Working Capital Management and Firm Value: Evidences from Brazilian Market

Abstract

We use a sample of Brazilian non-financial public companies listed on BM&FBOVESPA from 2010 to 2015 in order to evaluate the effect of net working capital (NWC) on firm performance and investment. Our results suggest that (i) the relation between excess NWC and stock return is non-linear (that is, there is an inverted U-shaped relationship between NWC investment and firm value), (ii) the relation between excess NWC and firm operating performance is also non-linear, and (iii) there is a negative relation between excess NWC and company investment, and this relation is driven by firms that have negative excess NWC.

Key Words: working capital; valuation; investment; performance.

Códigos *JEL*: G31, G32

1. Introduction

Assets and short-term liabilities are important components of the total assets of a company and need to be treated and managed carefully. Ernst and Young (2015), in a report devoted to the working capital management of 2,000 major US and European companies in 2014, points out that the excess part of the working capital of these companies is about $1,3 trillion and this amount is equivalent to 7% of the aggregate revenue of these firms.

In addition, the efficient working capital management plays a very important role in the strategy of any company, especially with respect to profitability (Shin and Soenen, 1998; Deloof, 2003), risk (Gardner *et al*., 1986; Weinraub and Visscher, 1998), as well as regarding to the firm value (Kieschnick *et al*, 2013; Almeida and Eid Jr, 2014). That is, it seems clear that the efficient working capital management is a key part of the overall strategy of any company to create shareholder value.

However, studies on working capital management highlights two conflicting views on the relationship between investment in working capital and the company's performance. On one hand, the additional investment in working capital can have positive effects, particularly for companies with low levels of working capital. This is the case of companies operating with high levels of inventories in order to, among others, reduce logistics costs, provide protection against commodity price fluctuations and minimize the possibility of loss of sales due to potential lack of inventory, as highlighted by Blinder and Maccini (1991), Fazzari and Petersen (1993) and Corsten and Gruen (2004), among others. Furthermore, increasing working capital by supplying credit to customers (trade credit) can also positively impact sales because, for example, it allows for price

discrimination, serves as a guarantee for the quality of the product sold and helps promote a long-term relationship with customers, as highlighted by Brennan *et al*. (1988), Long *et al*. (1993), Wilson and Summers (2002), among others.

On the other hand, excessive working capital investment can have adverse effects and lead to value destruction for shareholders, as shown by Kieschnick *et al*. (2013) and Almeida and Eid Jr (2014). The main idea is that, like any other investment, additional investment in working capital requires additional funding, which in turn involves financing and opportunity costs. Therefore, high working capital investment is expected to be associated with high interest expenses and higher credit risk (Aktas *et al*., 2015). In addition, higher levels of inventories are associated with other costs, like warehouse rent, insurance, and security (Baños-Caballero *et al*., 2014) which, in turns, may reduce firm performance. Another aspect of excessive working capital investment is related to the fact that many resources invested in working capital may also impede companies from implementing value-enhancing investment projects in the short term, as pointed out by Ek and Guerin (2011).

That is, combining the positive and negative effects, studies on working capital management seem to suggest the existence of a non-linear relationship between the level of working capital and the company's performance: (i) for companies with high level of working capital (excess working capital), the expected relationship is negative (in these cases, the increase in working capital would not create value for the company); and (ii) for companies with low level of working capital (underinvestment in working capital), the relationship is positive (in these cases, the increase in working capital would create value for the company). In this sense, Baños-Caballero *et al*. (2012), Baños-Caballero *et al*. (2014), Aktas *et al*. (2015) and Ben-Nasr (2016) found an inverted U-shaped relationship between firm value and working capital investment.

Therefore, we use a sample of non-financial public companies listed on BM&FBOVESPA from 2010 to 2015, which corresponds to the period after the adoption of IFRS in Brazil. Our motivation to analyze the effect of working capital management on firm performance and investment in Brazil stems from the fact that, as pointed out by Almeida and Eid Jr (2014), Brazilian companies, in general, have restrictions on access long-term resources (funding is scarce and expensive) to fund its activities. Besides, the main source of long-term financing is the National Bank for Economic and Social Development (BNDES), but this source is restricted mainly to large companies.

Our results suggest that the relation between excess working capital and stock return is non-linear: the relation is negative for firms with positive excess working capital and positive for firms with negative excess working capital (that is, there is an inverted U-shaped relationship between net working capital (NWC) investment and firm value, suggesting the existence of an optimal level of company working capital). These results aligns with the results of other studies, which also find an inverted U-shaped relation between NWC investment and firm value, particularly those ones of Baños -Caballero *et al*. (2012) for medium-sized Spanish firms, Baños -Caballero *et al*. (2014) for British firms, Aktas *et al*. (2015) for US firms and Ben-Nasr (2016) for a multinational sample of privatized firms from 54 countries.

Besides, we found a negative relation between excess NWC and company investment, and this relation is driven by firms that have negative excess NWC (compared to the firm's industry-median NWC). That is, we cannot say that firms with unnecessary working capital (over-investment in NWC) cut their working capital levels in order to fund additional CAPEX investments. In fact, our results suggest that the decrease in excess NWC in the previous year lead to an increasing in firm investment over the subsequent year only for companies that adopt an aggressive working capital policy (companies that have abnormally low NWC investment compared to the company's industry-median NWC). The characteristics of our sample of firms may explain these results concerning company NWC and investment.

Finally, we also evaluate how excess NWC affect firm operating performance and, using the same econometric approach and the same set of control variable used for evaluate excess NWC and stock performance, our results suggest that, for companies with unnecessary working capital (positive excess NWC), a reduction in the excess NWC may lead to an increasing in operating performance over the next period, and for companies with low investment in working capital (negative excess NWC), the opposite is true, that is, an increase in the excess NWC may lead to a superior operating performance over the next period. These results also suggest the existence of an inverted U-shaped relationship between excess NWC and firm operating performance.

We organize the remainder of this article as follows: section 2 will provide the literature review; section 3 will present the details of the selection criteria for the sample of stocks and the description of the methodology used in this study; in section 4 we will present summary statistics for each variable and we will explore the relationship between excess working capital and firm stock performance and investment. Section 5 concludes the study and section 6 provides the references.

