WORKING CAPITAL MANAGEMENT, CORPORATE PERFORMANCE, AND FINANCIAL CONSTRAINTS

Sonia Baños-Caballero[a], Pedro J. García-Teruel[b*], Pedro Martínez-Solano[c]

[a] University of Murcia, Faculty of Economics and Business, Dpt. Management and Finance, Campus Universitario de Espinardo, 30100-Murcia (SPAIN), tel: +34 868 883798, fax:+34 868 887537, email: sbanos@um.es

[b] University of Murcia, Faculty of Economics and Business, Dpt. Management and Finance, Campus Universitario de Espinardo, 30100-Murcia (SPAIN), tel: +34 868 887828, fax:+34 868 887537, email: pjteruel@um.es

[c] University of Murcia, Faculty of Economics and Business, Dpt. Management and Finance, Campus Universitario de Espinardo, 30100-Murcia (SPAIN), tel: +34 868 883747, fax:+34 868 887537, email: pmsolano@um.es

[*]Corresponding author

Abstract

This paper examines the linkage between working capital management and corporate performance for a sample of non-financial UK companies. In contrast to previous studies, the findings provide strong support for an inverted U-shaped relation between investment in working capital and firm performance, which implies the existence of an optimal level of investment in working capital that balances costs and benefits and maximizes a firm's value. The results suggest that managers should avoid negative effects on firm performance because of lost sales and lost discounts for early payments or additional financing expenses. The paper also analyzes whether the optimal working capital level is sensitive to alternative measures of financial constraints. The findings show that this optimum is lower for firms more likely to be financially constrained.

Keywords: working capital; corporate performance; financial constraints.

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1. Introduction

The literature on investment decisions evolved through many theoretical and empirical contributions. A number of studies show a direct relation between investment and firm value (Chung, Wright & Charoenwong, 1998; Burton, Lonie & Power, 1999; McConnell & Muscarella, 1985). Additionally, since the seminal work by Modigliani & Miller (1958) showing that investment and financing decisions are independent, extensive literature based on capital-market imperfections has appeared that supports the relation between these two decisions (Fazzari, Hubbard & Petersen, 1988; and Hubbard, 1998).

Despite the importance of the interrelations between the individual components of working capital when evaluating their influence on corporate performance (Kim & Chung, 1990; Sartoris & Hill, 1983; Schiff & Lieber, 1974), few studies of empirical evidence for the valuation effects of investment in working capital and, more specifically, the possible influence of financing on this relation exist. .

Studies on working capital management fall into two competing views of working capital investment. Under one view, higher working capital levels allow firms to increase their sales and obtain greater discounts for early payments (Deloof, 2003) and, hence, may increase firms' value. Alternatively, higher working capital levels require financing and, consequently, firms face additional financing expenses, which increase their probability of going bankrupt (Kieschnick, LaPlante & Moussawi, 2011). Combining these positive and negative working capital effects leads to the prediction of a nonlinear relation between investment in working capital and firm value. The hypothesis in this paper is that an inverted U-shaped relation may result if both effects are sufficiently strong.

Authors like Schiff & Lieber (1974), Smith (1980) and Kim & Chung (1990) suggest that working capital decisions affect firm performance. In this line, Wang (2002) finds that firms from Japan and Taiwan with higher values hold a significantly lower investment in working capital than firms with lower values. Kieschnick et al., (2011) study the relation between working capital management and firm value. They take Faulkender & Wang (2006) as their baseline valuation model and analyze how shareholders of US corporations value an additional dollar invested in net operating working capital by using a stock's excess return as proxy for firm value. Their results show that, on average, an additional dollar invested in net operating working capital is worth less than a dollar held in cash. They also find that an increase in net operating working capital, on average, would reduce the excess stock return and they show that this reduction would be greater for those firms with limited access to external finance. Since market imperfections increase the cost of outside capital relative to internally generated funds (Greenwald, Stiglitz, & Weiss, 1984; Jensen & Meckling, 1976; Myers & Majluf, 1984) and may result in debt rationing (Stiglitz & Weiss, 1981), Fazzari, Hubbard & Petersen (1988) suggest that firms' investment may depend on financial factors such as the availability of internal finance, access to capital markets or cost of financing. Fazzari & Petersen (1993) suggest in their analysis that investment in working capital is more sensitive to financing constraints than investment in fixed capital.

