsap (2015)
3	Current Liquidity	CL	Current Assets/Current Liabilities	Guimarães and Nossa (2010)
4	Size	Size	In (Net revenue)	Palombini and Nakamura (2012)
5	Size	Size (2)	In (Total Assets)	Nazir and Afza (2009); Gill (2011)
6	Leverage	ALAV	Gross Debt/Total Assets	Palombini and Nakamura (2012); Wasiuzzaman and Arumugam (2013); Azeem and Marsap (2015)
7	Sales Growth	Growth	Sales (t) – Sales (t-1)	Palombini and Nakamura (2012); Wasiuzzaman and Arumugam (2013)
8	Industrial Segment	IND	*Dummy* for the industry segment	Nazir and Afza (2009); Gill (2011)

Source: Prepared by the authors.

4 RESULTS

4.1 Descriptive Statistics of Variables

Table 3 presents the descriptive statistics of the variables used in the regression model. As expected, heterogeneous values have been observed, considering the diversity of the companies analyzed, different characteristics and sectors of the economy. The coefficient of variation, the ratio between deviation and mean of the variables, highlights companies' heterogeneity, especially in relation to companies' FC, WCR, ROA and Growth.

Table 3
Descriptive Statistics of Variables

	FC	**WCR**	**OCF**	**ROA**	**CL**	**Size**	**Size(2)**	**ALAV**	**Growth**
Unit	**Days**	**$/AT**	**$/AT**	**%**		**ln(RL)**	**ln(AT)**	**$/AT**	**$/AT**
No. Note	2,997	2,997	2,997	2,997	2,997	2,997	2,997	2,997	2,997
No. Emp.	112	112	112	112	112	112	112	112	112
Minimum	-259.4	-7.72	-0.16	-16.29	0.4	9.24	11.79	0	-2.69
Maximum	309.4	24.61	0.56	32.85	7.87	19.64	20.65	0.75	68.71
1st Q.	17.1	0.09	0.07	1.51	1.13	14	14.45	0.22	-0.02
3rd Q.	107.3	0.99	0.16	7.61	2.06	15.8	16.41	0.42	0.13
Average	66.75	0.61	0.12	4.54	1.7	14.95	15.41	0.32	0.12
Average	52.3	0.33	0.12	4.39	1.55	14.95	15.37	0.32	0.04

SD	71.32	1.02	0.08	5.06	0.83	1.47	1.49	0.14	1.76
VC	1.07	1.67	0.67	1.11	0.49	0.10	0.10	0.44	14.67

Source: Prepared by the authors.

Statistics show that companies have on average and median a need for positive working capital, demonstrating that, in general, companies have a long cash cycle, that is, they still need to work on managing their operating deadlines (of stocking, receipt and payment) with a view to trying to reduce the cash cycle by adopting operational measures such as shortening the terms granted to customers and advance payment terms with suppliers.

It is also observed that companies have, on average, a positive financial cycle showing that Brazilian companies' economic and operating cycles generally tend to be longer than the average payment term to suppliers. Companies also have, on average, low leverage (32%) and average sales growth of 12% over the period.

4.2. Estimation results

Table 4 shows results from the regression model for panel data with the companies' financial cycles as the dependent variable. There has been a choice to present results from the three models (pooling, fixed effects and random effects).

Table 4
Model Result for Dashboard Data (Financial Cycle)

	Financial Cycle		
	Pooling	Fixed effects	Random effects
OCF	-93,077***	49,823***	44,871***
	(17,567)	(13,574)	(13,574)
ROA	-1,161***	0,324*	0,283
	(0,270)	(0,179)	(0,180)
CL	29,124***	-0,327	0,431
	(1,367)	(1,021)	(1,022)
Size	-14,037***	-6,374***	-8,349***
	(0,794)	(1,585)	(1,453)
ALAV	-19,771**	9,007	7,328
	(8,390)	(8,011)	(7,948)
Growth	-0,195	0,326	0,300
	(0,636)	(0,302)	(0,306)
IND	4,730*		-0,242
	(2,849)		(12,093)
Constant	248,629***		181,980***
	(12,309)		(22,650)
R^2	0.27	0,016	0,019
F-Statistic	157,976***	7,789***	8,247***

Note. values in parentheses represent the standard error of variables; *, **, *** significance at 5%, 1% and 0.1% respectively. Source: Prepared by the authors.

From the model results shown in Table 4, it can be concluded that operating cash flow and companies' size have a statistically significant relationship with the financial cycle, with larger companies presenting smaller financial cycles. However, before making inferences, the model validation tests were performed, which can be observed in Table 53.

