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Escola de Economia e Gestão

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Working Capital Management, Performance and Financial Constraints: the case of German Firms

Abstract

The aim of this study is to analyse the impact of the working capital management on the profitability of German firms, considering also the effects of financial constraints. For this purpose, we used a sample of German listed firms, from different industries, between the period of 1999 and 2014. The data was collected from the Datastream database and it was analysed under the panel data methodology. Moreover, the return-on-assets and the net trade cycle are used to measure the profitability and the efficiency of the working capital management, respectively. To provide an accurate analysis we also applied the Instrumental Variables methodology, in order to avoid biased results due to the existence of endogeneity.

The results of this investigation provide evidence of a concave relationship between profitability and net trade cycle, which is in accordance with recent studies. These findings indicate that firms have an optimal level of investment in the working capital where they should stand as close as possible in order to maximize profitability. Furthermore, we also found a non-linear relationship between all the working capital accounts and firms' profitability.

Additionally, when the effects of financial constraints are taken into account, there is evidence of a lower optimal level in firms more likely to be financially constrained. These results suggest that the concave relationship between working capital and firms' performance always hold. Moreover, they confirm the impact of the availability of internal funds and the access to capital markets on firms' working capital investment decisions.

Keywords: Working capital management; firms' profitability; financial constraints.

Gestão do Fundo de Maneio, Desempenho e Restrições Financeiras: o caso das Empresas Alemãs

Resumo

O objetivo deste estudo é analisar o impacto da gestão do fundo de maneio na rendibilidade das empresas Alemãs, considerando também os efeitos das restrições financeiras. Para este propósito é usada uma amostra de empresas Alemãs cotadas, de diferentes indústrias, entre 1999 e 2014. Os dados foram recolhidos da base de dados Datastream e foram analisados usando a metodologia de dados em painel. Para além disso, é usado o rácio da rendibilidade dos ativos para medir a rendibilidade e o ciclo financeiro de exploração para medir a eficiência da gestão de fundo de maneio. Para fornecer uma análise mais precisa é também aplicada a metodologia das Variáveis Instrumentais, de maneira a evitar resultados enviesados devido à existência de endogeneidade.

Os resultados desta investigação demonstram evidência de uma relação concava entre a rendibilidade e o ciclo financeiro de exploração, o que está de acordo com recentes estudos. Estes resultados indicam que as empresas possuem um nível ótimo de investimento no fundo de maneio onde elas se devem manter o mais próximo possível, de forma a maximizar a rendibilidade. Para além disso, é também encontrada uma relação não linear entre as contas do fundo de maneio e a rendibilidade.

Adicionalmente, quando são analisados os efeitos das restrições financeiras, existe evidência de um nível ótimo do fundo de maneio mais baixo nas empresas que são mais suscetíveis de possuírem restrições financeiras. Estes resultados sugerem que a relação concava entre o fundo de maneio e a rendibilidade das empresas é sempre verificada. Para além disso, confirmam que a disponibilidade de fundos internos e o acesso a mercados de capital têm impacto nas decisões de investimento no fundo de maneio.

Palavras-chave: Gestão de fundo de maneio; rendibilidade das empresas; restrições financeiras.

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List of Abbreviations

AP	Accounts Payable
AR	Accounts Receivable
CCC	Cash Conversion Cycle
EBIT	Earnings Before Interest and Taxes
EU	European Union
FE	Fixed Effects
GMM	Generalized Methods of Moments
ICB	Industry Classification Benchmark
INV	Inventories
IV	Instrumental Variables
LEV	Leverage
NTC	Net Trade Cycle
OLS	Ordinary Least Squares
RE	Random Effects
ROA	Return-on-Assets
WCCC	Weighted Cash Conversion Cycle
WCM	Working Capital Management

1. Introduction

The working capital management (WCM) has been considered an important issue for financial managers since it takes most of their time in the decision process (Richards & Laughlin, 1980). This happens because the WCM reflects the time interval between the firms' purchase of raw material and the collection of money generated by the sales of the final product, during their regular cycle of operations (Richards & Laughlin, 1980). In other words, the working capital represents the firms' investment that circulates from cash to inventory to receivables and finally returns again in cash, generating the operating cycle. Therefore, a significant part of firms' balance sheet is composed of current assets and current liabilities (Fazzari & Peterson, 1993; García-Teruel & Martínez-Solano, 2007). Following this idea, it is expected that the WCM will have a significant impact on firms' profitability, due to the large amount of cash invested in working capital (Deloof, 2003). In fact, there is evidence that an efficient WCM can be essential for the survival and development of firms, especially for the small ones, and an inadequate strategy can increase the risk of bankruptcy (Richards & Laughlin, 1980). Thus, the main objective of the WCM is to balance the working capital level and the risk, in order to improve the financial performance (Gitman,1974).

According to the literature, there are two types of working capital policies that can be adopted by firms: the conservative and the aggressive policies. The conservative working capital policy implies a higher investment in working capital accounts[1] since it defends that firms become less risky as they increase the investment in working capital. However, due to this high investment, firms may also become less profitable. In contrast, the aggressive working capital policy implies a lower investment in working capital accounts. This strategy can lead to an increase in profitability but also to an increase in risk.

In this line, some authors defend that the adoption of an aggressive working capital policy will increase profitability and others disagree on this. Actually, there is empirical evidence that the aggressive working capital policy enhances profitability through a quick collection of payments from customers, a low level of inventory and delaying payments

[1] The working capital accounts are the accounts receivable, inventories and accounts payable.

to suppliers (Shin & Soenen, 1998; Wang, 2002; Deloof, 2003; García-Teruel & Martínez-Solano, 2007). On the other hand, the authors that defend the conservative working capital policy argue that profitability can be increased through the development of long-term relationships with customers and the discounts for early payments, granted by suppliers (Deloof & Jegers, 1996; Baños-Caballero, García-Teruel & Martínez-Solano, 2010).

More recently, Baños-Caballero, García-Teruel and Martínez-Solano (2012) present evidence of a non-linear relationship between profitability and WCM, indicating the existence of an optimal level of working capital that maximizes profitability. This non-linear relationship is positive at low levels of investment in working capital and becomes negative at higher levels.

Additionally, Baños-Caballero, García-Teruel and Martínez-Solano (2014) argue that, if there is a concave relationship between WCM and firms' profitability, the optimal level of working capital will differ in firms that are more or less likely to be financially constrained. Therefore, it is expected that the optimal level of working capital is going to be lower in financially constrained firms. According to Fazzari and Petersen (1993), the investments in working capital are more sensitive to financial restrictions, due to the fact that a positive working capital level needs to be financed. Moreover, firms' investments might depend on the cost of financing, availability of internal funds or access to capital markets (Baños-Caballero, García-Teruel & Martínez-Solano, 2014). In fact, smaller firms usually have higher costs and restrictions to access to external financing than larger firms. For this reason, it is believed that firms that are facing financial restrictions are going to present a lower optimal level of working capital compared to the unconstrained firms.

In this context, the aim of this study is to investigate the impact of the WCM on the profitability of German listed firms. Moreover, the impact of firms' financial constraints on the working capital investment is also analysed. To perform this study, a longitudinal database during the period of 1999 and 2014 was collected from Datastream.

Our findings suggest a concave relationship between WCM and profitability, which confirms the existence of an optimal working capital level that maximizes profitability, which is in line with previous studies (Deloof, 2003; Silva, 2011; Chiou, Cheng & Wu, 2006; Baños Caballero, García-Teruel & Martínez-Solano, 2012). Moreover, we also find a non-linear relationship between profitability and the working capital accounts, i.e. accounts receivable, inventories and accounts payable. However, instead of a maximum level, the results present a minimum level of profitability. This minimum is found in large values of the number of days-sales of accounts receivable, inventories and accounts payable. Therefore, these results suggest an overall decreasing trend of profitability as these variables increase. Pais and Gama (2015) and Lyngstadaas and Berg (2016) present similar results in their research.

In order to analyse the impact of financial restrictions, the firms are classified in more or less financially constrained according to some financial measures: dividend payout ratio, cash-flow, size, cost of internal financing and interest coverage. Our results provide evidence of a lower optimal level of working capital in firms more likely to be financially constrained. This is in line with the study of Baños-Caballero, García-Teruel and Martínez-Solano (2014).

This study is the first one that provides empirical evidence of a non-linear relationship between WCM and profitability for a sample of German firms, considering also the impact of financial restrictions that firms can be facing.

The remaining work is organized as follows. Section 2 reviews the WCM literature. Section 3 provides a description of the variables, the research hypotheses and the methods applied. Section 4 describes the sample used in this study. Section 5 presents and discusses the empirical results. Finally, section 6 provides the main conclusions and limitations of this dissertation and suggestions for future research.