However, while the above study focuses on the influence of an additional investment in working capital on firm value, our paper examines the functional form of the relation between investment in working capital and corporate performance. Given that financing conditions might play an important role in this relation, we also study whether firms' financing constraints affect the above relation. To our knowledge, our paper is the first to analyze the functional form of this relation as well as the possible influence of financial constraints on it.

We use non-financial companies from the United Kingdom. UK capital markets are well developed (Schmidt & Tyrell, 1997) and present more than 80 per cent of daily business transactions on credit terms (Summers & Wilson, 2000). In fact, Cuñat (2007) indicates that trade credit represents about 41% of the total debt and about half the short term debt in UK medium sized firms.

This study contributes to the working capital management literature in a number of ways. First, we offer new evidence on the effect of working capital management on corporate performance, by taking into account the possible non-linearities of this relation. Second, the paper investigates the relation between investment in working capital and firm performance according to the financing constraints of the firms. Third, we estimate the models by using panel data methodology in order to eliminate the unobservable heterogeneity. Lastly, we use the Generalized Method of Moments (GMM) to deal with the possible endogeneity problems.

Our results indicate that there is an inverted U-shaped relation between working capital and firm performance. That is, investment in working capital and corporate performance relate positively at low levels of working capital and negatively at higher levels. We also find that the results hold when firms are classified according to a variety of characteristics designed to measure the level of financial constraints borne by firms. The findings show that the optimum is sensitive to the financing constraints of the firms and that under each of our classification schemes optimal working capital level is lower for those firms that are more likely to be financially constrained.

The structure of the paper is as follows. The next section develops the predicted concave relation between working capital and corporate performance and outlines the possible influence of financing conditions on this relationship. In section 3 we describe our empirical model and data. We present our results in section 4 and analyse how the optimum changes between firms more or less likely to face financing constraints. Section 5 concludes.

2. Working capital, corporate performance and financing

2.1. Working capital and corporate performance

The investment in receivable accounts and inventories represents an important proportion of a firm's assets, while trade credit is an important source of funds for most firms. Cuñat (2007) reports that trade credit represents about 41% of the total debt and about half the short term debt in UK medium sized firms.

There is substantial literature on credit policy and inventory management, but few attempts to integrate both credit policy and inventory management decisions, even though Schiff & Lieber (1974), Sartoris & Hill (1983), and Kim & Chung (1990) do show the importance of taking into account the interactions between the various working capital elements (i.e. receivable accounts, inventories and payable accounts).

Lewellen, McConnel, & Scott (1980) demonstrate that under perfect financial markets, trade credit decisions do not serve to increase firm value. However, capital markets are not perfect and, consequently, several papers demonstrate the influence of trade credit and inventories on firm value (see, for instance, Emery, 1984; Bao & Bao, 2004). The idea that working capital management affects firm value also seems to enjoy wide acceptance, although the empirical evidence on the valuation effects of investment in working capital is scarce.

There are various explanations for the incentives of firms to hold positive working capital. Firstly, a higher investment in extended trade credit and inventories might increase corporate performance for several reasons. According to Blinder & Maccini (1991), larger inventories can reduce supply costs and price fluctuations and prevent interruptions in the production process and loss of business due to scarcity of products. They also allow firms better service for their customers and avoid high production costs arising from high fluctuations in production (Schiff & Lieber 1974). Granting trade credit, on the other hand, might also increase a firm’s sales, because it can serve as an effective price cut (Brennan, Maksimovic, & Zechner 1988; Petersen & Rajan 1997); it encourages customers to acquire merchandise at times of low demand (Emery 1987); it strengthens long-term supplier-customer relationships (Ng, Smith, & Smith 1999; Wilner 2000); it allows buyers to verify product and services quality prior to payment (Smith 1987; and Lee & Stowe 1993). Hence, it reduces the asymmetric information between buyer and seller. Indeed, Shipley & Davis (1991), and Deloof & Jegers (1996) suggest that trade credit is an important supplier selection criterion when it is hard to differentiate products. Emery (1984) suggests that trade credit is a more profitable short-term investment than marketable securities. Secondly, working capital may also act as a stock of precautionary liquidity, providing insurance against future shortfalls in cash (Fazzari & Petersen, 1993). Finally, from the point of view of accounts payable, Ng et al., (1999) and Wilner (2000) also demonstrate that a firm may obtain important discounts for early payments when it reduces its supplier financing.