2. Literature Review

As we highlighted in the Section 1, the efficient working capital management plays a very important role in the strategy of any company to create shareholder value, especially with respect to profitability (Shin and Soenen, 1998; Deloof, 2003), risk (Gardner *et al*., 1986; Weinraub and Visscher, 1998) and firm value (Kieschnick *et al*, 2013; Almeida and Eid Jr, 2014; Autukaite and Molay, 2014).

However, studies on working capital management highlights two conflicting views on how investment in working capital can affect firm value. On one hand, the additional investment in working capital can have positive effects, particularly for companies with low levels of working capital, and may increase sales and profitability and, hence, firm value. This is the case of companies operating with high levels of inventories in order to reduce logistics costs, provide protection against commodity price fluctuations and minimize the possibility of loss of sales due to potential lack of inventory, as highlighted by Schiff and Lieber (1974), Blinder and Maccini (1991), Fazzari and Petersen (1993) and Corsten and Gruen (2004). Furthermore,

increasing working capital by granting trade credit to customers may also positively impact sales because, for example, it allows for price discrimination, serves as a guarantee for the quality of the product sold, helps promote a long-term relationship with customers, encourages customers to buy products at times of low demand, as highlighted by Emery (1987), Brennan *et al*. (1988), Long *et al*. (1993), Petersen and Rajan (1997), Wilson and Summers (2002), among others. Another positive aspect related to the additional investment in working capital is that companies with higher investment in working capital are considered more liquid and, therefore, they have lower bankruptcy risk (Dunn and Cheatham, 1993).

On the other hand, there are also possible adverse effects of additional investment in working capital, which may lead to a negative impact on firm value and to value destruction for shareholders, as shown by García-Teruel and Martínez-Solano (2007), Kieschnick *et al*. (2013), Almeida and Eid Jr (2014) e Autukaite and Molay (2014). The main idea is that, like any other investment, additional investment in working capital requires additional funding, which in turn involves financing and opportunity costs. Therefore, high working capital investment is expected to be associated with high interest expenses and higher credit risk (Aktas *et al*., 2015). Besides, higher levels of inventories are associated with other costs, like warehouse rent, insurance and security (Baños-Caballero *et al*., 2014) which, in turns, may reduce firm performance. Another negative aspect of excessive investment in working capital is related to the fact that keeping high working capital levels means that money is locked up in working capital (Deloof, 2003) and may also impede companies from implementing value-enhancing investment projects in the short term, as pointed out by Ek and Guerin (2011).

The above discussion seems to suggest that there is a trade-off between the benefits and costs of investment in working capital. Combining the positive and negative effects, studies on working capital management seem to suggest the existence of a non-linear relationship between the level of working capital and the company's performance, that is: (i) for companies with high level of working capital (excess working capital), the expected relationship is negative (in these cases, the increase in working capital may not create value for the company); and (ii) for companies with low level of working capital (sub-investment in working capital), the relationship is positive (in these cases, the increase in working capital may create value for the company). Consistent with this point of view, Baños-Caballero *et al*. (2012), using a sample of small and medium-sized Spanish enterprises, show that there is a non-monotonic (concave) relationship between working capital and firm profitability, which indicates that firms have an optimal working capital level that maximizes their profitability. Baños-Caballero *et al*. (2014), using a sample of non-financial UK companies, found strong support for an inverted U-shaped relation between investment in working capital and firm performance. In the same direction, Aktas *et al*. (2015), using a large sample of US firms between 1982-2011, show the existence of an optimal level of working capital and firms that converge to that optimal level (either by increasing or decreasing their investment in working capital) improve their stock and operating performance. Recently, Ben-Nasr (2016), using a large multinational sample of privatized firms from 54 countries from emerging and developed countries,

show evidences indicating that the value-NWC curve is U-shaped, and that shareholders value less (more) increasing NWC in government-controlled (foreign-controlled) firms with a low level of NWC when compared to their non-government-controlled (non-foreign-controlled) peers.

Therefore, this research seeks to analyze the relationship between investment in working capital and firm value in the Brazilian market. Given the evidence presented above, the hypothesis (H1) formulated in this study suggests that for companies with a high level of working capital (excess working capital), the expected relationship between working capital and company's performance is negative (in these cases, the increase in working capital does not create value for the company). The additional hypothesis (H2) suggests that for companies with low level of working capital (sub-investment in working capital), the expected relationship between working capital and the company's performance is positive (in these cases, the increase working capital creates value for the company).

3. Methodology

This section presents the details of the selection criteria for the sample of stocks used in the calculations. Then, we present the description of the methodology used in this study.

3.1. Sample

We constructed a sample of listed firms on the BM&FBOVESPA from Economatica files for the period 2010–2015, which corresponds to the period after the adoption of IFRS in Brazil. Initially, the sample of firms to be analyzed in this study consists of all those ones listed on BM&FBOVESPA from 2010 to 2015.

From this initial sample of firms, we exclude: (i) financial institutions and utilities firms, the same procedure adopted by Faulkender and Wang (2006), Kieschnick *et al*. (2013), Aktas *et al*. (2015), among others; (ii) firms with negative equity values; (iii) stocks whose liquidity ratio on the stock exchange in the last year in which there was price is less than 0.001 (the goal of this filter is to let in the sample only stocks with a minimum of relevance in the stock market); and finally (iv) if the company has more than one class of shares (common and preferred), we select only the data of the most liquid stock.

Table 1 reports aggregate values for our sample of firms. Note that the number of companies in our sample range from 164 in 2010 to 142 in 2015. The reduction in the number of listed firms is due to the increased number of delisting processes that occurred in Brazil in recent years.

Table 1 also shows the aggregate values for each year of the reporting period for total assets, sales, cash holdings, net working capital and its components (inventories, accounts receivable and accounts payable). All values are expressed in billions of

Reais (Brazilian currency) and are converted to 2010 currency by the consumer broad price index - IPCA. The last line of Table 1 shows the average annual growth rate of each variable.

Table 1 - Aggregate values by year

This table reports yearly aggregate values for total assets, sales, cash holdings, net working capital (NWC) and its component. The NWC variable corresponds to inventories plus accounts receivables, minus accounts payable. The sample includes non-financial firms listed on BM&FBOVESPA from Economatica files for the period 2010–2015. All values are expressed in billions of reais (Brazilian currency), and adjusted to 2010 currency by the consumer broad price index - IPCA.