2. Literature Review

The purpose of this section is to present a theoretical overview of the impact of WCM on firms' performance and the presence of financial constraints. Therefore, we pretend to discuss the importance of an efficient working capital management and the different strategies that can be adopted by firms. Additionally, we present a few studies about the existence of an optimal level of working capital and its behaviour when firms are facing financial constraints.

2.1 Working Capital and Corporate Performance

Ding, Guariglia and Knight (2013) define the working capital as the management of the current assets[2] and the current liabilities[3] of a company, and as an indicator of the source and the use of short-term capital, i.e. it indicates how efficiently a firm is in its activity and how financially stable is in the short-term. Moreover, Ukaegbu (2014) consider that the main goal of the WCM is to guarantee that the firm will cover all their operating expenses and continue to be able to pay the short-term responsibilities (known as liquidity). For this reason, the WCM is important due to the effects on firms' profitability and risk, as well as in their value, requiring an efficient management (Smith, 1980).

According to Richards and Laughlin (1980), the major investigations performed in corporate finance are related to long-term investments, but in the balance sheet of most companies the short-term components have a higher weight. Furthermore, the WCM decisions require more time and accuracy from managers, due to the liquidity that might provide and that is essential to prevent losses. This happens because firms invest more in short-term assets and often use short-term liabilities as a financial source[4], which leads to a higher level of working capital (Brennan, Maksimovic & Zechner, 1988; Fazzari & Petersen, 1993). In this line, Shin and Soenen (1998) and Deloof (2003) refer that it is expected that the way in which the working capital is managed is going to have a

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[2] Include the accounts receivable, inventories and cash.

[3] Include the accounts payable and short-term debt.

[4] Mainly this situation is verified in small and median firms, which face more difficulties in accessing to external financing.

substantial impact on firms' performance and, for this reason, it is important to find the optimal level of working capital that maximizes their value. Moreover, Shin and Soenen (1998) confirm with their investigation that firms with higher returns have a better working capital management, mainly due to their market domain, wide bargaining power with suppliers and customers and better conditions in the capital market.

In order to find a performance indicator of WCM, Gitman (1974) develops the cash conversion cycle (CCC[5]), which measures the number of days that the money is retained in inventories and accounts receivable and subtracts the number of days that the payment to suppliers is delayed. With this measure it is possible to analyse the WCM's efficiency since it gives the period of time required to convert cash disbursements back into cash inflows from a firm's regular course of operations. On the other hand, Gentry, Vaidyanathan and Lee (1990) propose a weighted cash conversion cycle (WCCC) that also includes the capital invested in each part of the operating cycle. However, this measure is sometimes hard to calculate due to the lack of information available (Shin & Soenen, 1998).

Another indicator is developed later by Soenen (1993), the net trade cycle (NTC), arguing that the CCC has different denominators for the three components of the working capital and for this reason may not be accurate. The NTC differs from the CCC because it uses the sales as the denominator for all components and, therefore, is considered to be a simpler and more efficient measure of the WCM (Shin & Soenen, 1998; Baños-Caballero, García-Teruel & Martínez-Solano, 2014; Enqvist, Graham & Nikkinen, 2014; Mun & Jang, 2015).

Previous studies use these performance indicators in order to analyse whether shortening or expanding this cycle would have a positive or negative impact on firms' profitability. Therefore, there are two types of strategies that can be adopted to manage the working capital: implement working capital policies to increase the sales (conservative policy) or to minimize working capital investment (aggressive policy). These policies intend to establish a trade-off between profitability and risk, that should be assessed by the firm in order to find its optimal level of investment in current assets (Shin & Soenen, 1998).

[5] CCC = ((Accounts Receivable/Sales) + (Inventories/Purchases) – (Accounts Payable/Purchases)) * 365.

A conservative working capital policy (high NTC) means an overinvestment in working capital, in other words, this strategy focuses on to keep a high inventory level, extend the trade credit to customers and reduce the suppliers' financing. Blinder and Maccini (1991) argue that a high inventory level reduces the possibility of interruptions in the production process, by avoiding the lack of products, and protects against prices fluctuations, decreasing at the same time the supply costs. Regarding the trade credit, Emery (1987) defends that a conservative policy can increase sales due to the fact that it encourages customers to buy in periods of low demand and reduces transactions costs. Moreover, customers have more time to ensure that the services contracted have been carried out (Smith, 1987) and to verify the quality and quantity of the product ordered before pay (Deloof & Jegers, 1996), which at same time can also help firms to strengthen long-term relationships with their customers and differentiate their product (Emery, 1987; Ng, Smith & Smith, 1999). Finally, the conservative strategy also suggests a reduction in suppliers' financing to ensure early payments discounts, which lead to a decrease in costs of external financing (Baños-Caballero, García-Teruel & Martínez-Solano, 2010).

However, the conservative policy implies an increased investment in current assets and at the same time a higher liquidity, due to an extending trade credit and high level of inventory, which can cause a decrease in profitability (Deloof, 2003; Lazaridis & Tryfonidis, 2006). Kim and Chung (1990) indicate that keeping stock available can incur costs, such as warehouse rent and insurance. Moreover, if customers stop making their payments, the firms will face cash flow difficulties (Lazaridis & Tryfonidis, 2006). A large CCC can also imply opportunity costs because companies usually avoid to investe in positive projects, due to the fact that they have too much cash invested in working capital, which can increase the risk of bankruptcy (Soenen, 1993; Aktas, Croci & Petmezas, 2015). Usually, companies with a higher CCC are older and with higher cash flows (Baños-Caballero, García-Teruel & Martínez-Solano, 2010).

Regarding the aggressive strategy, there are previous empirical studies that support the idea that a low CCC increase profitability. An aggressive working capital policy (short NTC) means a quick collection of receivables, low inventory level and delays in payments to suppliers, which is considered a more efficient WCM (Enqvist, Graham & Nikkinen, 2014). For example, Wang (2002) in his investigation studies a sample of companies from Japan and Taiwan, during the period 1985-1996, and find a negative relationship between

CCC and profitability, as well as this relation is sensitive to industry factors, for instance, competitive forces and production processes. Deloof (2003), considering a sample of Belgian companies between 1991-1996, concludes that it is possible to improve profitability by decreasing the number of days of accounts receivable and inventories. Moreover, he confirms that less profitable firms usually postpone their payments to suppliers. García-Teruel and Martínez-Solano (2007) analyse for a sample of Spanish SME's, during 1996-2002, and also find the same evidence of a negative relationship between the CCC and firms' profitability. More recently, Pais and Gama (2015) study the effects of WCM in Portuguese firms, between 2002-2009, and conclude that a reduction in the inventory held and in the number of days to collect payments from customers and to settle the current liabilities are connected to a better performance. Furthermore, this relation is also verified when authors control for industry, which supports even more the adoption of an aggressive working capital policy.

Other empirical studies use the NTC as the performance indicator of the WCM and obtained similar results. For instance, Soenen (1993) for a sample of U.S. companies discoveres a significant negative relationship between NTC and profitability. In the same line, Silva (2011) tests this relation in a sample of Portuguese manufacturing companies, during the period of 1996-2006. The author finds evidence of an increase in the profitability caused by the reduction of the investment in current assets. However, this study differs from what would be expected since it presents that a reduction in the number of days of accounts payable also increases the profitability. Comparing previous empirical studies, it is possible to conclude that both performance indicators, i.e. NTC and CCC, provide the same evidence for a negative relation between the WCM and the firms' profitability. In fact, Kamath (1989) concludes in their study with U. S. large retail firms, that NTC presents the same information of the CCC and that both measures have a negative relationship with profitability indicators.

However, the aggressive policy can have a negative effect on some other aspects: in sales, since the supplier credit to customers is lower; in production process, due to a possible rupture of stocks regarding their lower level; and in inventory costs, because of the loss of discounts from suppliers for early payments (Deloof, 2003; García-Teruel & Martínez-Solano, 2007; Aktas, Croci & Petmezas, 2015). According to Petersen and Rajan (1997), the credit from suppliers, at a median term, can be more expensive than the external financing. This happens because the firms are going to lose consecutively discounts for early payments and, at a certain point, this is going to affect their cash-flows. On the other hand, firms can also face discrimination of prices because of their performance in the payments (Brennan, Maksimovic & Zechner, 1988).

