

**WORKING CAPITAL MANAGEMENT, CORPORATE
PERFORMANCE, AND FINANCIAL CONSTRAINTS**

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WORKING CAPITAL MANAGEMENT, CORPORATE PERFORMANCE, AND FINANCIAL CONSTRAINTS

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Abstract

This paper examines linkage between working capital management and corporate performance for a sample of non-financial UK companies. Since a higher investment in working capital can increase firms' sales, a positive relation between working capital and firm value would be expected. However, as working capital increases, a firm's value is also likely to decrease, due to the low return of current assets and the additional financing expenses borne by the firm. Consequently, a negative relation between working capital and firm value might be expected at high levels of working capital. Our findings provide strong support for an inverted U-shaped relation between investment in working capital and firm performance. Additionally, we also analyze whether the optimal working capital level is sensitive to financial constraints. Our findings show that this optimum is lower for firms more likely to be financially constrained.

Keywords: working capital; corporate performance; financial constraints.

JEL classification: G30; G31; G32.

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1. INTRODUCTION

The literature on investment decisions has been developed through many theoretical and empirical contributions. A direct relation between investment and firm value has been demonstrated by a number of studies (see, for example, McConnell and Muscarella, 1985; Chung et al., 1998; Burton et al., 1999). Additionally, since the seminal work by Modigliani and Miller (1958) showing that investment and financing decisions are independent, extensive literature based on capital-market imperfections has been published that supports the relation between these two decisions (Fazzari et al., 1988; and Hubbard, 1998). Finally, there is a large and growing literature documenting the sensitivity of investment to cash flow (Pawlina and Renneboog, 2005; Guariglia, 2008; among others).

However, empirical evidence on the valuation effects of investment in working capital and more specifically the possible influence of financing on this relation is scant, despite the importance of taking into account the interrelations between the individual components of working capital when evaluating their influence on corporate performance (Schiff and Lieber, 1974; Sartoris and Hill, 1983; Kim and Chung, 1990).

Previous 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 need to be financed and, consequently, firms face additional financing expenses that increase their probability of going bankrupt (Kieschnick et al., 2009). Combining these positive and negative working capital effects leads to the prediction of a nonlinear relation between investment in working capital and firm value. We hypothesize an inverted U-shaped relation may result if both effects are sufficiently strong.

Authors like Schiff and Lieber (1974), Smith (1980) and Kim and Chung (1990) suggested 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. Recently, Kieschnick et al., (2009) studied the relation between working capital management and firm value. The last of these take Faulkender and Wang (2006) as their baseline valuation model and analyze how an additional dollar invested in net operating working capital is valued by shareholders of US corporations 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. Additionally, they find that an increase in net operating working capital, on average, would reduce the excess stock return and 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 (Jensen and Meckling, 1976; Myers and Majluf, 1984; and Greenwald et al., 1984) and may result in debt rationing (Stiglitz and Weiss, 1981), Fazzari et

al., (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. Moreover, Fazzari and Petersen (1993) suggest in their analysis that investment in working capital is more sensitive to financing constraints than investment in fixed capital.

However, while that 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. In addition, and taking into account that financing conditions might play an important role in this relation, we also study whether the above-mentioned relation is affected by firms' financing constraints. To our knowledge, our paper is the first to carry out these analyses.

We use non-financial companies from United Kingdom. The UK is considered to have well developed capital markets (Schmidt and Tyrell, 1997), and it is estimated that more than 80 per cent of daily business transactions in the UK corporate sector are on credit terms (Summers and 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 depending on the financing constraints of the firms. Third, we estimate the models by using panel data methodology in order to eliminate the unobservable heterogeneity. In addition, 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. In addition, we find that the results obtained are maintained when firms are classified according to a variety of characteristics that are designed to measure the level of financial constraints borne by firms. The findings show that the optimum is sensitive to 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 remainder of this paper is organized 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 relation. In section 3 we describe our empirical model and data. We present our results in section 4. Moreover, we also analyse how the optimum changes between firms more or less likely to face financing constraints. Finally, section 5 concludes the paper.

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 received is an important source of funds for most firms. 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.

There is substantial literature on credit policy and inventory management, but few attempts have been made to integrate both credit policy and inventory management decisions, even though Schiff and Lieber (1974), Sartoris and Hill (1983), and Kim and 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 et al., (1980) demonstrate that under perfect financial markets, trade credit decisions cannot be used to increase firm value. However, capital markets are not perfect and, consequently, several works have demonstrated the influence of trade credit and inventories on firm value (see, for instance, Emery, 1984; Bao and Bao, 2004). The idea that working capital management affects firm value also seems to be generally accepted, although the empirical evidence on the valuation effects of investment in working capital is scarce.