However, there are also possible adverse effects of investment in working capital which may lead to a negative impact on firm value at certain working capital levels. Firstly, keeping stock available supposes costs such as warehouse rent, insurance and security expenses, which tend to rise as the level of inventory increases (Kim & Chung, 1990). Secondly, since a greater working capital level indicates a need for additional capital, which firms must finance, it involves financing costs and opportunity costs. On the one hand, companies that hold a higher working capital level also face more interest expenses as a result (Kieschnick et al., 2011) and, therefore, more credit risk. As working capital increases, it is more likely that firms will experience financial distress and face the threat of bankruptcy. This gives firms with high investment in working capital incentives to reduce working capital levels and minimize the risk of financial distress and costly bankruptcy. On the other hand, keeping high working capital levels means that money is locked up in working capital (Deloof, 2003), so large investment in working capital might also hamper the ability of firms to take up other value-enhancing projects.

These positive and negative working capital effects indicate that the working capital decisions involve a trade-off. Consequently, we expect firms to have an optimal working capital level that balances these costs and benefits and maximizes their value. Specifically, we expect corporate performance to rise as working capital increases until a certain working capital level is reached. Conversely, we expect that, beyond this optimum, the relation between working capital and performance will become negative.

2.2. Investment in working capital and financial constraints

If the results verify the hypothesis that there is an inverted U-shaped relation between working capital and performance of a firm, one would expect the optimal level of investment in working capital to differ between firms more or less likely to face financing constraints. Modigliani & Miller (1958) argue that in a frictionless world, companies can always obtain external financing without problems and, hence, their investment does not depend on the availability of internal capital. Once capital market imperfections (i.e., informational asymmetries and agency costs) are present, capital market frictions increase the cost of outside capital relative to internally generated funds (Jensen & Meckling, 1976; Myers & Majluf, 1984; Greenwald, Stiglitz, & Weiss, 1984).Consequently, external capital does not provide a perfect substitute for internal funds. Stiglitz & Weiss (1981) also describe how asymmetric information may result in debt rationing. In this line, Fazzari, Hubbard & Petersen, (1988) suggest that the firms' investment may depend on financial factors such as the availability of internal finance, access to capital markets or cost of financing.

Fazzari & Petersen (1993) suggest that investments in working capital are more sensitive to financing constraints than investments in fixed capital. Accordingly, since a positive working capital level needs financing, one would expect the optimal level of working capital to be lower for more financially constrained firms. In this line, empirical evidence demonstrates that investment in working capital depends on a firm's financing conditions. Specifically, Hill, Kelly & Highfield (2010) show that firms with greater internal financing capacity and capital market access hold a higher working capital level.

To test the effect of financial constraints on the optimal level of working capital, we estimate the optimal working capital investment for various firm subsamples, partitioned on the basis of the likelihood that firms have constrained access to external financing. There are several measures in previous studies to separate firms that are suffering from financial constraints from those that are not, but it is still a matter of debate as to which measure is the best. Thus, we classify firms according to the following proxies for the existence of financing constraints:

Dividends. Following Fazzari et al., (1988) we use this variable to identify a firm's degree of financial constraints. Financially constrained firms tend not to pay dividends (or to pay lower dividends) to reduce the probability of raising external funds in the future. Thus, we first split the data into zero-dividend and positive-dividend groups. We expect that zero-dividend firms are the most likely to face financial constraints. Accordingly, non-dividend paying (dividend paying) companies are financially constrained (unconstrained). Secondly, following Almeida, Campello & Weisbach (2004), and Faulkender & Wang (2006), we also categorize firms according to their dividend payout ratio (measured by dividends/net profit). Thus, we consider that firms with a dividend payout ratio above the sample median are less financially constrained than those with a payout ratio below the sample median.

Cash Flow. We have also categorized firms according to their cash flow, similar to the approach by Moyen (2004), which suggests that, unlike the dividends, this variable allows one to focus on the firm's beginning-of-the-period funds, since dividends also take into account the investment and financial decisions taken by the firms during that period. This variable is defined as the ratio of earnings before interest and tax plus depreciation to total assets. Firms with a cash flow above the sample median are assumed to be less likely to face financing constraints.