For this reason, Baños-Caballero, García-Teruel and Martínez-Solano (2012) suggest the existence of a trade-off between the WCM and profitability, i.e. a concave relationship. This means that all benefits and costs mentioned above should be balanced by managers in order to find an optimal working capital level, where the profitability of the firms is maximized. Outside this optimal, due to the low return of current assets, the firms' profitability should be positively related to low levels of working capital and negatively related to higher levels. A recent study of Baños-Caballero, García-Teruel and Martínez-Solano (2012) for a sample of Spanish SME's, during the period of 2002-2007, concludes that there is a concave relationship between working capital level and profitability, which means the existence of an optimal working capital level. The authors also confirm the greater profitability effect and the greater risk effect for companies with low levels of working capital. Aktas, Croci and Petmezas (2015) find a similar evidence in a sample of U.S. firms during 1982-2011. The results show that when firms meet the optimal level of working capital policy, by increasing or decreasing their investment in working capital, they improve their operating performance. Moreover, firms tend to use unnecessary working capital resources in a more efficient way, such as funding growth investments (Aktas, Croci & Petmezas, 2015).

However, the optimal working capital level will depend on the characteristics of the firms, like the size, type of industry, sales growth, operating cash-flow, among others (Hill, Kelly & Highfield, 2010). As noted by Chiou, Cheng and Wu (2006), there is a positive relationship between CCC and the size of the firms, where the smallest ones have a greater use of the suppliers' credit, that result in a lower CCC. On the other hand, the largest companies, and also older, present a decrease in growth opportunities in relation to the smallest and young ones (Niskanen & Niskanen, 2006). Furthermore, Fazzari and Petersen (1993) show evidence that firms with more capacity in generating money also show higher levels of investments in currents assets, due to the lower costs of keeping them. Regarding the sector in wich the firms operate, Ng, Smith and Smith (1999) find that the money invested in working capital has a relation with the different management policies and presents significant changes from sector to sector.

Nevertheless, the optimal level of working capital also depends on outside factors, for instance, bargaining power with suppliers and customers, cost of external financing and availability of internal financing (Chiou, Cheng & Wu, 2006; Baños-Caballero, García-Teruel & Martínez-Solano, 2010). According to Petersen and Rajan (1997), these outside factors are very important, mainly for small firms, because most of the firms hold in the accounts receivable a large quantity of money and, therefore, the credit from suppliers is the major source of financing.

2.2 Working Capital and Financial Constraints

Baños-Caballero, García-Teruel and Martínez-Solano (2014) argue that, if a concave relationship between WCM and firms' profitability is confirmed, it is expected that the optimal level of working capital will differ in firms that are more or less financially constrained. This fact is mainly related to firms' investments that may depend on the cost of financing, availability of internal finance or access to capital markets, as mentioned before.

According to Modigliani and Miller (1958), firms' capital structure is not revelant to its value by the fact that external finance (new debt and/or equity issues) and internal finance are perfect alternatives and, therefore, firms' investment and financing decisions are independent of each other. In other words, companies will always get external financing without any problems and, consequently, their investment is not restricted to the availability of internal finance. However, the capital market is not perfect and agency conflicts and information asymmetry problems (between lenders and borrowers and/or between managers and shareholders) arise when firms try to have access to external financing, which increases their cost. Consequently, the credit from suppliers can be considered cheaper (Martínez-Sola, García-Teruel & Martínez-Solano, 2013).

Thus, Niskanen and Niskanen (2006) conclude that firms with more financial restrictions use more the trade credit as an alternative to financing. In addition, Baños-Caballero, García-Teruel and Martínez-Solano (2010) find that small and median firms accept more credit from suppliers, which suggest the existence of financial constraints. This situation can be justified by the fact that usually smaller firms have more costs and issues in accessing to external financing (Baños-Caballero, García-Teruel & Martínez-Solano, 2010). On the other hand, largest companies have better conditions in capital markets and therefore can be considered financial intermediaries by their costumers (Martínez-Sola, García-Teruel & Martínez-Solano, 2014).

According to Fazzari and Petersen (1993), the investments in working capital are more sensitive to financial restrictions in relation to fixed investments, which can be explained by the fact that a positive working capital level needs to be financed. In this context, the optimal level of working capital will be lower for financially constrained firms and, on the other hand, a higher optimal will be seen on those firms with a greater internal financing capacity and access to capital markets (Baños-Caballero, García-Teruel & Martínez-Solano, 2014). However, Ding, Guariglia and Knight (2013) in their study also confirm that firms with high sensitivity of fixed investments to cash flows are expected to have more financial constraints since they tend to adjust the fixed and working capital investments when variations occur in their cash flows.

In order to analyse the effects of financial constraints in WCM, it is necessary to identify the companies that are constrained and unconstrained. Unfortunately, there are several measures and no consensus between previous studies in identifying the best ones for the classification. However, there are some measures used more frequently. The dividends policy is one of them since firms financially constrained tend not to pay or pay lower dividends, in order to decrease the possibility of raising external funds in the future (Fazzari, Hubbard & Petersen, 1988). As well as the dividends, the cash flow follows the same base but allows to concentrate on firms' beginning-of-the-period funds (Moyen, 2004). The size is one of the most used measures in previous empirical studies (Fazzari & Petersen, 1993; Almeida, Campello & Weisbach, 2004; Faulkender & Wang, 2006). As mentioned before, smaller companies usually face higher informational asymmetry and agency costs, and consequently are more financially constrained (Baños-Caballero, García-Teruel & Martínez-Solano, 2014). On the other hand, large companies usually have better conditions on capital markets and therefore have fewer costs of external financing and borrowing restrictions (Whited, 1992). Another measure used is the cost of external financing, that as already stated, firms with lower costs of external financing are more likely to be unconstrained (Fazzari, Hubbard & Petersen, 1988). Finally, there is the interest coverage that is commonly used to determine the level of bankruptcy risk of firms, because a firm in financial distress is more likely to have more financial constraints (Whited, 1992).

To summarize the review of literature about the working capital it is possible to say that recent studies show a strong evidence of a concave relationship between the WCM and profitability (Baños-Caballero, García-Teruel & Martínez-Solano, 2012; Silva, 2012; Aktas, Croci & Petmezas, 2015). Therefore, the information of an optimal level of working capital policy can help firms improve their performance, and consequently their value. For this reason, managers should analyse their optimal level of working capital in order to plan an efficient management and avoid costs associated with the distance (by excess or defect) from its level.

Additionally, financial constraints can influence this optimal level of investment in working capital, which can indicate that the availability of internal funds and the access to external financing influence the investment decisions and internal policies of the firms.

3. Methods

According to the literature review, an effective WCM keeps a balance between the current assets and liabilities that allows firms to not only cover their financial obligations but also help to boost their earnings. For this reason, there is evidence of a non-linear relationship between the WCM and profitability, which indicates the existence of an optimal level of working capital where profitability is at its maximum. This optimal level is going to depend mainly on industry factors[6] and the financial constraints that firms may be facing.

The aim of this study is to contribute to the analysis of the WCM impact on firms' profitability by providing empirical evidence with a sample of German listed firms, from all industries[7]. In this line and according to the mentioned before, we intend to study the non-linear relationship between the investment in working capital and the firms' profitability. Moreover, it is also analysed how the firms' financial conditions can affect this relationship.

In this section we describe all variables included in the study, the hypotheses that are going to be tested and the models applied to perform the investigation.

3.1 Variables

In order to perform the study, we defined the following variables that, according to the literature, have a significant impact on the profitability of the companies and in the working capital.

[6] The needs of working capital change from industry to industry due to differences in the collection and payment policies, the time necessary to purchase raw material, inventory necessity, among others.

[7] These industries include: Basic Materials (i.e. chemicals and basic resources); Consumer Goods (i.e. automobile, food and beverage, personal and household goods); Consumer Services (i.e. retail, media and travel and leisure); Health Care (i.e. health care equipment and services, pharmaceuticals and biotechnology); Industrials (i.e. construction materials, electronic, transports and electrical equipment); Oil & Gas; Technology; Telecommunications and Utilities (i.e. electricity, water and gas). It is not included the Financial industry due to its particularities.

3.1.1 Dependent Variable

The dependent variable is the firm's performance and it is measure by the Return-on-Assets (ROA) ratio, as follows:

$$\textbf{ROA} = \frac{\text{EBIT}^{8}}{\text{Total Assets - Financial Assets}}$$

[1]

This ratio is an indicator of how proficient is the management of assets in generating income, which indicates that the higher is the ratio the better is the firm in converting its investments into profit. Moreover, is not affected by special items or affected by the capital structure of the firms (Barber & Lyon, 1996).

For the reasons mentioned above, this variable is one of the most used in previous studies as an indicator of the firms' performance (Wang, 2002; García-Teruel & Martínez-Solano, 2007; Enqvist, Graham & Nikkinen, 2014).