Various explanations have been offered for the incentives of firms to hold a positive working capital. Firstly, a higher investment in trade credit extended and inventories might increase corporate performance for several reasons. According to Blinder and 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. Moreover, it allows firms better service for their customers and avoids high production costs arising from high fluctuations in production (Schiff and Lieber 1974). Granting trade credit, on the other hand, might also increase a firm's sales, because it is used as an effective price cut (Brennan et al., 1988; Petersen and Rajan 1997), it encourages customers to acquire merchandise at times of low demand (Emery 1987), it strengthens long-term supplier-customer relationships (Ng et al., 1999; Wilner 2000), and it allows buyers to verify product and services quality prior to payment (Smith 1987; Long et al., 1993; and Lee and Stowe 1993). Hence, it reduces the asymmetric information between buyer and seller. Indeed, Shipley and Davis (1991), and Deloof and Jegers (1996) suggest that trade credit is an important supplier selection criterion when it is hard to differentiate products. Emery (1984), moreover, 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 and Petersen, 1993). Finally, from the point of view of accounts payable, Ng et al., (1999) and Wilner (2000) also demonstrate that a firm may get 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 and Chung, 1990). Secondly, since a greater working capital level indicates a need for additional capital that 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 expense as result (Kieschnick et al., 2009) and, therefore, face 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 becomes negative.

2.2. INVESTMENT IN WORKING CAPITAL AND FINANCIAL CONSTRAINTS

If our hypothesis is verified, that is, there is an inverted U-shaped relation between working capital and firm performance, one would expect the optimal level of investment in working capital to differ between firms more or less likely to face financing constraints. Modigliani and Miller (1958) argue that in a frictionless world, companies can always obtain external financing without problem 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 introduced, however, capital market frictions increase the cost of outside capital relative to internally generated funds (Jensen and Meckling, 1976; Myers and Majluf, 1984; and Greenwald et al., 1984) and, consequently, external capital does not provide a perfect substitute for internal funds. Stiglitz and Weiss (1981) also describe how asymmetric information may result in debt rationing. These studies suggest that one of the consequences of market imperfections is distortions in a firm's investment decisions. In this line, Fazzari et al., (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 and Petersen (1993), moreover, suggest in their analysis that investment in working capital is more sensitive to financing constraints than is investment in fixed capital. Accordingly,

since a positive working capital level needs to be financed, one would expect the optimal level of working capital to be lower for firms more financially constrained. In this line, empirical evidence demonstrates that investment in working capital depends on a firm's financing conditions (Hill et al., 2010 among others). Specifically, they show that firms with greater internal financing capacity and capital market access hold a higher working capital level.

In order 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 that have been used by previous studies in order 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 based on the following proxies for the existence of financing constraints:

Dividends. Following Fazzari et al., (1988) we use this variable in order to identify firms' 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 classified as financially constrained (unconstrained). Secondly, following Gilchrist and Himmelberg (1995), Hubbard et al., (1995); Almeida et al., (2004), and Faulkender and 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. Firms are also categorized according to their cash flow, similar to the approach used by Moyen (2004). She 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. This variable is used as an inverse proxy of financial constraints by many studies (Devereux and Schiantarelli, 1990; Carpenter et al., 1994; Gilchrist and Himmelberg, 1995, Almeida et al., 2004, Faulkender and Wang, 2006; Carpenter and Guariglia, 2008; Spaliara, 2009) based on 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. Thus, firms with size above (below) the sample median are considered to be firms less (more) likely to be financially constrained.

Tangibility ratio. We also group our companies according to the tangibility ratio (defined as the book value of tangible assets divided by total assets). According to Bhagat et al., (2005), companies with fewer tangible assets face greater information asymmetry when communicating their value to outside investors and, hence, they are more likely to face a higher degree of financial constraints. Thus, we consider a firm as being more (less) financially constrained when its tangibility ratio is below (above) the median value of this variable in our sample.

Cost of external financing. Fazzari et al., (1988) consider firms as constrained when external financing is too expensive. Thus, firms are also distinguished as more and 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 considered to be firms more (less) likely to be financially constrained.