Size. Many studies use this variable as an inverse proxy of financial constraints (Carpenter, Fazzari & Petersen, 1994; Almeida, Campello & Weisbach, 2004, Faulkender & Wang, 2006) following the notion that smaller firms face higher informational asymmetry and agency costs and, hence, will be more financially constrained. In this line, Whited (1992) indicates that larger firms have better access to capital markets, so they face lower borrowing constraints and lower costs of external financing. Therefore, we separate firms according to their size, measured by the natural logarithm of sales, and we consider firms with size above (below) the sample median to be less (more) likely to be financially constrained.

Cost of external financing. Fazzari et al., (1988) consider firms as constrained when external financing is too expensive. Thus, firms are also more or less likely to face financial constraints when considering their external financing cost, calculated by the ratio financial expenses/total debt. In particular, companies with costs of external financing above (below) the sample median are more (less) likely to be financially constrained.

Whited and Wu Index. We also group our companies according to the external finance constraints index constructed by Whited and Wu (2006), which is a linear combination of six factors: cash flow, a dividend payer dummy, leverage, firm size, industry sales growth, and firm sales growth. A greater index means a firm has less access to external capital markets. Thus, we consider a firm as being more (less) financially constrained when its WW index is above (below) the median value of this index in our sample.

Finally, we also classify firms according to two measures for bankruptcy risk that a firm presents (interest coverage and Z-score) because a firm in financial distress is more likely to face a higher degree of financial constraints:

Interest coverage. This variable is a common measure of a firm’s bankruptcy risk and financial constraints (see, for example, Whited, 1992). Firms go into two groups on the basis of their interest coverage ratio, which comes from the calculation of the ratio earnings before interest and tax to financial expenses. The greater this ratio, the fewer problems the firm would have in repaying its debt and the firm's earnings before interest and tax would cover the interest payment. Hence, companies that have an interest coverage ratio below (above) the sample median are more (less) likely to be financially constrained.

Z-score. We also consider Z-score in order to capture the probability of financial distress of firms, which can also influence a firm's access to credit and, therefore, might limit its investment. We use the re-estimation of Altman's (1968) model by Begley, Mings, & Watts (1996). Thus, firms with below-median scores (low Z-score) are financially constrained, while above-median firms (high Z-score) are financially unconstrained.

3. Model and Data

3.1. Specification of the model and Methodology

According to the previous section, there are reasons which justify that the relation between working capital and firm performance may be non-monotonic. Specifically, we expect a concave relation to exist. In order to test the proposed functional form, we analyse a quadratic model. Following Shin & Soenen (1998), we use the Net Trade Cycle (NTC) as a measure of working capital management. We regress corporate performance against Net Trade Cycle (NTC) and its square (NTC^2). Additional variables are also present in the performance regression model to control for other potential influences on the performance of the firm. Specifically, the variables are firm size (SIZE), leverage (LEV), opportunities growth (GROWTH), and return on assets (ROA). Therefore, we estimate the following model:

$$Q_{i,t} = \beta_0 + \beta_1 NTC_{i,t} + \beta_2 NTC^2{}_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 GROWTH_{i,t} + \beta_6 ROA + \lambda_t + \eta_i + \varepsilon_{i,t} \quad (1)$$

where $Q_{i,t}$ is the corporate performance. Following Agrawal & Knoeber (1996); Himmelberg, Hubbard & Palia (1999); Thomsen, Pedersen & Kvist (2006), Florackis, Kostakis & Ozkan (2009), and Wu (2011) among others, the calculation of corporate performance is the ratio of the sum of the market value of equity and the book value of debt to the book value of assets. This variable mitigates most of the shortcomings inherent in accounting profit ratio, since accounting practices affect accounting profit ratios and capital market valuation appropriately incorporates firm risk and minimizes any distortions introduced by tax laws and accounting conventions (Smirlock, Gilligan & Marshall, 1984). Perfect & Wiles (1994) demonstrate that the improvements over this variable obtained with the estimation of Tobin's q based on replacement costs are limited.