3.1.2 Independent Variables

The independent variables for this investigation are the working capital accounts considered individually and in the aggregate summary indicator, the NTC. Therefore, the explanatory variables are:

- The average number of days-sales of accounts receivable (AR), calculated through:

$$\textbf{AR} = \left(\frac{\text{Accounts Receivable}}{\text{Sales}}\right) \times 365$$

[2]

This variable represents the average number of days that a firm takes to collect payments from customers. A high number of days indicates a high investment in AR by firms. Following this idea, it is more likely to find a negative relationship between the AR and firms' profitability.

[8] EBIT is considered the Earnings Before Interest and Taxes.

➲ The average number of days-sales of inventories (INV), measured in the following way:

$$\mathbf{INV}=\left(\frac{\text{Inventories}}{\text{Sales}}\right)\times 365$$

[3]

With this variable it is possible to estimate the average number of days that the inventories are stored in firms. A high number of days means that firms hold their stocks for a long period and, therefore, it requires a high level investment.
As well as AR, it is expected that profitability and inventories relate negatively.

➲ The average number of days-sales of accounts payable (AP), estimated by:

$$\mathbf{AP}=\left(\frac{\text{Accounts Payable}}{\text{Sales}}\right)\times 365$$

[4]

This variable shows the average number of days that firms take to pay to their suppliers. The higher the number of days of accounts payable the higher is the period that firms need to pay their liabilities to suppliers. Therefore, it is expected a positive relationship between AP and firms' profitability.

➲ The Net Trade Cycle, measured in the following way:

$$\mathbf{NTC}=\left(\frac{\text{AR + INV - AP}}{\text{Sales}}\right)\times 365$$

[5]

The NTC variable allows studying the average number of days, relating to firms' sales, which the firms have to finance its working capital needs. Usually, a high NTC indicates that firms follow a conservative policy, with an extensive trade credit to customers, a high inventory level and a short period for payments to suppliers. On the other hand, a low NTC can mean the adoption of an aggressive working capital policy, with a quick collection of payments from customers, a low inventory level and delays in payments to suppliers.

As mentioned before, previous studies point to a non-linear relationship between profitability and NTC, where profitability and NTC relate positively at low levels of working capital and negatively at higher levels. In other words, it is expected that firms' profitability is going to rise as well as NTC until a certain point, where the increase in profitability will not offset the higher risk taken. Outside that level, due to the low return of current assets it is expected that an increase in NTC will lead to a decrease in profitability (Baños-Caballero, García-Teruel & Martínez-Solano, 2012).

3.1.3 Control Variables

In addition to the independent variables, we also included some control variables that can influence the profitability of the companies. In this study we use the following control variables:

- **Size**: is measured by the logarithm of sales. According to the investigation of Chiou, Cheng and Wu (2006) there is a positive relationship between size and firm's performance, where the working capital requirements increase with the size of the firms. In this line, Baños-Caballero, García-Teruel and Martínez-Solano (2010) state that smaller firms have lower accounts receivable and inventories, mainly because of the higher cost of keeping funds invested in current assets. Therefore, it is expected to find a positive relationship between the profitability and size.

- **Leverage** (LEV): is measured by the ratio of total debt to total assets. This ratio captures the financial risk of a business since it indicates the proportion of assets that are being financed with debt. As pointed out by Chiou, Cheng and Wu (2006) the empirical evidence shows a reduction in the working capital accounts when firms increase their level of leverage. For this reason, a negative relationship between ROA and the leverage ratio is expected.

- **Growth:** this variable measures the past sales growth through the formula GROWTH = $[(Sales_t - Sales_{t-1}) / Sales_{t-1}]$. According to Baños-Caballero, García-Teruel and Martínez-Solano (2010) firms with higher past growth rates are more likely to continue to grow in the future. However, it is not very clear the expected relationship between ROA and GROWTH since profitable firms tend to maximize their level of profits through profitable growth opportunities but experience a decrease in profit rates (SooCheong & Kwangmin, 2011).

3.1.4 Measures of Financial Constraints

As mentioned in section 2, to identify the firms that are more likely to have financial constraints from the others it is necessary to estimate some financial measures in order to classify the firms. Due to the fact that there is still no consensus on the variable to use, we consider the different variables commonly used in previous studies. Therefore, the financial variables are calculated as follows:

- **Dividends** – to apply this measure, it is necessary to calculate the dividend payout ratio (estimated by the value of dividends over the net profit). Thus, the firms with a ratio below the sample median are considered to have more constraints in relation to the others with a higher ratio (Almeida, Campello & Weisbach, 2004).

- **Cash Flow** – it can be determined by the ratio of earnings before interest and taxes plus depreciation, divided by total assets. Thus, firms with a cash flow below the sample median are more likely to face financial constraints (Baños-Caballero, García-Teruel & Martínez-Solano, 2014).

- **Size** – the size is calculated based on the natural logarithm of sales and the firms with values below the median are considered to be more constrained.

- **Cost of external financing** – it is estimated through the ratio of financial expenses over total debt. Firms with costs above the sample median are considered to have more financial constraints.

- **Interest coverage** – it can be measured by the ratio of earnings before interest and taxes to financial expenses. The lower is this ratio, the more problems firms have in repaying its obligations, and therefore are more likely to be financially constrained (Baños-Caballero, García-Teruel & Martínez-Solano, 2014).

3.2 Research Hypotheses

Previous empirical studies point to a linear relationship between the WCM and profitability. For this reason, first we are going to test hypotheses based on a linear relationship, to study the connection between working capital accounts and firms' profitability.

- ➲ **Hypothesis 1**: There is a negative relationship between the NTC and firms' profitability.
- ➲ **Hypothesis 2**: A decrease in the average number of days in accounts receivable will have a positive impact on firms' profitability.
- ➲ **Hypothesis 3:** A decrease in the average number of days in inventories will have a positive impact on firms' profitability.
- ➲ **Hypothesis 4:** An increase in the average number of days in accounts payable will have a positive impact on firms' profitability.

Then, we also analyse the existence of a non-linear (concave) relationship between WCM and profitability. Moreover, we also investigate if this relationship holds in all working capital accounts.

- ➲ **Hypothesis 5:** There is an optimal NTC level that maximizes profitability.
- ➲ **Hypothesis 6:** There is an optimal AR level that maximizes profitability.
- ➲ **Hypothesis 7:** There is an optimal INV level that maximizes profitability.
- ➲ **Hypothesis 8:** There is an optimal AP level that maximizes profitability.

As referred previously, we aim also to study the impact of financial constraints on the working capital level. For this reason, we test whether or not the optimal level of working capital differs on firms that are more likely to be financially constrained from the others.

- ➲ **Hypothesis 9:** The optimal level of working capital is lower in firms with more financial constraints.

3.3 Methods Applied

To test the research hypotheses mentioned above we conduct a multivariate analysis, that consists in the study of multiple regressions that analyse the relationship between the dependent variable and the independent and control variables. In this analysis we use the panel data methodology (also called as longitudinal data), that contains observations for *n* cases (629 firms in this study) over *t* time periods (between 1999-2014 in this study).

According to Brooks (2008), there are several advantages in using this methodology, for instance, it presents more information through the combination of time-series (over a period of time) and cross-sectional (different firms); allows the inclusion of a large number of observations, while guarantees the asymptotic properties of the estimators with more degrees of freedom and a more robust *t* and *F* test. Moreover, the panel data reduces the risk of multicollinearity[9], due to the fact that the data have different structures among entities, and provides more efficient and stables estimators, through a wide range of tests that allow a better choice between different methods (Brooks, 2008). Finally, Baum (2006) also states that the panel data methodology controls for heterogeneity[10], through the fact that it excludes biased estimators that may arise from the existence of individual effects.

In this study, we have an unbalanced panel data since there are some unknown observations during all the period of the sample (StataCorp, 2013). However, and according to Greene (2003), an unbalanced panel data does not interfere with the accuracy of the results.

To analyse this panel data there are some models that can be applied: the Pooled Ordinary Least Squares (OLS) Model, the Fixed Effects (FE) Model and the Random Effects (RE) Model.

3.3.1 Pooled Ordinary Least Squares Model

According to Johnson and DiNardo (1997), the Pooled OLS model is the simplest estimator since it ignores the general structure of the panel data and considers the observations for each entity as not correlated. Moreover, the model assumes homoscedastic errors[11] between entities and the period of time, leading to a biased and inconstant model affected by the unobservable heterogeneity (Johnson & DiNardo, 1997).