Year	Number of firms	Total assets	Sales	Cash	NWC	Inventories	Accounts receivable	Accounts payable
2010	164	2,094.28	979.74	174.98	199.71	121.76	230.24	94.24
2011	152	2,254.40	1,057.64	159.58	207.17	136.54	251.37	114.64
2012	151	2,343.89	1,077.40	168.24	196.48	134.14	245.72	118.80
2013	151	2,010.69	1,078.09	45.06	152.88	128.71	152.69	123.93
2014	153	2,022.19	1,077.57	53.86	140.57	130.35	139.90	125.76
2015	142	2,106.15	1,032.68	39.92	130.42	129.87	128.23	126.52
Growth rate	N/A	0.11%	1.06%	-25.59%	-8.17%	1.30%	-11.05%	6.07%

First, it is important to note that the sample composition has changed over time, with a few firms came in and several other ones came out of the sample. Nevertheless, it is noted that: (i) while the volume of funds held in cash was virtually the same volume invested in working capital at the beginning of the period, but towards the end of the period there was a greater reduction in the companies' cash holdings, especially during the period of 2013-2015, showing a distinct pattern of than that observed in other studies like Bates *et al*. (2009) and Aktas *et al*. (2015), who analyzed US companies; (ii) the cash holdings for Brazilian companies shows a different pattern than that reported by Ernst and Young (2015) and Aktas *et al*. (2015), that is, in Brazil the cash holdings relative to sales is much less significant, showing the cash holdings is equivalent to only 5% of the aggregate sales for our sample of firms; (iii) total assets and sales remained practically at the same level over the period considered, possibly a result of the severe economic crisis faced by Brazil in the last years; (iv) the level of inventories virtually remained the same over the sample period, while there was a great reduction in accounts receivable (which showed an yearly average reduction of more than 11% in the period) and a substantial increase in accounts payable (annual growth rate of 6% in the period); and (v) the aggregate amount invested in NWC was reduced both in terms of revenues (from 20% of revenue at the beginning of the period to 13% in 2015) and in relation to total assets (in 2010 the amount invested in NWC was equivalent to 9.5% of total assets, and at the end of the sample period this ratio was 6.2%), showing an annual reduction rate of 8.2% in the period.

3.2. Description of the methodology

The primary objective of this research is to analyze the effect of working capital management on company performance and investment. So, a similar methodology from that developed by Aktas *et al*. (2015) was used to test the hypotheses in this study, in which the dependent variable measures the company performance or investment.

When referring to the company's performance, the dependent variable is the excess stock return over the year, defined as the return on stock *i* during year *t* minus the return on stock *i's* benchmark portfolio during year *t*. The construction of the reference portfolios is designed to compensate for the component of the expected stock return that is due to its size and its book-to-market ratio (B/M), as suggested by Fama and French (1993). It is also important to mention that the model proposed by Fama and French (1993) includes the construction of 25 (twenty five) reference portfolios formed by firms size and B/M ratio, and the return of these portfolios was obtained by weighting the market value of each company included in each portfolio (value-weighted approach).

Thus, in each year of the analysis period we allocated each sample firm in each of the 25 (twenty five) benchmark portfolios based on the join cross of size and B/M dimensions. Therefore, the return of the stock *i's* benchmark portfolio during year *t* is the return of the portfolio of which the stock *i* belongs at the beginning of fiscal year *t*.

When referring to the firm investment, as well as in Aktas *et al*. (2015) and Bates *et al*. (2009), the dependent variable is defined as investment in fixed assets (capital expenditures - CAPEX) divided by total assets at the beginning of the period. The underlying idea is that, managing working capital efficiently, companies may reduce their dependence on external funding and use resources released from working capital to fund new investments, improving the company financial flexibility. Therefore, if there is a decline in excess NWC, it is expected to lead to an increase in company investment.

Thus, to evaluate the effect of excess working capital on the firm performance and investment, we use the following linear regression model:

$$V_{i,t} = \alpha_t + \beta_1 \text{ x } \text{Excess\_NWC}_{i,t-1} + \beta_2 \text{ x } \text{Controls}_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

The dependent variable, *V*, measures the company's performance or investment, as defined above. The *Excess_NWC* variable is the main independent variable of interest and measures the excess (or the lack) of working capital on company's performance or investment. The study of Hill *et al*. (2010) points out that the needs and practices related to working capital management are different from one industry to another and, so, it is important we control for changes in the characteristics of each industry. Thus, to determine the *Excess_NWC* variable, as in Aktas *et al*. (2015), we subtract from the NWC / sales ratio of company *i* in year *t* the ratio of the median NWC / sales ratio of the corresponding industry of company *i* in year *t*, and NWC is equal to inventories plus accounts receivable minus accounts payable. By adopting this procedure, we are implicitly assuming that the

efficient level of the company's working capital is equivalent to the industry-median level of working capital (in which there would be no excess in working capital).

In other words, the idea is that for each company in a given year, the *Excess_NWC* variable measure the unnecessary cash invested in working capital, meaning that (i) when the *Excess_NWC* is positive, the company has an over-investment in working capital, which implies that the company has room to improve the its efficiency of working capital management (which could occur, for example, by reducing inventory levels and payment terms granted to customers); and (ii) when *Excess_NWC* is negative, the company has a sub-investment in working capital, indicating that the company has adopted a very aggressive working capital policy, which could increase the risk of loss of sales due to potential lack of inventory, as shown by the studies of Fazzari and Petersen (1993) and Corsten and Gruen (2004). In this second case (companies with low working capital levels), additional investment in working capital is expected to be more valuable because, for example, it would allow the increase of trade credit supply to customers, which could positively impact sales by allowing a better price discrimination, serve as a guarantee for the quality of the product sold and help promote a long-term relationship with customers, as shown by Brennan *et al*. (1988), Long *et al*. (1993) and Wilson and Summers (2002).

Thus, a negative coefficient β_1 in the equation (1) measure the increase in the company's performance or investment associated with a reduction of one unit in the *Excess_NWC* variable over time. And, similarly, a positive coefficient β_1 measures the reduction in the company's performance or investment associated with a reduction of one unit in the *Excess_NWC* variable over time.