Interest coverage. This variable is often used as a measure of the financial constraints likely to be faced by a firm (see, for example, Whited, 1992; Hu and Schiantarelli, 1998; and Guariglia, 2008). Firms are classified into two groups based on their interest coverage ratio, which is calculated by the ratio earnings before interest and tax to financial expenses. To the extent that this ratio is greater, the firm would have fewer problems repaying its debt, since the interest payment would be covered by the firm's earnings before interest and tax. Hence, companies that have an interest coverage ratio below (above) the sample median are considered to be firms 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. It is calculated according to the re-estimation of Altman's (1968) model carried out by Begley et al., (1996), given by the following expression:

$$ZSCORE_{it} = 0,104 * X_1 + 1,010 * X_2 + 0,106 * X_3 + 0,003 * X_4 + 0,169 * X_5$$

where $X_1 = \text{Working capital} / \text{Total assets}$; $X_2 = \text{Retained earnings} / \text{Total assets}$; $X_3 = \text{Net operating profits} / \text{Total assets}$; $X_4 = \text{Market value of capital} / \text{Book value of debt}$; and $X_5 = \text{Sales} / \text{Total assets}$. A higher ZSCORE implies a lower probability of insolvency. Thus, firms with below-median scores (low Zscore) are classified as financially constrained, while above-median firms (high Zscore) are categorized as 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 that a concave relation exists. In order to test the proposed functional form, we analyse a quadratic model. Following Shin and Soenen (1998), we use the Net Trade Cycle (NTC) as a measure of working capital management. Thus, corporate performance is regressed against Net Trade Cycle (NTC) and its square (NTC^2). Additional variables are also included in the performance regression model to control for other potential influences on the performance of the firm. Specifically, the variables included are firm size (SIZE), leverage (LEV), opportunities growth (GROWTH), and return on assets (ROA). Therefore, the following model is estimated:

$$Q_{i,t} = \beta_0 + \beta_1 \text{NTC}_{i,t} + \beta_2 \text{NTC}_{i,t}^2 + \beta_3 \text{SIZE}_{i,t} + \beta_4 \text{LEV}_{i,t} + \beta_5 \text{GROWTH}_{i,t} + \beta_6 \text{ROA}_{i,t} + \lambda_t + \eta_i + \varepsilon_{i,t} \quad (1)$$

where $Q_{i,t}$ is the corporate performance. Following Agrawal and Knoeber (1996); Himmelberg et al., (1999); Thomsen et al., (2006), King and Santor (2008), Tong (2008), Beiner et al., (2009), and Jostarndt and Sautner (2010) among others, corporate performance is calculated as the ratio of the sum of the market value of equity and the book value of debt to the book value of assets. Perfect and Wiles (1994) demonstrated that the improvements over this variable obtained with the estimation of Tobin's q based on replacement costs are limited.

According to Shin and Soenen (1998), NTC is calculated by the following expression: $\text{NTC} = (\text{accounts receivables} / \text{sales}) * 365 + (\text{inventories} / \text{sales}) * 365 - (\text{accounts payable} / \text{sales}) * 365$. Hence, it is a dynamic measure of ongoing liquidity management that provides an easy estimate for additional financing needs with regard to working capital (Shin and Soenen, 1998), 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.

Firm size (Size) is measured as the natural logarithm of sales; leverage (LEV) by the ratio of total debt to total assets; growth opportunities (GROWTH) is calculated by the ratio (book value of intangibles assets / total assets); and return on assets (ROA) is measured by the ratio

earnings before interest and taxes over total assets. The parameter λ_t is a time dummy variable that changes in time but is equal for all firms in each of the time periods considered. This parameter is designed 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 that 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, since it can be calculated by the following expression: $-\beta_1 / 2\beta_2$. Since we expect that NTC and corporate performance relate positively at low levels of working capital and negatively at higher levels, β_2 is hypothesised to be 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 using the panel data methodology, because of the benefits it provides. First, it allows one 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 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 analysis. Wang (2002), for example, finds that a firm's value affects investment in working capital. We estimated our models using the two-step generalized method of moments (GMM) estimator based on Arellano and 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 until four times, as instruments in the difference equations. We use this estimator because, although the estimator of instrumental variables in one stage is always consistent, when the disturbances show heteroskedasticity, conducting the estimation in two stages increases efficiency.

3.2. DATA AND SUMMARY STATISTICS

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

The information obtained was refined. Specifically, we eliminated firms with lost values, cases with errors in the accounting data and extreme values presented by all variables. In addition, we also required firms to have presented data for at least five consecutive years¹. This left us with an unbalanced panel of 258 firms (1606 observations).