[9] Multicollinearity is defined as the correlation between the independent variables in a regression model, that can lead to ambiguous results when trying to explain the dependent variable (Farrar & Glauber, 1967).

[10] Heterogeneity is the correlation between the variables that are in the model (observable variables) and other relevant variables that are not included in the model (unobservable variables). In other words, if some characteristics are omitted in the model and have a direct effect in the explanatory variables, it is possible that these variables are correlated with errors and, therefore, the regression coefficients will be biased measures. This problem is frequent in cross-sectional analysis (Arellano, 2003).

[11] Homoscedasticity assumes that the variance of the error term of a regression is the same across all values taken by the independent variable.

On the other hand, this model allows the application of different periods of time for the same company, which means a higher sample and a better quality of the statistics tests. However, the Pooled OLS is just indicated in the cases that the relation between the dependent and independent variables remain constant over time (Wooldridge, 2003).

If the investigation aims to include specific characteristics of the firms (for instance, the type of industry), this model allows the inclusion of dummy variables[12] that interact with the variables and show the relationship between the firm characteristic and these variables.

3.3.2 Fixed Effects Model

The FE is a more complete model than the Pooled OLS due to the fact that it analyses the changes over time of the explanatory variables and it can be used if there´s a correlation between them (Wooldridge, 2003). Moreover, the model controls for the effects of omitted variables that change across firms and over time, by assuming that those effects are captured by the unobservable heterogeneity term (Wooldridge, 2002). Despite this fact, FE method is recommended for situations where there is the risk of omission of important explanatory variables. A disadvantage of this methodology is the impossibility of using data time-invariant in the model (Wooldridge, 2002).

3.3.3 Random Effects Model

In the RE model, and comparing with the FE, it is assumed that the differences between firms are random and not correlated with the independent variables of the model (Wooldridge, 2003). This methodology considers that the constant term is not related to the explanatory variables and, for this reason, it only should be applied when all relevant variables are not omitted in the model (Wooldridge, 2003).

However, the RE model has a reduced number of estimated parameters in relation to FE, which allows to include dummies variables in order to analyse individual effects of the firms (Wooldridge, 2003).

[12] A dummy variable is a variable that takes the value of 1 or 0, where 1 means something true (for instance, the type of industry is Consumer Goods). They are also called as indicator variables (StataCorp, 2013).

3.3.4 Choice of the Model

Considering the models mentioned above, it is possible to conclude that the best models and also the most used are the FE and RE models. Nevertheless, in order to apply the adequate method to the panel data it is necessary to perform some tests (Wooldridge, 2002).

Firstly, the data is analysed considering the Pooled OLS model to verify the existence of unobserved heterogeneity across firms in this study. This model provides an *F* Statistic test, which verifies the global significance of the regression under the null hypothesis that the constant terms are equal across all firms. If the null hypothesis is rejected this means that the model is affected by unobservable individual effects of the firms and that they needed to be treated. For this reason, the FE model is preferable to the Pooled OLS (Greene, 2003).

Then it is necessary to run the Hausman test[13] to verify if the unobservable heterogeneity term is correlated or not with the explanatory variables (FE model or RE model). The null hypothesis of this test is that they are not correlated. If the null hypothesis is not rejected it means that there are random effects and the RE model is the appropriated. On the other hand, if the null hypothesis is rejected, the effects are considered to be fixed and the FE model should be chosen (Hausman, 1978).

In this study, the result of the Hausman test indicates that the best estimator is given by the FE model, through the rejection of the null hypothesis.

Additionally, it is required to test for the presence of heteroskedasticity[14] and serial correlation[15] in the FE model. Therefore, it is necessary to perform a Breuch-Pagan test (suggested by Greene, 2003) for heteroskedasticity and a Wooldridge test (Wooldridge, 2002) for serial correlation, under the null hypothesis of homoskedastic and no serial correlation, respectively.

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[13] Hausman test is a statistical test that evaluates the estimators of two different models and indicates the one that is more efficient and consistent (Hausman, 1978).

[14] Heteroskedasticity occurs when the variance of the error term changes due to a change in the values of the independent variables (Arellano, 2003).

[15] Serial correlation is the correlation between a certain variable and itself at different points in time (Arellano, 2003).

Our results point out for the existence of both, which requires the adoption of clustered robust standard errors. This method allows the assumption that observations of the same firm (i.e. cluster) over time are correlated with each other but uncorrelated with the observations of other firms.

3.3.5 Instrumental Variables Methodology

Another issue that can arise is the endogeneity due to the fact that in the FE model the unobservable heterogeneity term is correlated with regressors (Cameron & Triverdi, 2009). The endogeneity is present in the regression when the independent variable is affected by the dependent variable and not vice-versa, which leads to unreliable results (García-Teruel & Martínez-Solano, 2007). For this reason, it is necessary to test whether or not a particular regressor is endogenous, in order to apply an efficient method. In this line, we use the Instrumental Variables (IV) methodology[16] that provides a robust estimation through the inclusion of valid instruments in the regression (Cameron & Triverdi, 2009). These instrumental variables need to fulfil two important requirements: they must be correlated with the endogenous explanatory variable but uncorrelated with the disturbance error, in order to respect the exogeneity assumption (Cameron & Triverdi, 2009). An appropriate instrument seems to be the endogenous independent variables lagged one or more periods, for the fact that in FE model the observations of the same firm in two different time periods are correlated but the observations of two different firms are not.

According to Baum, Schaffer and Stillman (2003), the Durbin-Wu-Hausman test is a method of investigating whether or not the regressors are endogenous and is a powerful test at detecting violations of restrictions and also at determining the consistency of the most efficient estimator. Moreover, it is one of the most used test in empirical studies (Pais & Gama, 2015). The test gives two observations: the value of the chi-square, under the Durbin test, and the value of the F test, under the Wu-Hausman test, and it is performed under the null hypothesis that regressors are exogenous. If this hypothesis is rejected it is possible to conclude that the independent variable is endogenous and, therefore, it is necessary to apply the IV methodology.

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[16] Another efficient methodology to deal with the endogeneity is the Generalized Methods of Moments (GMM), that requires the specification of a set of moment conditions that the model should satisfy (Arellano, 2003).

4. Sample Description

In this section we describe the data used to implement the methods mentioned above. Firstly, we present the sample of firms chosen for this investigation and general descriptive statistics for the dependent and independent variables. Secondly, we report the correlations between all variables and their statistical significance.

4.1 Data

Our dataset is composed of listed firms from Germany, between the period of 1999 and 2014. The financial data for these companies is collected from the Datastream database and aggregates year-end financial information (i.e. income statements, balance sheets and cash flow statements), expressed in Euros at current prices.

As far as we are aware of, there is no study about the effects of WCM on firms' profitability considering their financial constraints in Germany. Moreover, there are some recent studies that refer a higher working capital level in German firms comparing with other European countries (PWC, 2014). Regarding the time period, it is intended to analyse the behaviour of the firms regarding the WCM before and during the European financial crisis, that started mainly in 2008.

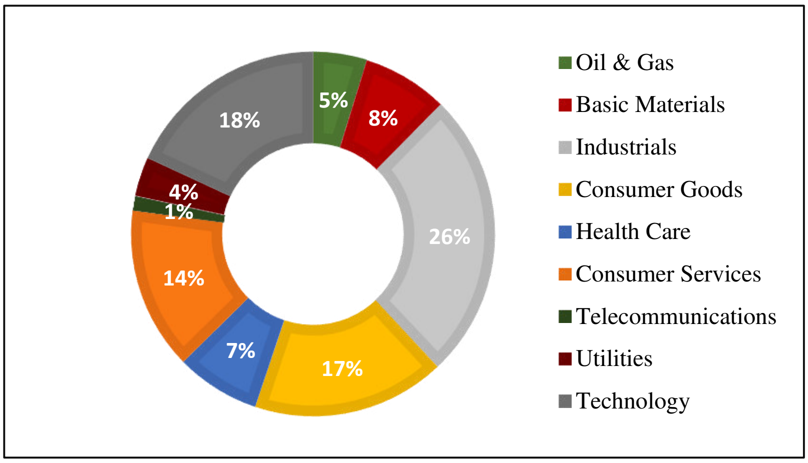
This dataset of German firms includes a wide variety of industries divided as can be observed in Figure 1. The industries with higher weights are Industrials, Consumer Goods and Consumer Services[17]. Moreover, it was necessary to apply some criteria in order to obtain a robust sample. The firms with less than 5 years[18] of information available and with anomalies[19] in their accounting values were excluded. In addition, all variables are winsorized at 1 percent level to avoid biased results due to outliers.