In addition, as the primary objective of this research is to analyze the effect of working capital management in the company's performance or investment, it is important to control for other factors that may be correlated with changes in working capital and may also interfere with performance or corporate investment. Thus, in the regression model presented in (1), *Controls* refers to a set of variables that may affect company's performance or investment, and includes the following variables:

- *Cash reserves*: is defined as the sum of the cash account and cash equivalents (highly liquid securities) divided by total assets. Bates *et al*. (2009) points out that there is a substitution effect between cash reserves and working capital components that can be quickly converted into cash. Thus, to mitigate any concerns that our results could be biased by this substitution effect, the cash reserves control variable was included in the regression models;
- *B/M*: is the book-to-market ratio, defined as the book value of equity divided by market value of equity;
- *Firm size*: is defined as the natural logarithm of the market value of equity;
- *Leverage*: is defined as total debt divided by total assets;
- *Risk*: is defined as the standard deviation of daily stock return during each year, as suggested in Coles *et al*. (2006) and Armstrong and Vashishtha (2012);

- *Intangible assets*: is defined as intangible assets divided by total assets;
- *Asset growth*: Cooper *et al*. (2008) and Lipson *et al*. (2011) point out that stock performance is also related to the assets growth. Thus, one of the independent control variables is the annual growth rate of fixed assets (we do not use the growth rate of total assets because it includes components of the working capital);
- *Cash flow*: is defined as operating profit before depreciation and amortization (EBITDA) divided by total assets;
- *Tobin's Q*: is defined as the market value of equity plus total assets value minus book value of equity, divided by total assets;
- *Sales growth*: is defined as the growth rate of sales during one year, that is, the result of the following equation: $(sales_t - sales_{t-1}) / sales_{t-1}$;
- *Sales volatility*: following Hill *et al*. (2010), it is defined as the standard deviation of the company`s annual sales over the previous five years period (the observation is only included in the database in a given year only if the company has at least three observations in the previous five years period). The variable company`s annual sales is scaled by company`s net assets, defined as total assets minus cash and cash equivalents.

Further, given the reference estimates in (1), to assess whether the relationship between excess working capital and company performance (or investment) is not linear, we use, as well as in Aktas *et al*. (2015), the following asymmetric model in which it is possible that the slope coefficient of the *Excess_NWC* variable to be different for positive or negative excess working capital:

$$V_{i,t} = \alpha_t + \beta_1 \text{ x } [Excess\_NWC_{i,t-1} \text{ x } D] + \beta_2 \text{ x } [Excess\_NWC_{i,t-1} \text{ x } (1 - D)] + \beta_3 \text{ x } Controls_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

Where *D* is a dummy variable which assumes value equal to 1 if the *Excess_NWC* variable is positive (ie, given the methodology adopted in this study, the company has an over-investment in working capital) and value 0 otherwise.

Finally, important to note that all independent variables in (1) and (2) are lagged by one period in order to mitigate concerns that working capital, company's performance and investment may be simultaneously determined in equilibrium, as pointed out by Aktas *et al*. (2015).

4. Analysis of Results

In this section, we explore the relationship between excess working capital investment and stock performance. Then we explore whether business investment is a means by which the working capital management translates into higher company performance.

We have performed all analyzes and regressions using a sample of publicly traded companies listed on Brazilian Stock Exchange from 2010 to 2015. We grouped data using the panel methodology with fixed effects in order to mitigate omitted

variables problems. In addition, in order to mitigate the influence of extreme values, we winsorize all variables at the 1st and 99th percentiles.

Section 4.1 shows the summary statistics for each of the variables used in this study. In Section 4.2 we present some preliminary analysis of the main independent variable of interest in this study (*Excess_NWC*). And in section 4.3 we present the results of the regressions performed.

4.1. Summary statistics

Before presenting the results of multiple regressions that consider the effect of working capital management on the firm performance and investment, in this section we present in Table 2 summary statistics of each variable used in the calculations. Note that the mean NWC / sales ratio is 34,29% and for the variable NWC / sales adjusted for industry-median (*Excess NWC*), the mean is 2.01% and the median is 0% by construction.

Table 2 – Summary statistics

This table provides summary statistics on our sample firms. Q1 and Q3 denote the first and third quartiles, respectively. The sample includes non-financial firms listed on BM&FBOVESPA from Economatica files for the period 2010–2015. Excess NWC is the industry-median adjusted NWC-to-sales ratio. Variable definitions are provided in Section 3.2. N denotes the sample size.

Variable	Mean	Median	Q1	Q3	Std. Dev.	N
NWC	34.291%	22.518%	9.054%	37.019%	66.047%	901
Excess NWC	2.014%	0.000%	-7.386%	10.037%	44.843%	901
Stock excess return	7.732%	3.296%	-11.568%	21.865%	31.799%	814
Investments	6.457%	4.843%	2.087%	8.309%	7.293%	897
ROA	2.100%	3.554%	0.126%	7.661%	16.843%	941
Cash reserves	9.126%	5.121%	1.793%	12.357%	11.495%	598
B/M	1.003	0.647	0.349	1.162	1.158	852
Firm size	21.391	21.428	20.206	22.432	1.691	888
Leverage	31.122%	29.938%	18.071%	41.194%	19.255%	890
Risk	2.555%	2.197%	1.865%	2.798%	1.306%	913
Intangible assets	14.146%	6.208%	1.162%	20.867%	17.298%	925
Asset growth	15.028%	3.833%	-4.788%	19.730%	46.523%	915
Cash flow	9.688%	9.593%	5.715%	14.773%	9.554%	912
Tobin's Q	1.530	1.178	0.932	1.720	1.041	865
Sales growth	9.775%	5.036%	-5.807%	15.154%	41.423%	889
Sales volatility	19.469%	12.208%	6.346%	22.720%	25.519%	784

In addition, from the analysis of data presented in Table 2, it appears that: (i) the mean stock excess return is 7.7%, while the median for this variable is 3.3%, indicating that the distribution of stock excess returns being positively skewed; (ii) return on assets (ROA) annual shows a mean of 2.1% in our sample, while the median is greater and equal to 3.5%, indicating that the

distribution of ROA is negatively skewed; (iii) the mean investments (CAPEX) represent 6.5% of the firm total assets; (iv) the mean and the median firm market capitalization is similar in our sample, R$ 1,95 billion and R$ 2,02 billion, respectively. Table 3 shows, for each industry, the summary statistics for NWC / sales variable. To group companies into 20 different industries, as shown in Table 3, we consider the industry classification from Economatica, remove firms from financial services (banking, insurance, etc.) and utilities, and dismember the industry classified as others into another two: education and real estate.