Table 1 reports some descriptive statistics for corporate performance, net trade cycle, and the control variables. Table 2 displays correlations among variables used in the subsequent analyses. In addition, we also 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 included 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 I. Summary statistics

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.

| | 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 |

Table II. Correlation matrix

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. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level, respectively.

| | 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 |

¹ This is a necessary condition to have a sufficient number of periods to be able to test for second-order serial correlation.

4. EMPIRICAL EVIDENCE

4.1. EFFECTS OF WORKING CAPITAL MANAGEMENT ON FIRM PERFORMANCE

The results obtained from equation (1) are presented in Table 3. Consistent with predictions, they confirm a large and statistically significant inverted U-shaped relation between working capital and corporate performance, since the coefficient on the NTC variable is positive ($\beta_1 > 0$), and the one on its square is negative ($\beta_2 < 0$). 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.

With regard to control variables, we find that leverage and growth opportunities are positively related to corporate performance. However, our findings do not provide any empirical support for the influence of size and return on assets on corporate performance.

Table III. Estimation results of Net Trade Cycle-firm performance relation

The dependent variable is the corporate performance; NTC is the Net Trade Cycle divided by 100 and NTC² 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. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level, respectively.

| | |
|------------------|--------------------|
| 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 |

4.2. FINANCIAL CONSTRAINTS AND OPTIMAL WORKING CAPITAL LEVEL

Once it has been 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 (Stiglitz and Weiss, 1981) and a wedge between the costs of internal and external financing (Jensen and Meckling, 1976; Myers and Majluf, 1984; and Greenwald et al., 1984), 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 must be financed, which would mean additional financing 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 Table 4 we report the mean NTC of firms in our sample after classifying them into more and less likely to be financially constrained according to the different classifications schemes commented in Section 2 (dividend paying, payout ratio, cash flow, size, tangibility ratio, external financing cost, interest coverage and Z-score). We also present a t-statistic in order to test whether the investment in working capital held by firms more likely to face financing constraints is significantly different from those less likely. We find that there are significant differences between more and less constrained firms in their investment in working capital decisions in five of the eight criteria used. In addition, we can see that the investment in working capital is significantly lower for those firms more likely to be financially constrained in four of these five criteria.

Table IV. Net Trade Cycle by financial constraint groups

This Table shows the mean Net Trade Cycle of financially constrained and unconstrained firms according to the various criteria used to categorize our sample of firms.

t-statistic is the t-statistic in order to test whether the mean length of NTC held by financially constrained firms differs significantly from that held by unconstrained firms, under the null hypothesis of equal means.

| Classification schemes | Constrained firms | Unconstrained firms | <i>t-statistic</i> |
|----------------------------------|-------------------|---------------------|--------------------|
| Dividend paying grouping | 54.6163 | 57.0883 | 0.7853 |
| Payout ratio grouping | 51.9333 | 61.0212 | 3.3572 |
| Cash flow grouping | 52.5434 | 60.4111 | 2.9039 |
| Size grouping | 64.8766 | 48.0779 | -6.2591 |
| Tangibility ratio grouping | 57.8111 | 55.1434 | -0.9823 |
| External financing cost grouping | 55.9866 | 56.9679 | 0.3613 |
| Interest coverage grouping | 49.9482 | 63.0063 | 4.8421 |
| Z-score grouping | 51.4940 | 61.4605 | 3.6844 |

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 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:

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

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 is captured by $-(\beta_1 + \delta_1) / 2(\beta_2 + \delta_2)$.

The regression results for more financially constrained and less financially constrained firms categorized using the different classification schemes commented above are presented in Table 5. Our findings provide evidence of the role played by financing in the working capital-firm performance relation. It can be seen that although the concave relation between working capital and firm performance is always maintained, the optimal investment in working capital depends on the financing constraints borne by firms. In addition, different classifications of financial constraints lead to a consistent result. When financing conditions are included 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 result mainly from 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 obtained by Hill et al., (2010) that investment in working capital depends on internal financing resources, external financing costs, capital market access and financial distress of the firms. Their findings suggest that internal financing capacity and capital market access positively influence investment in working capital. Conversely, they find that firms with higher cost of external financing and financial distress hold a lower working capital level.