[17] This classification is based on the Industry Classification Benchmark (ICB) available in the Datastream. See Appendix A, Table A.1 for a complete description of the industry per sector.

[18] As suggested by Baños Caballero, García-Teruel and Martínez-Solano (2014).

[19] The anomalies considered were negative values in fixed assets, current assets, total assets, inventories, long-term liabilities, current liabilities, depreciation and sales.

Figure 1 – Composition of the sample per industry



Finally, after calculating all the ratios mentioned previously (section 3) we obtained a sample with 7,928 firm-year observations for 629 different firms, during the period of time of 1999-2014.

4.2 Descriptive Statistics

The descriptive statistics of our dependent and independent variables are summarized in Table 1.

Table 1 – Descriptive Statistics

Variable	Obs.	Mean	SD	Min.	Median	Max.	10th Perc	90th Perc
ROA	7,928	0.0284	0.1770	-0.9295	0.0590	0.3836	-0.1256	0.1656
AR	7,928	79.9121	69.8713	0	64.8539	532.3796	26.4527	134.0792
INV	7,928	47.2575	43.3034	0	41.8933	233.0740	0.8541	99.9299
AP	7,928	33.4707	30.0486	0	26.7614	211.6859	8.9548	60.5403
NTC	7,928	94.6507	81.3581	-27.4094	80.4274	566.5454	18.5801	177.5806
SIZE	7,928	12.2109	2.2962	1.9249	11.9511	18.0617	9.5235	15.3639
LEV	7,928	0.2083	0.1924	0	0.1745	0.8777	0	0.4695
GROWTH	7,928	0.1528	0.1667	-0.5361	0.0894	0.6882	0.0044	0.4084

This table reports descriptive statistics during the period 1999-2014. Descriptive statistics are the following: Number of Observations, Mean, Standard Deviation, Minimum, Median, Maximum, 10th Percentile and 90th Percentile. Variables are as follows: Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [$(Sales_t – Sales_{t-1})/Sales_{t-1}$].

As can be observed from Table 1[20], the ROA is on average 2.8 percent and the NTC is about 95 days-sales. This means that, on average, firms are not very efficient in using their assets to generate income, as well as they only generate cash from its assets within 95 days. Moreover, the NTC has a median and maximum value of 80 and 566 days, respectively, which may indicate that firms take a long time to collect from customers and also to pay to suppliers since the purchase of raw materials is made. The number of days-sales of accounts receivables (AR) is on average 80, days-sales of inventories (INV) is 47 and days-sales of accounts payable (AP) is 33. With these statistics we can conclude that most firms have a large amount of cash invested in working capital.

German firms also exhibit a level of leverage of 20.83 percent and a growth per annum of 15.28 percent, on average. Thus, we can conclude that 21 percent of firms' assets are being financed by debt, which indicates a low degree of leverage, and they are growing rapidly.

Table 2 provides information about the variables average per industry. From it, we can verify that the Telecommunications industry has the larger firms and also present a higher growth in relation to the others, about 37.88 percent a year. In fact, according to some news during the period under analysis, it was expected a growth and a continued investment in Telecommunications in the European Union (EU), mainly due to the development of the internet wireless (Noam, 2006; Thomas, 2013). Moreover, it only holds the inventory about 6 days, what can be justified by the fact that telecommunications virtually don't need inventory to run their business. The Health Care, Oil and Gas and the Technology sector show a negative ROA, as well as a high NTC with 116, 99 and 88 days, respectively. The Utilities industry takes more days to collect payments from the customers, 108 days on average, and also needs a long period to pay to their suppliers, around 43 days. The sector that holds inventory for a longer period is the Industrials, with 62 days. In relation to the Basic Materials and Consumer Services they present high levels of leverage, around 25 percent and 24 percent respectively, and slightly low values of ROA, 3.8 percent and 1.8 percent respectively. Finally, the Consumer Goods industry shows the highest value of ROA, 6.5 percent, and only takes 30 days to pay their liabilities to suppliers.

[20] All the results presented in this section and in the next one were obtained using the Statistical Software Stata, version 13.

Table 2 – Variables Average Per Industry

Classification	ROA	AR	INV	AP	NTC	SIZE	LEV	GROWTH
Basic Materials	0.0383	73.2993	53.8231	33.6993	94.7611	12.8133	0.2453	0.1315
Consumer Goods	0.0649	66.7231	60.9708	30.3162	99.2250	13.1463	0.2404	0.0877
Consumer Services	0.0178	59.2487	27.8619	36.4480	52.1189	11.9139	0.2399	0.2134
Health Care	-0.0377	98.0448	54.3946	36.9820	116.2939	11.5744	0.2283	0.2161
Industrials	0.0525	84.7821	62.1765	31.8288	115.3737	12.4885	0.2177	0.1230
Oil & Gas	-0.0096	79.9312	60.4998	41.8017	99.1747	11.7544	0.2125	0.0877
Technology	-0.0027	92.3463	25.6031	30.7341	87.5653	11.0218	0.1216	0.2030
Telecommunications	0.0349	67.5337	6.3178	37.8367	36.9723	14.0687	0.2329	0.3788
Utilities	0.0572	107.9005	38.1106	43.3780	105.6393	13.3857	0.1758	0.0545

This table reports the average values of the variables per industry, during the period 1999-2014. The industries represented are: Basic Materials, Consumer Goods, Consumer Services, Health Care, Industrials, Oil & Gas, Technology, Telecommunications and Utilities. Variables are as follows: Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$].

4.3 Correlation Analysis

Table 3 presents the Pearson's[21] correlation coefficients between all variables and their statistical significance.

[21] The Pearson Correlation Coefficient allows to measure the correlation level between two variables.

Table 3 – Correlation Matrix

	ROA	AR	INV	AP	NTC	SIZE	LEV	GROWTH
ROA	1							
AR	-0.1343***	1						
INV	-0.0208**	0.0531***	1					
AP	-0.2763***	0.3785***	0.1172***	1				
NTC	-0.0388***	0.7665***	0.5530***	0.0491***	1			
SIZE	0.2834***	-0.1809***	-0.0119	-0.0899***	-0.1472***	1		
LEV	-0.0903***	-0.1298***	0.0797***	0.0439***	-0.0788***	0.1437***	1	
GROWTH	-0.0647***	0.0072	-0.2002***	0.0868***	-0.1360***	-0.0112	0.0890***	1

This table reports Pearson's correlation coefficients, during the period 1999-2014. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. Total of observations are 7,928. The variables used in this analysis are as follows: Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$].

According to the results and analysing the relation between the ROA and the explanatory variables, most of the correlation coefficients are significant at 1 percent level and all of them are significant at 5 percent level. This means that all independent variables are significant to explain the dependent variable. As expected, there is a negative relationship between ROA and AR and between ROA and INV, indicating that late payments from customers and a high level of inventories will lead to a decrease in profitability. On the other hand, there is a negative relationship between ROA and AP, which goes against the predictions. This result can be explained by the fact that delaying payments to suppliers can lead to losing discounts for early payments. Furthermore, and according to Deloof (2003), the less profitable firms usually delay payments to suppliers due to financial restrictions.

As expected, there seems to be a negative relationship between ROA and NTC, which suggests that a higher NTC will have a negative impact on profitability. Oppositely, a reduction in NTC is associated with an increase in profitability, showing that an efficient WCM can lead to a higher profit. A positive relationship between the NTC and their three components is also observed, which indicates that firms with a higher credit from their suppliers tend also to grant more time to customers to make the payments.

In relation to the control variables, there seems to be a positive relationship between ROA and SIZE. This suggests that the largest the firm the better is its profitability. Moreover, there is a negative relationship between ROA and LEV, that is consistent with the relation between ROA and AP. This indicates that a low level of leverage might lead to an increase in firm's profitability. However, there is a negative relationship between ROA and GROWTH. This can be explained by the fact that profitable firms maximize their level of profits through profitable growth opportunities but experience a decrease in profit rates (SooCheong & Kwangmin, 2011). In the same line, Mueller (1972) argues that frequently the managerial objective of a firm is to maximize growth rather than profit, which suggests the possibility that growth minimizes profit.

Concerning the correlations between the independent variables, there are a few positive relationships between them, particularly between NTC and their components as mentioned before. Therefore, these results are taken into account to prevent multicollinearity problems in the following analysis.

To conclude, the Pearson's correlation analysis, despite their undoubted utility to study the variables' relationship, does not allow to differentiate causes from consequences. In other words, it is not possible to conclude whether it is the WCM that influences profitability or if it is profitability that influences WCM (Shin & Soenen, 1998). Therefore, this issue is going to be treated in the following section.