The distribution of the NWC / sales variable among industries shows that there is great heterogeneity in terms of working capital management practices across industries: (i) companies from construction industry have a mean NWC that is equivalent to 1,5 sales; (ii) companies from the telecommunications and oil and gas industries have, on average, negative working capital.

Table 3 – Summary statistics for NWC-to-sales ratio by industry

This table provides summary statistics for NWC-to-sales ratio variable sorted by industry. The sample includes non-financial firms listed on BM&FBOVESPA from Economatica files for the period 2010–2015. For each industry in our sample period, we compute the mean, median, first quartile (Q1), third quartile (Q3) and standard deviation of the NWC-to-sales ratio. N denotes the number of observations.

Industry	Mean	Median	Q1	Q3	Std. Dev.	N
Agriculture	35.568%	30.945%	26.670%	39.512%	26.324%	18
Food and beverages	13.799%	9.895%	4.275%	25.091%	13.322%	54
Retail	15.067%	12.930%	4.186%	23.649%	12.610%	88
Construction	154.659%	136.696%	116.473%	164.515%	74.063%	103
Education	24.268%	20.028%	15.913%	27.212%	11.770%	34
Electronics	19.786%	25.524%	2.909%	31.963%	15.181%	18
Real estate	20.231%	21.598%	15.904%	24.058%	8.767%	54
Industrial machines	25.349%	27.239%	21.774%	28.056%	4.385%	12
Mining	20.035%	16.998%	12.557%	33.501%	13.872%	16
Non-metallic minerals	54.344%	40.864%	29.557%	79.524%	33.130%	17
Others	16.105%	14.979%	6.227%	25.516%	28.561%	153
Paper and cellulose	24.807%	26.013%	24.326%	27.321%	4.025%	18
Oil and gas	-25.927%	0.126%	-10.804%	9.595%	77.645%	26
Chemicals	13.666%	5.697%	3.521%	25.138%	19.110%	31
Steel and metal	31.220%	26.113%	23.943%	41.213%	34.931%	56
Computer software	66.907%	19.214%	16.326%	52.723%	121.036%	27
Telecommunications	-2.265%	-0.420%	-1.743%	8.234%	35.840%	24
Textiles	28.496%	38.258%	29.037%	45.171%	52.720%	46
Transport services	-2.210%	7.580%	-1.210%	14.727%	98.599%	49
Vehicles and parts	18.757%	26.675%	15.190%	32.394%	34.068%	57

4.2. Preliminary analysis

Table 4 shows the mean and median values of our dependent and control variables for two subsamples based on the sign of the excess NWC (positive or negative). It is noteworthy that for each variable showed in the Table 4, the last two columns display the p-values from a test of mean differences and a test of median differences between negative and positive excess NWC subsamples, respectively.

By analyzing firms characteristics reported in Table 4, the evidence suggests that there are significant differences between the two subsamples of firms (positive versus negative excess NWC). That is, when we compare firms with negative excess NWC, firms with positive excess NWC have on average significantly higher book-to-market ratio. On the other hand, firms with negative excess NWC are on average slightly bigger, riskier and hold more cash reserves than firms with positive excess NWC. The evidence reported in Table 4 also suggest that firms with negative excess NWC have on average more resources invested in intangible assets, tend to have more growth opportunities (see the statistics for sales growth variable) and tend to have more volatile sales.

Table 4 – Sample characteristics of firm with negative and positive excess NWC

This table compares the sample characteristics of firms with negative and positive excess NWC. Excess NWC is the industry-median adjusted NWC-to-sales ratio. The sample includes non-financial firms listed on BM&FBOVESPA from Economatica files for the period 2010–2015. Variable definitions are provided in Section 3.2. For each variable, the last two columns display the p-values from a test of mean differences and a test of median differences between negative and positive excess NWC subsamples, respectively.

Variable	Negative excess NWC		Positive excess NWC		p-value for a test of differences	
	Mean	Median	Mean	Median	Mean	Median
Stock excess return	7.674%	3.529%	7.670%	3.602%	0.998	0.765
Investments	6.395%	4.862%	6.584%	4.929%	0.697	0.585
ROA	2.317%	3.925%	3.612%	3.480%	0.171	0.868
Cash reserves	10.473%	6.069%	6.880%	4.410%	**0.000**	**0.019**
B/M	0.887	0.611	1.120	0.688	**0.004**	**0.008**
Firm size	21.565	21.559	21.262	21.280	**0.007**	**0.004**
Leverage	30.961%	29.616%	30.360%	30.641%	0.620	0.758
Risk	2.572%	2.262%	2.403%	2.140%	**0.036**	**0.007**
Intangible assets	15.920%	9.741%	12.914%	4.895%	**0.010**	**0.009**
Asset growth	18.140%	4.192%	13.417%	3.950%	0.137	0.105
Cash flow	9.990%	9.818%	9.948%	9.497%	0.946	0.496
Tobin's Q	1.570	1.187	1.494	1.177	0.294	0.252
Sales growth	15.837%	6.042%	3.011%	2.305%	**0.000**	**0.000**
Sales volatility	19.699%	12.592%	15.048%	9.811%	**0.006**	**0.039**

4.3. Analysis of multiple regressions

The evidence reported in Table 4 suggests that there are significant differences between the two subsamples (firms with positive versus firms with negative excess NWC). So, in the multivariate analysis to be reported ahead we control for firms characteristics in order to explore, in a first moment, the relationship between excess NWC and stock performance (see Table 5). Table 5 show the fixed effects regressions in which we evaluate the relationship between excess NWC and stock performance (it is important to highlight that the dependent variable is the 1-year excess stock return over year *t* and that all the independent variables are lagged by one period with respect to the dependent variable).

The relation between excess NWC and stock performance is negative in column 1 and this relation is robust to the inclusion of control variables in column 2 (the coefficient of variable *Excess_NWC* is negative and statistically significant at 10% and

5%, respectively). That is, firms with excess NWC reduce their stock performance, causing value destruction for shareholders, in line with García-Teruel and Martínez-Solano (2007), Kieschnick *et al*. (2013), Almeida and Eid Jr (2014) e Autukaite and Molay (2014).