Table V. Financial constraints and Net Trade Cycle-firm performance relation

The dependent variable is the corporate performance; NTC is the Net Trade Cycle divided by 100 and NTC² 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. ***, ** and * denote statistical significance at the 1%, the 5% and the 10% level, respectively.

| | Financial constraints criteria | | | | | | | |
|-----------------------|--------------------------------|--------------------------|-----------------------|-----------------------|----------------------------------|--|----------------------------------|-----------------------|
| | Dividend Paying grouping | Payout ratio grouping | Cash flow grouping | Size grouping | Tangibility ratio grouping | External financing cost grouping | Interest coverage grouping | Z-score grouping |
| NTC | 0.3260*** (6.50) | 0.1091*** (3.32) | 0.1982*** (5.92) | 0.1751*** (2.77) | 0.1220*** (4.07) | 0.0324** (2.26) | 0.2025*** (5.11) | 0.1879*** (4.69) |
| NTC*DFC | -0.3306*** (-6.39) | -0.0804*** (-2.81) | -0.1812*** (-6.00) | -0.1825*** (-2.97) | -0.1226*** (-3.74) | -0.0457* (-1.76) | -0.1824*** (-5.10) | -0.1557*** (-3.97) |
| NTC ² | -0.1358*** (-7.48) | -0.0530*** (-3.27) | -0.1047*** (-7.83) | -0.0862*** (-3.53) | -0.0540*** (-4.63) | -0.0198*** (-5.14) | -0.0998*** (-7.56) | -0.1006*** (-7.29) |
| NTC ² *DFC | 0.1227*** (6.77) | 0.0367** (2.36) | 0.0832*** (6.38) | 0.0672*** (2.79) | 0.0344*** (3.00) | -0.0241*** (-2.81) | 0.0892*** (5.81) | 0.0787*** (5.73) |
| SIZE | -0.0315 (-1.54) | -0.0520** (-2.32) | -0.0911*** (-4.25) | -0.0448* (-1.79) | -0.0512*** (-2.79) | -0.0497** (-2.25) | -0.0603*** (-2.70) | -0.0602*** (-2.59) |
| LEV | 0.5044*** (8.20) | 0.4682*** (6.28) | 0.5908*** (7.58) | 0.3841*** (5.28) | 0.5348*** (8.32) | 0.4917*** (7.57) | 0.6720*** (7.95) | 0.5212*** (7.52) |
| GROWTH | 0.7552*** (7.21) | 0.4060*** (3.65) | 0.8067*** (6.96) | 1.0104*** (7.16) | 0.8020*** (6.86) | 0.7432*** (5.96) | 0.6460*** (5.75) | 0.8110*** (5.88) |
| ROA | 0.0601 (1.05) | 0.1107 (1.60) | -0.0393 (-0.57) | 0.0950 (1.31) | -0.0430 (-0.70) | 0.0984 (1.37) | -0.0893 (-1.20) | 0.0566 (0.81) |
| F_1 | 0.19 | 5.67 | 1.83 | 0.35 | 0.00 | 0.18 | 2.44 | 6.50 |
| F_2 | 26.36 | 23.86 | 30.36 | 36.68 | 47.93 | 27.13 | 5.64 | 52.45 |
| m_2 | -0.57 | -0.51 | -0.51 | -0.73 | -0.64 | -0.64 | -0.65 | -0.61 |
| Hansen Test | 142.45 (136) | 143.81 (136) | 133.26 (136) | 139.34 (136) | 131.24 (136) | 143.98 (136) | 137.20 (136) | 133.24 (136) |
| Observations | 1606 | 1606 | 1606 | 1606 | 1606 | 1606 | 1606 | 1606 |

5. CONCLUSIONS

The aim of this paper is to provide empirical evidence of the relation between working capital and corporate performance. Although few studies empirically examine whether investment in working capital is associated with firm value, the idea that working capital management influences firm value seems to be generally accepted. 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 in this paper was to study the functional form of the above-mentioned relation. This analysis, which has not been considered previously in the literature, 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 the firm's 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 at keeping as close to their firm's optimal level as possible and try to avoid any deviations from it that destroy firm value.

Moreover, following Fazzari and Petersen (1993) and Hill et al., (2010), who suggest that investment in working capital is sensitive to firms' capital market access, we also analyzed 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 is always maintained, 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 access to external financing on companies' working capital investment decisions obtained in previous studies.

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, due to the costs of moving away from the optimal working capital level. Managers should avoid negative effects on firm performance because of 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.

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