5. Empirical Results

This section presents the multivariate analysis based on different multiple regressions, in order to test the research hypotheses proposed in section 3. With this analysis, we intend to study the effects on profitability caused by each independent variable, including also some control variables. Moreover, the possible impact of firms' financial constraints on the working capital level is also analysed, using the methodology and econometrics tests as described in the previous section.

Firstly, we test which model is more appropriate to estimate the regressions, as mentioned in section 3. We start by using the Pooled OLS model to run the regressions and analyse the *F* Statistic test. Since the null hypothesis was rejected this means that there are unobservable individual effects and, consequently, the OLS model is rejected. The Hausman test is then performed to investigate if those effects are considered to be random or fixed. Finally, the null hypothesis of the test was rejected, indicating that the unobservable individual effects are considered to be fixed and, therefore, the best model is the FE.

Then, some additional tests were conducted in order to verify the existence of problems that may bias the results. We tested the null hypothesis of homoscedasticity and no serial correlation using the Breuch-Pagan test and the Wooldridge test, respectively. As mentioned before, the tests confirm the presence of both and, therefore, it was adopted the cluster technique, which provides robust standard errors and a robust *t* Statistic. In addition, the Variance Inflation Factor (VIF) for each independent variable, that analyses the presence of multicollinearity, was also computed. Since the largest VIF value is 1.05, we can conclude that there is no multicollinearity in our sample, as the value is far away from 5 (Greene, 2003).

After all these tests it is then possible to perform the multiple regression analysis with a robust sample and the adequate model.

5.1 Multivariate Analysis: Multiple Regression Analysis

Multiple regression analysis allows to investigate the impact of the WCM on firms' profitability. In other words, it will help to understand the relationship between the profitability and each explanatory variable. As mentioned previously, the estimation uses the FE model, with the inclusion of time dummies.

5.1.1 Multiple Regression Analysis: Linear Relationship

There is a wide empirical evidence about a linear relationship between profitability and WCM, showing that a reduction on the components of the WCM will have a positive impact on firms' profitability (Deloof, 2003; Lazaridis & Tryfonidis, 2006; García-Teruel & Martínez-Solano, 2007).

Therefore, the objective is to test the hypotheses described in section 3. Equation [6] is estimated to test the Hypothesis 1, while equations [7], [8] and [9] are estimated to study the Hypotheses 2, 3 and 4, respectively.

$$ROA_{it} = \beta_0 + \beta_1 NTC_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [6]$$

$$ROA_{it} = \beta_0 + \beta_1 AR_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [7]$$

$$ROA_{it} = \beta_0 + \beta_1 INV_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [8]$$

$$ROA_{it} = \beta_0 + \beta_1 AP_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [9]$$

In the equations above i refers to firms and t to time periods. ROA is the dependent variable that measures the Return-on-Assets. β_0 is the intercept term. The independent variables are: NTC (measured as NTC = AR+INV-AP) is the average number of days-sales that the company has to finance its working capital needs. AR is the number of days-sales of accounts receivable. INV measures the number of days-sales of inventories. AP is the number of days-sales of accounts payable. The control variables are the following: SIZE is firms´ size proxy measured by the logarithm of sales, LEV is the level of leverage of the firms and GROWTH represents the sales growth. The μ_i measures the unobservable heterogeneity of the individual precise effects of each firm and ε_{it} is the disturbance term.

Table 4 summarizes the regressions estimates, using the FE model for the equations [6] to [9].

Table 4 – Results of the regression analysis using the FE model

	[6]	[7]	[8]	[9]
Observations	7,928	7,928	7,928	7,928
NTC	-0.0001**			
	(-1.85)			
AR		-0.0001***		
		(-2.50)		
INV			-0.0006***	
			(-4.53)	
AP				-0.0008***
				(-4.57)
SIZE	0.0296***	0.0291***	0.0281***	0.0271***
	(5.68)	(5.55)	(5.64)	(5.39)
LEV	-0.2193***	-0.2202***	-0.2143***	-0.2152***
	(-6.93)	(-6.98)	(-6.73)	(-6.68)
GROWTH	-0.0604*	-0.0587**	-0.0617*	-0.0378
	(-1.62)	(-1.57)	(-1.65)	(-1.00)
C	-0.2727***	-0.2660***	-0.2345***	-0.2263***
	(-4.30)	(-4.18)	(-3.93)	(-3.78)
Hausman Test	25.39	29.42	47.55	69.07
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
F Test	26.41	44.36	32.00	201.10
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	9.79	10.17	9.00	13.54

This table reports the regression estimates for equations [6] to [9] using FE methodology, during the period 1999-2014. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. Hausman test evaluates the significance of an estimator (RE) versus an alternative estimator (FE). P-value of Hausman test is in parentheses. F test is estimated under the null hypothesis that the constant terms are equal across entities (firms). The null hypothesis, for both tests, are rejected at the 5 percent significance level. P-value of F test is in parentheses. R square is expressed in percentage.

It is possible to observe from Table 4 that most of the coefficients are statistically significant[22] at the 1 percent level.

From the equation [6] we can conclude that the NTC has a negative relationship with the ROA. This means that if the NTC length increases for one day, the ROA decreases 0.01 percent[23]. For this reason, we cannot reject Hypothesis 1. There is also evidence of a negative relationship between AR and ROA (equation [7]), indicating that an increase in days-sales of accounts receivable causes a decrease in profitability. Therefore, we do not reject Hypothesis 2. In relation to the equation [8], we can analyse that also an increase in days-sales of inventories leads to decrease in ROA and, thus, we cannot reject Hypothesis 3. Finally, in equation [9] there is a negative relationship between the ROA and the AP variable. This indicates that delaying payments to suppliers will increase profitability and, consequently, we reject Hypothesis 4. In fact, Ng, Smith and Smith (1999) mention that delaying payments to suppliers might have an implicit opportunity cost due to losing discounts for early payments. However, prompt payment discounts are considered financial income and does not affect the operating income. On the other hand, and as already stated, Deloof (2003) explains that firms with financial restrictions usually tend to delay payments to suppliers. This happens due to the excessive costs that these firms face when they try to obtain external financing.

Regarding the control variables, the variables SIZE and LEV are statically significant at 1 percent level and have the same relationship with ROA in all equations. SIZE and ROA are positively related, indicating that the larger is the firm, the better the profitability is. In relation to the firms' leverage (LEV), it is negatively related to profitability. The variable GROWTH presents a negative relationship with ROA, although not statistically significant in equation [9]. These results are in line with the study of Baños-Caballero, García-Teruel and Martínez-Solano (2014).

To summarize, it is possible to conclude that the best strategy to enhance profitability is to reduce the days-sales of accounts receivable, the days-sales of inventories, as well as the days-sales of accounts payable.

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[22] Except the variable GROWTH, that loses their significance in the regression [9].

[23] As mentioned previously, the NTC represents the average number of days-sales that firms needs to finance its working capital needs and all components of the NTC are measured in days-sales.

Equations [6] to [9] are re-estimated including time dummy variables, to study the robustness of the coefficients. Table 5 presents the estimates of those regressions.

Table 5 – Results from regression analysis using the FE model and considering time dummy variables

	[6]	[7]	[8]	[9]
Observations	7,928	7,928	7,928	7,928
NTC	-0.0001*			
	(-1.41)			
AR		-0.0001***		
		(-2.28)		
INV			-0.0005***	
			(-4.18)	
AP				-0.0008***
				(-4.60)
SIZE	0.0337***	0.0329***	0.0322***	0.0293***
	(5.94)	(5.71)	(5.90)	(5.22)
LEV	-0.2062***	-0.2071***	-0.2019***	-0.2020***
	(-6.55)	(-6.61)	(-6.38)	(-6.34)
GROWTH	-0.0568**	-0.0562**	-0.0576*	-0.0404
	(-1.59)	(-1.57)	(-1.61)	(-1.12)
C	-0.3001***	-0.2899***	-0.2620***	-0.2365***
	(-4.49)	(-4.27)	(-4.14)	(-3.65)
F Test	171.86	155.93	82.28	94.76
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	11.67	12.02	11.08	15.63

This table reports the regression estimates for equations [6] to [9] using FE model and including time dummy variables, during the period 1999-2014. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. F test is estimated as described before. P-value of F test is in parentheses. Coefficients of the dummies are not reported. R square is expressed in percentage.

As we can see from Table 5, the relations between ROA and NTC remain exactly the same, as well as with the NTC components. Moreover, the coefficients and the significance of the variables are almost the same if we compare them with the results from Table 4. However, the statistical significance of the NTC changes to the 10 percent level.