According to Shin & Soenen (1998), NTC comes from: NTC= (accounts receivable/ sales)*365 + (inventories/sales)*365 - (accounts payable/sales)*365. Hence, it is a dynamic measure of ongoing liquidity management that provides an easy estimate for additional financing needs with regard to working capital, with a shorter NTC meaning a lower investment in working capital. We use this variable to avoid the deficiencies of traditional liquidity ratios such as current ratio and quick ratio.

We measure firm size (SIZE) as the natural logarithm of sales; leverage (LEV) by the ratio of total debt to total assets; growth opportunities (GROWTH) is the ratio (book value of intangibles assets / total assets); and the measurement of return on assets (ROA) is through the ratio earnings before interest and taxes over total assets. The parameter λ_t is a time dummy variable that aims to capture the influence of economic factors that may also affect corporate performance but which companies cannot control. η_i is the unobservable heterogeneity or the firm's unobservable individual effects, so we can control for the particular characteristics of each firm. Finally, $\varepsilon_{i,t}$ is the random disturbance. We also control for industry effects by introducing industry dummy variables.

The coefficients on net trade cycle variables allow us to determine the inflection point in the net trade cycle-corporate performance relation, because this comes from: $-\beta_1 / 2\beta_2$. Since we expect NTC and corporate performance to relate positively at low levels of working capital and negatively at higher levels, the hypothesis is that β_2 is negative, because it would indicate that firms have an optimal working capital level that balances the costs and benefits of holding working capital and maximizes their performance.

We tested our hypothesis on the effect of working capital management on firm performance with the panel data methodology, because of the benefits it provides. First, it allows us to control for unobservable heterogeneity and, therefore, eliminate the risk of obtaining biased results arising from this heterogeneity (Hsiao 1985). Firms are heterogeneous and there are always characteristics that might influence their value that are difficult to measure or are hard to obtain, and which are not in our model (Himmelberg et al., 1999). Second, panel data also allows us to avoid the problem of possible endogeneity, which might be present in our analyses and could seriously affect the estimation results. The endogeneity problems arise because it is possible that the observed relationships between firm performance and firm-specific characteristics reflect not only the effect of independent variables on a firm’s performance but also the effect of corporate performance on those variables. Shocks affecting performance are also likely to affect some other firm-specific characteristics. We therefore estimated our models using the two-step generalized method of moments (GMM) estimator based on Arellano & Bond (1991), which allows us to control for endogeneity by using instruments. Specifically, we have used all the right-hand-side variables in the models, lagged up to four times, as instruments in the difference equations.

3.2. *Data and summary statistics*

The data in this paper are from the Osiris database. The sample comprises non-financial quoted firms from the United Kingdom for the period 2001-2007.

The information was refined. Specifically, we eliminated firms with lost values, cases with errors in the accounting data and extreme values presented by all variables. We also required firms to have presented data for at least five consecutive years, which is a necessary condition to have a sufficient number of periods to be able to test for second-order serial correlation. This left an unbalanced panel of 258 firms (1606 observations). A *t* test confirms that there are no significant differences between the mean NTC of our sample (56.48) and the mean NTC of non-financial quoted firms from the United Kingdom (54.85) for the period analyzed (p-value is 0.7808). Neither are there significant differences (p-value of 0.3071) between the mean Market to Book ratio of our sample (1.49) and the mean Market to Book ratio for non-financial quoted firms from the United Kingdom (1.48).

Table 1 reports some descriptive statistics for corporate performance, net trade cycle, and the control variables. Market to book ratio is on average 1.48, while the median is 1.30. The mean Net Trade Cycle is 56.47 days (median is 52.29 days). On average debt finances 56.87% of total assets, the mean growth opportunities ratio is 0.21, and mean return on assets is only 5.59% (median is 6.87%). Table 2 displays correlations among variables used in the subsequent analyses. In addition, we used a formal test to ensure that the multicollinearity problem is not present in our analyses. Specifically, we calculated the Variance Inflation Factor (VIF) for each independent variable in our models. The largest VIF value is 2.87, which confirms that there is no multicollinearity problem in our sample, because it is far from 5 (Studenmund 1997).