In order to examine the potential non-linearity between excess working capital and company performance, we use an asymmetric model that allows the slope coefficient of the *Excess_NWC* variable to be different for positive or negative excess working capital, as shown in columns 3 and 4 of Table 5. Regressions specifications in columns 3 and 4 include two interactions variable: the first one interacts the excess NWC with a dummy variable *D* that assumes value equal to 1 if the *Excess_NWC* is positive, and the second variable, *Excess NWC* x (1 - *D*), interacts the excess NWC with dummy variable identifying firms with negative excess NWC.

The results presented in columns 3 and 4 of Table 5 show that, for firms that have positive excess NWC, the increase in excess NWC in the previous year is negatively associated with stock performance over the subsequent year (note that the coefficient of variable *Excess_NWC* x *D* is negative and statistically significant at 1% level in the specifications presented in columns 3 and 4). In other words, for firms that have positive excess NWC, the decrease in excess NWC in the previous year is positively associated with stock performance over the subsequent year. The evidence presented in Table 5 show that, for those firms that have positive excess NWC, for example, the costs reduction (like warehouse rent, insurance and security) from a reduction in inventories in the previous year may improve firm stock performance. This evidence supports the hypothesis (H1) formulated in this study.

On the other hand, for firms that have negative excess NWC, the increase in excess NWC in the previous year is positively associated with stock performance over the next year (note that the coefficient of variable *Excess_NWC* x (1 - *D*) is positive and statistically at 10% only in the specifications presented in column 3). In this case, for companies with low level of working capital, the evidence suggests that the increase of inventories in order to, for example, reduce logistics costs, provide protection against commodity price fluctuations and minimize the possibility of loss of sales due to potential lack of inventory, may create value for the company. This evidence supports the additional hypothesis (H2) formulated in this study.

Taken together, the results reported in Table 5 confirm our prediction the existence of an inverted U-shaped relationship between NWC investment and firm value, in line with Baños-Caballero *et al*. (2014), Aktas *et al*. (2015) and Ben-Nasr (2016), suggesting the existence of an optimal level of company working capital, as pointed by Graph 1. As we can see, companies with low level of NWC (i.e., the company`s NWC-to-sale ratio is lower than the corresponding year industry-median of the NWC-to-sale ratio) may increase firm value by investing in NWC, and the opposite is true (firms with high level of NWC can lead to value destruction for shareholders when they invest additional resources in NWC.

Graph 1 – Excess NWC and stock performance

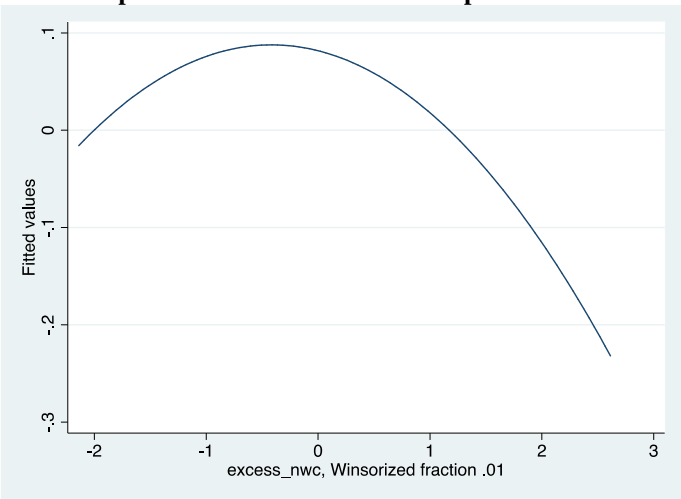

Table 5 – Excess net working capital and stock performance

This table provides the fixed effects stock performance regressions. In each regression, the dependent variable is the 1-year excess stock return over year *t*. All the independent variables are lagged by one period with respect to the dependent variable. The variables definitions are provided in Section 3.2. Columns 1 and 2 of this table present the estimation of a linear model (see specification presented in eq. 1), and columns 3 and 4 present the estimation of an asymmetric model (see specification presented in eq. 2). D is a dummy variable taking value one if the corresponding excess NWC is positive (i.e., firms with abnormally high level of cash tied up in NWC) and 0 otherwise. ***, ** and * denotes statistical significance at 1%, 5% and 10%, respectively.

Variable	**(1)**	**(2)**	**(3)**	**(4)**
Excess NWC	-0.0851*	-0.1795**		
Excess NWC x D			-0.2868***	-0.3021***
Excess NWC x (1 - D)			0.1456*	0.0253
Cash reserves		-0.0077		0.0650
Firm size		0.1013***		0.1029***
Leverage		-0.8219***		-0.7871***
Risk		8.9455***		8.8064***
Intangible assets		-1.3837***		-1.0964**
Asset growth		-0.0330		-0.0355
Cash flow		0.7986**		0.7431**
Tobin's Q		0.1221***		0.1306***
Sales growth		0.1139**		0.1012**
Sales volatility		0.3330**		0.3249**
Firm and year-fixed effects	Yes	Yes	Yes	Yes
N	783	439	783	439
Adj. R-sqr	0.020	0.244	0.037	0.249

In addition, if we look at the coefficients of control variables in Table 5, we see that the coefficients of firm size, leverage, risk, intangible assets, cash flow, Tobin's Q, sales growth and sales volatility are statistically significant at conventional levels (stock performance decreases with leverage and intangible assets, and increases with risk, sales volatility, sales growth and Tobin's Q, as intuitively expected, that is, riskier firms and firms with more growth opportunities show better stock

performance). Stock performance also increases with firm size (bigger firms show better stock performance in the Brazilian market) and cash flow.

Table 6 show the fixed effects regressions in which we evaluate the relationship between excess NWC and company investment (it is important to highlight that the dependent variable is the firm capital expenditures over year *t*, scaled by total assets at the beginning of the period, and all the independent variables are lagged by one period with respect to the dependent variable). The underlying idea is that, managing working capital efficiently, companies may reduce their dependence on external funding and use resources released from working capital to fund new investments, improving the company financial flexibility. Therefore, if there is a decline in excess NWC, it is expected to lead to an increase in company investment.

Table 6 – Excess net working capital and investment

This table provides the fixed effects investment regressions. In each regression, the dependent variable is the capital expenditures (CAPEX) over year *t*, scaled by total assets at the beginning of the period. All the independent variables are lagged by one period with respect to the dependent variable. The variables definitions are provided in Section 3.2. Columns 1 and 2 of this table present the estimation of a linear model (see specification presented in eq. 1), and columns 3 and 4 present the estimation of an asymmetric model (see specification presented in eq. 2). D is a dummy variable taking value one if the corresponding excess NWC is positive (i.e., firms with abnormally high level of cash tied up in NWC) and 0 otherwise. ***, ** and * denotes statistical significance at 1%, 5% and 10%, respectively.