Results from the VIF (Variance Inflation Factor) test (Table 5) have returned values below two, thus pointing to an absence of multicollinearity among the proposed model explanatory variables. The normality test of the Shapiro-Wilk residual distribution terms has led to rejection of the null hypothesis of normality thus leading to the conclusion that the model error terms are not normally distributed. The Breusch-Pagan test has also led to rejection of the null hypothesis of error terms homoscedasticity, that is, the data present heteroscedasticity. As for the Hausman specification test, it points to rejection of the null hypothesis and to appropriateness of using a fixed effects model.

Table 5
Validation Test Results

Test	Statistics	p-value
VIF (higher value)	1.5049	-
Shapiro-Wilk	0.83089	0.0000*
Breush-Pagan	995.65	0.0000*
Hausman - Test	17,256	0.0083*

Note. *, **, *** significance at 5%, 1% and <0.1%, respectively.
Source: Prepared by the authors.

Due to results from the model validation tests, a robust regression model has been applied to the presence of heteroscedasticity. Thus, the Equation 6 model was estimated by the feasible generalized least squares method with fixed effects. The results of this estimation are shown in Table 8. However, before applying a robust model, the results for the panel data model for Equation 7 are verified, which can be observed in Table 6.

Table 6
Model Result for Dashboard Data (WCR)

	NCG		
	Pooling	Fixed effects	Random effects
OCF	-0,568**	0,830***	0,674**
	(0,233)	(0,280)	(0,272)
ROA	0,002	0,006*	0,006*
	(0,004)	(0,004)	(0,004)
CL	0,241***	-0,008	0,015
	(0,018)	(0,021)	(0,021)
Size (2)	-0,094***	0,066**	-0,011
	(0,011)	(0,033)	(0,025)
ALAV	-0,515***	-1,132***	-1,042***
	(0,111)	(0,165)	(0,156)
Growth	0,323***	0,324***	0,323***
	(0,008)	(0,006)	(0,006)
IND	0,096**		0,110
	(0,038)		(0,131)
Constant	1,767***		0,908**
	(0,163)		(0,378)
R^2	0,378	0,491	0,478
F-Statistic	259,072***	463,384***	390,534***

Note: values in parentheses represent the standard error of variables; *, **, *** significance at 5%, 1% and 0.1% respectively. Source: Prepared by the authors.

Results in Table 6 show that operating cash flow, asset return, leverage and sales growth are statistically significant variables for determining WCR. However, as for the previous model, before making inferences, validation tests of the model have been performed. The results are shown in Table 7.

Table 7
Validation Test Results

Test	Statistics	p-value
VIF (higher value)	1.5049	-
Shapiro-Wilk	0.38948	0.0000*
Breush-Pagan	28764	0.0000*
Hausman – Test	57,491	0.0000*

Note. *, **, *** significance at 5%, 1% and <0.1%, respectively.
Source: Prepared by the authors.

The VIF test has indicated absence of multicollinearity among the explanatory variables of the model. The normality test of the Shapiro-Wilk error terms has again led to rejection of the null hypothesis of normality thus leading to the conclusion that the model error terms are not normally distributed. The Breusch-Pagan test also led to rejection of the null hypothesis of homoscedasticity of error terms, that is, the data present heteroscedasticity.

Thus, as for the previous model, it was decided to apply a regression model that is robust to the presence of heteroscedasticity. Thus, the model of Equation 7 has also been estimated by the feasible generalized least squares method and results from this estimation can be seen in Table 8.

Table 8
Results from the feasible generalized least squares (GLS) regression model

	MQG	
	FC	WCR
OCF	-15,042***	0,526***
ROA	0,424***	0,007***
CL	0,128	-0,042***
Size	0,714	
Size (2)		-0,019*
ALAV	1,884	-0,802***
Growth	0,169***	0,523***
Multiple R-squared	0.8436	0.5656

Note: values in parentheses represent the standard error of variables; *, **, *** significance at 5%, 1% and 0.1% respectively. Source: Prepared by the authors

As shown in Table 8, operating cash flow, asset profitability and sales growth have been statistically significant variables in determining companies' financial cycles. In turn, operating cash flow, asset return, current liquidity, size, leverage and sales growth have been statistically significant variables in determining working capital requirements.

These results indicated that companies with higher operating cash flow (OCF) tend to have shorter financial cycles. Increase in operating cash flow may be due to increase in sales, which causes a reduction in companies' economic cycles, i.e., the average storage period tends to be reduced as well as the average customer receipt period, which consequently means shortening financial cycles.

The positive relationship found between OCF and WCR corroborates the study by Hill, Kelly and Highfield (2010). According to the authors, companies with higher operating cash flows tend to adopt more conservative working capital management, with less restrictive inventory management policies and credit standards, thus increasing profitability.