Table 1 here

Table 2 here

4. Empirical evidence

4.1. Effects of working capital management on firm performance

The results obtained from equation (1) appear in Table 3. Consistent with predictions, they confirm a large and statistically significant inverted U-shaped relation between corporate performance and working capital[1], since the coefficient for the NTC variable is positive ($\beta_1 > 0$), and that for its square is negative ($\beta_2 < 0$) [2]. Therefore, our findings indicate that at working capital levels below the optimal level the effects of higher sales and discounts for early payments dominate and, hence, working capital has a positive impact on firm performance. Conversely, the opportunity cost and financing cost effects dominate when the firm has a working capital level above this optimum and, consequently, the relation between working capital and firm performance becomes negative. The coefficients for net trade cycle variables allow us to determine for our sample the turning point in the relationship between performance of firms and net trade cycle. Specifically, we find a turning point of 66.95 days.

Table 3 here

4.2. Financial constraints and optimal working capital level

Once we have verified that firms have an optimal working capital level that maximizes their performance, our aim is also to explore the possible effect of financing on this optimal level. As we commented above, asymmetric information between the firm and the capital market may result in credit rationing and a wedge between the costs of internal and external financing, because insufficient information lowers the market's assessment of the firm and of its projects and raises the firm's cost of external financing. Thus, since a higher working capital level needs financing, which would mean additional expenses, we expect firms more likely to face financial constraints to have a lower optimal working capital level than those that are less likely.

In order to test whether or not the optimal working capital level of more financially constrained firms differs from that of less constrained ones, equation 1 is extended by incorporating a dummy variable that distinguishes between firms more likely to face financing constraints and those that are less likely according to the different classifications commented on above. Specifically, DFC is a dummy variable that takes a value of 1 for firms more financially constrained, and 0 otherwise. Thus, we propose the following specification:

$$Q_{i,t} = \beta_0 + (\beta_1 + \delta_1 DFC_{i,t})NTC_{i,t} + (\beta_2 + \delta_2 DFC_{i,t})NTC^2{}_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 LEV_{i,t} + \beta_5 GROWTH_{i,t} + \beta_6 ROA + \lambda_t + \eta_i + \varepsilon_{i,t} \quad (2)$$

All dependent and independent variables are as previously defined. By construction, the expression $-\beta_1 / 2\beta_2$ measures the optimal working capital investment of less financially constrained firms. The optimum of more financially constrained firms comes from $-(\beta_1 + \delta_1)/2(\beta_2 + \delta_2)$.

Table 4 shows the regression results for more financially constrained and less financially constrained firms categorized according to the classification schemes above.

The results indicate the existence of a concave relation between working capital and firm performance for less financially constrained firms. This table also includes an F-test in order to check whether the coefficients of the NTC variable are significant for more financially constrained firms. Specifically, for these firms, F_1 test indicates whether the NTC coefficient (i.e. $(\beta_1 + \delta_1)$) is significant, while the F_2 test check whether the NTC^2 coefficient (i.e. $(\beta_2 + \delta_2)$) is significant. Since the F_2 test indicates that the NTC^2 coefficient of more constrained firms is negative and significant in all the classifications used, it shows that the concave relation also holds for these firms.

However, the optimal investment in working capital depends on the financing constraints borne by firms. When financing conditions are present in the analysis, the results indicate that the optimal level of working capital is lower for those firms more likely to be financially constrained. This may be mainly because of the higher financing costs of those firms and their greater capital rationing, since the lower the investment in working capital, the lower the need for external financing.

Therefore, the approach we propose here allows us to understand why the level of financial constraints borne by a company influences its investment in working capital decisions. Specifically, it would allow us to justify the results of previous studies, which find that investment in working capital depends on internal financing resources, external financing costs, capital market access and financial distress of the firms.

Table 4 here

5. Conclusions

The aim of this paper is to provide empirical evidence for the relation between working capital and corporate performance. Although few studies empirically examine whether there is an association between investment in working capital and firm value, the idea that working capital management influences firm value enjoys widespread acceptance. We use a panel data model and employ the GMM method of estimation, which allows us to control for unobservable heterogeneity and for potential endogeneity problems.

In contrast to previous findings, our main contribution here is to study the functional form of the above-mentioned relation. This analysis, which the literature has not considered previously, reveals that there is an inverted U-shaped relation between working capital and corporate performance, which implies that there exists an optimal level of investment in working capital that balances costs and benefits and maximizes a firm's performance.