Variable	**(1)**	**(2)**	**(3)**	**(4)**
Excess NWC	0.0040	-0.0208*		
Excess NWC x D			0.0329***	-0.0047
Excess NWC x (1 - D)			-0.0428***	-0.0356**
Cash reserves		-0.0249		-0.0294
Firm size		0.0120**		0.0113**
Leverage		-0.0321		-0.0344
Risk		-0.5917*		-0.5920*
Cash flow		-0.3308***		-0.3218***
Tobin's Q		0.0086		0.0087
Sales growth		0.0153*		0.0172**
Sales volatility		-0.0040		-0.0026
Firm and year-fixed effects	Yes	Yes	Yes	Yes
N	874	448	874	448
Adj. R-sqr	0.080	0.204	0.099	0.207

The results presented in Table 6 indicate that we cannot say that firms with unnecessary working capital (overinvestment in NWC) cut their working capital levels in order to fund additional CAPEX investments. In column 2, the coefficient estimate of excess NWC is negative and statistically significant at 10% level, showing that the decrease in excess NWC in the previous year may lead to an increasing in company investment over the subsequent year, in line with the our prediction. However, when we examine the potential non-linearity between excess working capital and company investment, as shown in columns 3 and 4 of Table 6, we see that the negative relation between excess NWC and company investment is driven by firms that have negative excess NWC. In column 3 the coefficient estimate of *Excess_NWC* x *D* is positive (i.e., with opposite sign than

that expected) and statistically significant, while the coefficient of *Excess NWC* x (1 - *D*) is negative (i.e., also with opposite sign than that expected) and statistically significant, both of them at 1% level. And in column 4, with the inclusion of control variables, only the coefficient of *Excess NWC* x (1 - *D*) is negative and remains statistically significant. This indicates that, for firms with positive excess NWC, the release of unnecessary cash tied up in working capital does not lead to an increasing in company investment.

That is, surprisingly, the results presented in Table 6 indicates that the decrease in excess NWC in the previous year lead to an increasing in firm investment over the subsequent year only for companies that adopt an aggressive working capital policy (companies that have abnormally low NWC investment compared to the company's industry-median). Besides, from Table 4, our sample of firms with negative excess NWC are on average slightly bigger, riskier, hold more cash reserves, have more resources invested in intangible assets and tend to have more growth opportunities than firms with positive excess NWC. That is, the evidence from Tables 4 and 6 suggest that firms with negative excess NWC may reduce their NWC and yet increase their corporate investment possibly because there are bigger, hold more cash and have more growth opportunities.

In Table 7 we explore the impact of excess NWC on operating performance (in this case, the dependent variable is the firm return on assets and all the independent variables are lagged by one period with respect to the dependent variable). The idea is that if the reduction in excess NWC lead to an increase in company investment, then these additional investments should also lead to an increase in the firm operating performance in the future. Therefore, the decline in excess NWC is expected to lead to an increase in company operating performance or, in other words, a positive excess NWC is expected to negatively affect firm operating performance.

In Table 7, we use the same econometric approach and the same set of control variable used in Table 5, and the results reported in Table 7 also suggest the existence of an inverted U-shaped relationship between excess NWC and firm operating performance (i.e., suggesting the existence of an optimal level of working capital), in line with our results presented in Table 5. If we look at column 2, the coefficient of excess NWC variable is negative and statistically significant at 1% level, suggesting that firms with excess NWC reduce their operating performance, or when firms with over-investment in NWC when cutting their working capital investment they may improve their operating performance. But more importantly, if we look at column 3, which reports the results of the asymmetric model, for positive and negative excess NWC, the coefficient estimates are −0.0468 and 0.0876, respectively (both of them statistically significant at 5% and 1%, respectively). And these results are robust with the inclusion of controls variable in column 4.

These results suggest that, for companies with unnecessary working capital (positive excess NWC), a reduction in the excess NWC may lead to an increasing in operating performance over the next period, and for companies with low investment in

working capital (negative excess NWC), the opposite is true, that is, an increase in the excess NWC may lead to a superior operating performance over the next period.

Table 7 – Excess net working capital and operating performance

This table provides the fixed effects operating performance regressions. In each regression, the dependent variable is the firm return on assets (ROA) in year *t*. All the independent variables are lagged by one period with respect to the dependent variable. The variables definitions are provided in Section 3.2. Columns 1 and 2 of this table present the estimation of a linear model (see specification presented in eq. 1), and columns 3 and 4 present the estimation of an asymmetric model (see specification presented in eq. 2). D is a dummy variable taking value one if the corresponding excess NWC is positive and 0 otherwise. ***, ** and * denotes statistical significance at 1%, 5% and 10%, respectively.

Variable	(1)	(2)	(3)	(4)
Excess NWC	0.0062	-0.0507***		
Excess NWC x D			-0.0468**	-0.0352*
Excess NWC x (1 - D)			0.0876***	0.0701***
Cash reserves		0.1388**		0.1485**
Firm size		0.0138**		0.0140**
Leverage		-0.0786*		-0.0743*
Risk		-0.1637		-0.1784
Intangible assets		-0.0255		0.0096
Asset growth		0.0456***		0.0453***
Cash flow		1.2145***		1.2076***
Tobin's Q		-0.0275***		-0.0265***
Sales growth		-0.0441***		-0.0457***
Sales volatility		0.0252		0.0244
Firm and year-fixed effects	Yes	Yes	Yes	Yes
N	898	448	898	448
Adj. R-sqr	0.045	0.323	0.062	0.418

5. Conclusions

In this study, we use a sample of Brazilian non-financial public companies listed on BM&FBOVESPA from 2010 to 2015 in order to evaluate the effect of working capital management on firm performance and investment.

Our results suggest that the relation between excess working capital and stock return is non-linear: the relation is negative for firms with positive excess working capital and positive for firms with negative excess working capital (that is, there is an inverted U-shaped relationship between NWC investment and firm value, suggesting the existence of an optimal level of company working capital). These results aligns with the results of other studies, which also find an inverted U-shaped relation between NWC investment and firm value, particularly those ones of Baños -Caballero *et al*. (2012) for medium-sized Spanish firms, Baños -Caballero *et al*. (2014) for British firms, Aktas *et al*. (2015) for US firms and Ben-Nasr (2016) for a multinational sample of privatized firms from 54 countries.