Contrary to expectations and in disagreement with notes by Deloof (2003), asset profitability has been positively related to companies' financial cycles and working capital requirement (WCR), indicating that more profitable companies tend to have longer financial cycles and WCR. Regarding this, Nazir and Afza (2009) and Gill (2011) have found similar results. According to Gill (2011), the positive relationship between profitability and working capital requirements has indicated that the most profitable companies apparently pay less attention to efficient working capital management.

The negative relationship found for current liquidity and WCR has indicated that companies with higher liquidity tend to have lower working capital requirements. Generally speaking, the higher the margin by which companies' current assets cover current liabilities, the greater their ability to meet obligations within an established period. Thus, the more predictable the cash inflows, the lower the companies' net working capital requirements. Thus, the greater the current liquidity of a company, the smaller the WCR tends to be.

Regarding the size variable, a positive relationship with WCR was expected, as argued by Chiou, Cheng and Wu (2006) and Kieschnick, Laplante and Moussawi (2006). This indicates that an increase in companies' size may lead to an increase in operating activities and, as a result, in current assets and liabilities. However, a negative relationship has been observed between WCR and size. This implies that larger companies tend to have a lower working capital requirement. Hill, Kelly and Highfield (2010) argue that smaller companies tend to follow operating strategies related to working capital management more closely because they have fewer financing alternatives available to meet their working capital demand. Although nonsignificant, Palombini and Nakamura (2012) have also found similar results for Brazilian companies, although considering another period of analysis and sample spectrum.

Moreover, results have pointed to a significant and negative relationship between WCR and indebtedness, signaling that more leveraged companies tend to adopt a more aggressive working capital management policy to avoid new bond and stock issues. The same results have been obtained by Chiou, Cheng and Wu (2006), Nazir and Afza (2008) in the international literature and by Palombini and Nakamura (2012) in the national literature.

According to Nazir and Afza (2009), indebted companies tend to be more careful about efficient working capital management to avoid too much capital being tied to short-term accounts. Hill, Kelly and Highfield (2010) stress that struggling companies manage capital more aggressively and with more restrictive working capital policies. These companies are likely to reduce investment in operating working capital by collecting receivables, restricting credit policies to customers, lowering inventory levels and extending payment terms with suppliers.

Finally, sales growth (Growth) has been positively related to companies' financial cycles and working capital requirements. This growth may be driven by the increase in the concession of terms to customers, which would consequently lead to an increase in the financial cycle. In addition, companies with good sales growth prospects may be adopting a more liberal working capital policy aimed at increasing sales. The Brazilian economic crisis could partly explain this positive relationship, given that in a crisis environment, aiming to increase their sales, companies tend to adopt strategies that result in increasing their operating assets and liabilities.

5 CONCLUSION

Working capital management is a relevant issue in corporate management as it consumes a great deal of time and effort from financial managers since this management demands establishment and observance of policies that define the optimal level of each component, in a way

of ensuring risk, return, liquidity and profitability levels that contribute to maximization of companies' value.

However, despite the recognized relevance in the field of corporate finance, it is apparently more valued from the perspective of business praxis than from the academic area, as it is a little explored subject in finance. This scarcity of research on working capital results in: 1. Poor understanding of the impacts of inadequate management on profitability; 2. Little knowledge of its determinants; and 3. Lack of empirical evidence linking the impact of its inadequate management with insolvency and bankruptcy of various types and sizes of companies.

Given this scenario, this study has aimed to identify and analyze the possible determinants of working capital requirements and the financial cycles of Brazilian publicly traded nonfinancial corporations from 2010 to 2016. To this end, model analyses have been performed for panel data as well as feasible generalized least squares models to reduce the effect of sample heteroscedasticity, making the results more robust.

Results have shown that asset profitability and sales growth are statistically significant variables and positively related to companies' financial cycles. On the other hand, operating cash flow has presented a negative and statistically significant relationship with the companies' financial cycles. Contrary to expectations, more profitable companies have tended to have longer financial cycles.

Regarding the determinants of WCR, results have shown a positive relationship for operating cash flow, asset profitability and sales growth while, on the other hand, showing a negative relationship for current liquidity, size and leverage. Thus, it can be concluded that larger companies with high current liquidity and higher leverage tend to have lower working capital requirements. This result is consistent as larger companies find it easier to obtain credit to finance their working capital requirements. In addition, higher current liquidity also indicates greater predictability of cash inflows.

Moreover, this study is not exempt from limitations as the results may have been affected by the sample of companies studied, the variables chosen and the period used. For future research, it is suggested to analyze working capital determinants by comparing traditional and advanced working capital analyses. In addition, one can try to predict the effectiveness of adding short-term financial analysis variables to business failure prediction models.

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