This supports the idea that at lower levels of working capital managers would prefer to increase the investment in working capital in order to increase firms' sales and the discounts for early payments received from its suppliers. However, there is a level of working capital at which a higher investment begins to be negative in terms of value creation due to the additional interest expenses and, hence, the higher probability of bankruptcy and credit risk of firms. Thus, firm managers should aim to keep as close to the optimal level as possible and try to avoid any deviations from it that destroy firm value.

Following Fazzari & Petersen (1993) and Hill et al., (2010), who suggest that investment in working capital is sensitive to firms' capital market access, we also analyze whether financing constraints influence the optimal level of investment in working capital. Our findings indicate that, although the concave relation between working capital and firm performance always holds, the optimal working capital level of firms that are more likely to be financially constrained is lower than that of less constrained firms. In addition, this result is robust to various proxies of financial constraints. It justifies the impact of internally generated funds and the access to external financing on companies' working capital investment decisions that previous studies reported.

There are several implications of our study which may be relevant for managers and research on investment in working capital. First, our results suggest that managers should be concerned about working capital, because of the costs of moving away from the optimal working capital level. Managers should avoid negative effects on firm performance through lost sales and lost discounts for early payments or additional financing expenses. Second, our findings extend the research on the relevance of a good working capital management and suggest that future studies on working capital should control for financial constraints.

[1] "We also find an inverted U-shaped relation between firm performance and each individual component of Net Trade Cycle (accounts receivable to sales ratio, inventories to sales ratio and accounts payable to sales ratio)."

[2] We also find this concave relation between working capital and firm performance when using the Ordinary Least Squares (OLS) and the Two-Stage Least Squares (2SLS) estimation method. These results hold when we use measures of accounting profitability (earnings before tax over sales, net profit over sales, and earnings before interest and taxes over sales) to measure a firm's performance."

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Table 1
Summary statistics

	Mean	Standard deviation	Perc. 10	Median	Perc. 90
Q	1.4874	0.7343	0.8675	1.3098	2.2711
NTC	56.4772	54.4139	-1.8250	52.2906	107.6327
SIZE	12.1233	2.0233	9.5025	12.1041	14.8708
LEV	0.5687	0.1774	0.3300	0.5717	0.8048
GROWTH	0.2119	0.1950	0.0141	0.1592	0.5157
ROA	0.0559	0.1182	-0.0498	0.0687	0.1571

Q represents the corporate performance; NTC the Net Trade Cycle; SIZE is the natural logarithm of total sales; LEV the leverage; GROWTH the growth opportunities; and ROA the return on assets.

Table 2
Correlation matrix

	Q	NTC	SIZE	LEV	GROWTH	ROA
Q	1.0000					
NTC	0.1478***	1.0000				
SIZE	0.0138	-0.1818***	1.0000			
LEV	-0.0229	-0.2126***	0.3118***	1.0000		
GROWTH	0.0116	-0.0371	-0.0435*	-0.1347***	1.0000	
ROA	0.2562***	0.1032***	0.3065***	-0.0007	-0.1545***	1.0000

Q represents the corporate performance; NTC the Net Trade Cycle; SIZE the size; LEV the leverage; GROWTH the growth opportunities; and ROA the return on assets.
*indicates significance at 10% level.
**indicates significance at 5%level.
***indicates significance at 1% level.

Table 3
Estimation results of net trade cycle-firm performance relation

NTC	0.0391** (2.41)
NTC^2	-0.0292*** (-5.90)
SIZE	-0.0470 (-1.41)
LEV	0.4843*** (4.49)
GROWTH	1.0798*** (6.31)
ROA	-0.0395 (-0.43)
m_2	-0.74
Hansen Test	108.28 (102)
Observations	1606

The dependent variable is the corporate performance; NTC is the Net Trade Cycle divided by 100 and NTC^2 its square; SIZE the size; LEV the leverage; GROWTH the growth opportunities; and ROA the return on assets. Time and industry dummies are included in the estimations, but not reported.

Z statistic in brackets. m_2 is a serial correlation test of second-order using residuals of first differences, asymptotically distributed as N(0,1) under null hypothesis of no serial correlation. Hansen test is a test of over-identifying restrictions distributed asymptotically under null hypothesis of validity of instruments as Chi-squared. Degrees of freedom in brackets.