Moreover, we found a negative relation between excess NWC and company investment, and this relation is driven by firms that have negative excess NWC. Our results suggest that the decrease in excess NWC in the previous year lead to an increasing

in firm investment over the subsequent year only for companies that adopt an aggressive working capital policy (companies that have abnormally low NWC investment compared to the company's industry-median NWC). The characteristics of our sample of firms may explain these results concerning company NWC and investment.

Finally, we also evaluate the relation between excess NWC and firm operating performance, and our results suggest that, for companies with unnecessary working capital (positive excess NWC), a reduction in the excess NWC may lead to an increasing in operating performance over the next period, and for companies with low investment in working capital (negative excess NWC), the opposite is true, that is, an increase in the excess NWC may lead to a superior operating performance over the next period. These results also suggest the existence of an inverted U-shaped relationship between excess NWC and firm operating performance.

6. References

Aktas. N, Croci, E. & Petmezas, D. (2015). Is working capital management value-enhancing? Evidence from firm performance and investments. *Journal of Corporate Finance, 30,* 98-113.

Almeida, J. R. & Eid Jr, W. (2014). Access to finance, working capital management and company value: Evidences from Brazilian companies listed on BM&FBOVESPA. *Journal of Business Research, 67,* 924-934.

Armstrong, C. S.; & Vashishtha, R. (2012). Executive stock options, differential risk-taking incentives, and firm value. Journal of Financial Economics, 104, 70–88.

Autukaite, R.; & Molay, E. (2014). Cash holdings, working capital and firm value: Evidence from France. *Bankers, Markets & Investors, 132,* 53-62.

Baños-Caballero, S.; García-Teruel, P. J.; & Martínez-Solano, P. (2012). How does working capital management affect the profitability of Spanish SMEs? *Small Business Economics, 39(2),* 517-529.

Baños-Caballero, S.; García-Teruel, P. J.; & Martínez-Solano, P. (2014). Working capital management, corporate performance, and financial constraints. *Journal of Business Research, 67,* 332-338.

Bates, T.W., Kahle, K.M. & Stulz, R.M. (2009). Why do U.S. firms hold so much more cash than they used to? *Journal of Finance, 64*(5), 1985-2022.

Ben-Nasr, H. (2016). State and foreign ownership and the value of working capital management. *Journal of Corporate Finance, 41*, 217-240.

Blinder, A. S. & Maccini, L.J. (1991). The resurgence of inventory research: what have we learned? *Journal of Economic Surveys, 5*(4), 291-328.

Brennan, M. J., Maksimovic, V., & Zechner, J. (1988). Vendor financing. *Journal of Finance, 43*(5), 1127-1141.

Coles, J. L.; Daniel, N. D.; & Naveen, L. (2006). Managerial incentives and risk-taking. Journal of Financial Economics, 79, 431–468.

Cooper, M. J., Gulen, H., & Schill, M. J. (2008). Asset growth and the cross-section of stock returns. *Journal of Finance, 63*(4), 1609-1651.

Corsten, D. & Gruen, T. (2004). Stock-outs cause walkouts. *Harvard Business Review, 82*, 26-28.

Deloof, M. (2003). Does working capital management affect profitability of Belgian firms? *Journal of Business, Finance and Accounting, 30*(3-4), 573-587.

Dunn, P.; & Cheatham, L. (1993). Fundamentals of small business financial management for start-up, survival, growth, and changing economic circumstances. *Managerial Finance, 19(8)*, 1-13.

Emery, G.W. (1987). An optimal financial response to variable demand. *Journal of Financial and Quantitative Analysis*, 22, 209-225.

Ek, R. & Guerin, S. (2011). Is there a right level of working capital? *Journal of Corporate Treasury Management, 4*(2), 137-149.

Ernst, Young. (2015). All tied up: working capital management report. Available at: www.ey.com. Accessed 08/29/2016.

Fama, E. F. & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33*, 3-56.

Faulkender, M. & Wang, R. (2006). Corporate financial policy and the value of cash. *Journal of Finance, 61*(4), 1957-1990.

Fazzari, S. & Petersen, B. (1993). Working capital and fixed investment: New evidence on financing constraints. *RAND Journal of Economics*, *24*(3), 328-342.

García-Teruel, P. J.; & Martínez-Solano, P. (2007). Effects of working capital management on SME profitability. *International Journal of Managerial Finance, 3*(2), 164-177.

Gardner, M. J., Mills, D. L. & Pope, R. A. (1986). Working capital policy and operating risk: An empirical analysis. *The Financial Review, 21*(3), 31-31.

Hill, M.D., Kelly, G.W., & Highfield, M.J. (2010). Net Operating Working Capital Behavior: a First Look. *Financial Management, 39*, 783-805.

Kieschnick, R., Laplante, M., & Moussawi, R. (2013). Working capital management and shareholders' wealth. *Review of Finance*, *17*(5), 1827-1852.

Lipson, M. L., Mortal, S., & Schill, M. J. (2011). On the scope and drivers of the asset growth effect. *Journal of Financial and Quantitative Analysis, 46*(6), 1651-1682.

Long, M. S., Malitz, I. B., & Ravid, S. A. (1993). Trade credit, quality guarantees and product marketability. *Financial Management, 22*(4), 117-127.

Petersen, M.; & Rajan, R. (1997). Trade credit: theories and evidence. *Review of Financial Studies*, *10*(3), 661-691.

Schiff, M.; & Lieber, Z. (1974). A model for the integration of credit and inventory management. *Journal of Finance, 29*(1), 133-140.

Shin, H. & Soenen, L. (1998). Efficiency of working capital management and corporate profitability. *Financial Practice and Education, 8*(2), 37-45.

Weinraub, H. J. & Visscher, S. (1998). Industry practice relating to aggressive conservative working capital policies. *Journal of Financial and Strategic Decision*, *11*(2), 11-18.

Wilson, N. & Summers, B. (2002). Trade credit terms offered by small firms: survey evidence and empirical analysis. *Journal of Business Finance & Accounting*, *29*(3-4), 317-335.