*indicates significance at 10% level.

**indicates significance at 5%level.

***indicates significance at 1% level.

Table 4
Financial constraints and net trade cycle-firm performance relation

	Financial constraints criteria							
	Dividend Paying grouping	Payout ratio grouping	Cash flow grouping	Size grouping	External financing cost grouping	Whited and Wu Index grouping	Interest coverage grouping	Z-score grouping
NTC	0.3260***	0.1091***	0.1982***	0.1751***	0.0324**	0.2724***	0.2025***	0.1879***
	(6.50)	(3.32)	(5.92)	(2.77)	(2.26)	(5.93)	(5.11)	(4.69)
NTC*DFC	-0.3306***	-0.0804***	-0.1812***	-0.1825***	-0.0457*	-0.2650***	-0.1824***	-0.1557***
	(-6.39)	(-2.81)	(-6.00)	(-2.97)	(-1.76)	(-5.87)	(-5.10)	(-3.97)
NTC^2	-0.1358***	-0.0530***	-0.1047***	-0.0862***	-0.0198***	-0.1832***	-0.0998***	-0.1006***
	(-7.48)	(-3.27)	(-7.83)	(-3.53)	(-5.14)	(-4.51)	(-7.56)	(-7.29)
NTC^2*DFC	0.1227***	0.0367**	0.0832***	0.0672***	-0.0241***	0.1666***	0.0892***	0.0787***
	(6.77)	(2.36)	(6.38)	(2.79)	(-2.81)	(4.10)	(5.81)	(5.73)
SIZE	-0.0315	-0.0520**	-0.0911***	-0.0448*	-0.0497**	-0.0255	-0.0603***	-0.0602***
	(-1.54)	(-2.32)	(-4.25)	(-1.79)	(-2.25)	(-1.06)	(-2.70)	(-2.59)
LEV	0.5044***	0.4682***	0.5908***	0.3841***	0.4917***	0.5861***	0.6720***	0.5212***
	(8.20)	(6.28)	(7.58)	(5.28)	(7.57)	(6.97)	(7.95)	(7.52)
GROWTH	0.7552***	0.4060***	0.8067***	1.0104***	0.7432***	0.7972***	0.6460***	0.8110***
	(7.21)	(3.65)	(6.96)	(7.16)	(5.96)	(5.94)	(5.75)	(5.88)
ROA	0.0601	0.1107	-0.0393	0.0950	0.0984	0.1320*	-0.0893	0.0566
	(1.05)	(1.60)	(-0.57)	(1.31)	(1.37)	(1.76)	(-1.20)	(0.81)
F_1	0.19	5.67	1.83	0.35	0.18	0.32	2.44	6.50
F_2	26.36	23.86	30.36	36.68	27.13	18.54	5.64	52.45
m_2	-0.57	-0.51	-0.51	-0.73	-0.64	-0.56	-0.65	-0.61
Hansen Test	142.45 (136)	143.81 (136)	133.26 (136)	139.34 (136)	143.98 (136)	144.14(128)	137.20 (136)	133.24 (136)
Observations	1606	1606	1606	1606	1606	1606	1606	1606

The dependent variable is the corporate performance; NTC is the Net Trade Cycle divided by 100 and NTC^2 its square; SIZE the size; LEV the leverage; GROWTH the growth opportunities; and ROA the return on assets. DFC is a dummy variable equals 1 for firms more likely to be financially constrained and 0 otherwise. Time and industry dummies are included in the estimations, but not reported. Z statistic in brackets. F_1 is a F-test for the linear restriction test under the following null hypothesis: H_0: $(\beta_1+\delta_1)=0$. F_2 is a F-test for the linear restriction test under the following null hypothesis: H_0: $(\beta_2+\delta_2)=0$. m_2 is a serial correlation test of second-order using residuals of first differences, asymptotically distributed as N(0,1) under null hypothesis of no serial correlation. Hansen test is a test of over-identifying restrictions distributed asymptotically under null hypothesis of validity of instruments as Chi-squared. Degrees of freedom in brackets.
*indicates significance at 10% level.
**indicates significance at 5%level.
***indicates significance at 1% level.