Regarding the time dummy variables, although the coefficients are not reported, there are a few that are statistically significant at the 1 percent level during the period 2007-2014, across all regressions. There is a negative relationship between these dummies and the ROA, which can be explained by the fact that the European financial crisis started mainly in 2008 and affected firms' profitability.

We also estimate equations [6] to [9] considering firms, time and also industry dummies[24]. The main objective is to understand if the variables behaviour is different across different industries. The results, reported in Table B.1 of Appendix B, are very similar to the previous ones since the estimated coefficients show the same relationships between the dependent variable and the explanatory variables. However, the NTC and AR variables lose their significance. Nevertheless, and although the coefficients are not reported, the Health Care, the Industrials and the Oil & Gas industries still present a statistic significant at the 1 percent level in both equations [6] and [7]. Moreover, the Consumer Goods industry also is statistically significant in equation [6] and the Technology industry in equation [7], at the 1 percent level.

5.1.1.1 Endogeneity problems

According to previous studies (Deloof, 2003; García-Teruel & Martínez-Solano, 2007), there is the possibility of endogeneity problems that may affect the results due to the fact that the independent variable may be affected by the dependent variable. For this reason, it is important to test all the independent variables and treat endogeneity problems.

Therefore, equations [6] to [9] are re-estimated using the IV methodology, as described in section 3. As instrumental variables we use the first lagged value of the independent variables. The results are present in Table 6 (below).

[24] The FE model that does not allow to estimate the regressions with variables that remain constant over time. Therefore, we estimate the model including firm, time and industry dummies.

Table 6 – Results from regression analysis using IV methodology

	[6]	[7]	[8]	[9]
Observations	7,288	7,288	7,288	7,288
NTC	-0.0001***			
	(-2.50)			
AR		-0.0005***		
		(-7.49)		
INV			-0.0003***	
			(-3.62)	
AP				-0.0018***
				(-11.44)
SIZE	0.0230***	0.0214***	0.0234***	0.0212***
	(25.82)	(19.90)	(21.01)	(21.62)
LEV	-0.1255***	-0.1417***	-0.1228***	-0.1084***
	(-12.00)	(-9.90)	(-8.54)	(-8.14)
GROWTH	-0.0506**	-0.0414**	-0.0472**	-0.0208
	(-4.20)	(-3.36)	(-3.60)	(-1.70)
C	-0.2117***	-0.1617***	-0.2235***	-0.1466***
	(-17.07)	(-10.46)	(-14.38)	(-10.97)
Durbin Test	10.5646	49.2219	18.0613	15.0179
(*P*-value)	(0.0012)	(0.0000)	(0.0003)	(0.0001)
Wu-Hausman	10.5712	49.5157	18.555	15.0365
(*P*-value)	(0.0012)	(0.0000)	(0.0003)	(0.0001)
R^2	9.79	10.61	9.77	11.81

This table reports the regression estimates for equations [6] to [9] using IV methodology, during the period 1999-2014. Time dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. The Durbin-Wu-Hausman test is an exogeneity test, under the null hypothesis that regressors are exogenous. The null hypothesis must be rejected at the 5 percent significance level. P-value of Durbin and Wu-Hausman test is in parentheses. R square is expressed in percentage.

From Table 6 is possible to observe that almost all the coefficients are statistically significant at the 1 percent level. Comparing these results with the results from Table 4 and 5, estimated with the FE model, the relations between the independent variables and ROA are exactly the same and all the coefficients remain significant. Only the variable GROWTH loses its statistical significance in equation [9], but is according with the previous one.

According to the Durbin-Wu-Hausman test, the variables NTC and AR are considered endogenous, since we reject both null hypotheses for exogenous regressors. In these cases, we can conclude that the IV methodology[25] provides a more robust estimator for these variables than the FE model.

5.1.2 Multiple Regression Analysis: Non-linear Relationship

As referred previously, most of the literature about WCM assume a linear relationship between profitability and WCM. However, there are some recent studies that point out to a non-linear relationship between profitability and WCM, indicating the existence of an optimal working capital level that balances benefits and costs through an efficient management of the working capital (Silva, 2011; Baños Caballero, García-Teruel & Martínez-Solano, 2012; Baños Caballero, García-Teruel & Martínez-Solano, 2014). In this context, and in order to test the Hypotheses 5, 6, 7 and 8, we investigate the possibility of a concave relationship between the dependent variable ROA and the NTC, AR, INV and AP independent variables, respectively, by analysing the following equations.

$$ROA_{it} = \beta_0 + \beta_1 NTC_{it} + \beta_2 NTC^2_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} + \beta_5 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [10]$$

$$ROA_{it} = \beta_0 + \beta_1 AR_{it} + \beta_2 AR^2_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} + \beta_5 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [11]$$

$$ROA_{it} = \beta_0 + \beta_1 INV_{it} + \beta_2 INV^2_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} + \beta_5 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [12]$$

$$ROA_{it} = \beta_0 + \beta_1 AP_{it} + \beta_2 AP^2_{it} + \beta_3 SIZE_{it} + \beta_4 LEV_{it} + \beta_5 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [13]$$

These equations are estimated using the IV methodology and time dummy variables. The variables are defined as before, with the inclusion of the square value of each independent variable in the respective equation. The NTC and NTC^2, the AR and AR^2, the INV and INV^2, the AP and AP^2 are the endogenous variables and the instruments applied are the first lagged value of these variables for equation [10], [11], [12] and [13]

[25] We also estimate the equations [6] to [9] using IV methodology and including time, firm and industry variables. The results are reported in Table C.1 of Appendix C and are similar to these ones.

respectively. We also estimated these equations using the FE model and the results are reported in Table D.1 in Appendix D.

5.1.2.1 Non-linear relationship between ROA and the NTC, AR, INV and AP variables

In fact, the presence of an optimal level of working capital implies a positive relationship between ROA and the independent variables, at low levels of investments in working capital, and a negative relationship between ROA and the quadratic value of each independent variable, indicating that from the optimal level there is a negative impact on profitability due to the high investment in working capital.

In this line, the quadratic function of the equations [10] to [13] are going to present the maximum point if the coefficients of the square value of the variables are negative. Therefore, the optimal level of working capital can be measured by deriving this equation in relation to each independent variable, and equal to zero. Thus, the maximum point is obtained from: NTC/AR/INV/AP = $(-\beta_1/2\beta_2)$. If this relation is verified, it is possible to conclude that the benefits of investing in working capital increase until their maximum point as well as profitability. Beyond that level, an increase of the investment in working capital will lead to a decrease in profitability.

Table 7 presents the results of the regression for a non-linear relationship between ROA and NTC and each of its components. As it can be seen, there is evidence of a positive relationship between profitability and NTC in a low level of investment in working capital. In another hand, there is a negative relationship between ROA and NTC^2, which means that from a certain point the high level of investment in working capital causes a decrease in profitability. For these reasons, it is possible to conclude that we find a non-linear relationship between ROA and NTC, i.e. a concave relationship, which is in agreement with previous studies (Silva, 2012; Baños-Caballero, García-Teruel & Martínez-Solano, 2014). Moreover, the coefficient of the NTC and NTC^2 variables are statistically significant at the 1 percent level.

Regarding the control variables, they show a statistical significance at the 5 percent level and the relationships between ROA and them remain the same. Moreover, the

Durbin-Wu-Hausman test for the exogeneity of the independent variables is rejected, which means that, again, the IV methodology provides a more robust estimator than the FE model.

As mentioned before, we also can find the optimal level of working capital of our sample by replacing the coefficients estimated in the regression, presented in Table 7. Thus, we obtain: NTC = [-0.0002 / (2 * -2.26E-06)] = 44.25 days-sales. With this result, we can confirm that there is an optimal NTC level when NTC is 44 days-sales and, for this reason, we cannot reject Hypothesis 5.

With this evidence it is possible to confirm the existence of an optimal working capital level. This fact can be very important for firms since they can find their optimal level and avoid losing money due to an underinvestment or overinvestment in the working capital accounts.

Table 7 – Results from regression analysis testing for a non-linear relationship between ROA and NTC, AR, INV and AP using IV methodology

	[10]	[11]	[12]	[13]
Observations	7,288	7,288	7,288	7,288
NTC	0.0002***			
	(3.79)			
NTC^2	-2.26E-06***			
	(-3.00)			
AR		-1.76E-03***		
		(-4.67)		
AR^2		3.09E-06***		
		(3.69)		
INV			-3.17E-03***	
			(-4.88)	
INV^2			1.26E-05***	
			(3.85)	
AP				-1.87E-03**
				(-2.01)
AP^2				5.36E-06
				(0.86)
SIZE	0.0393***	0.0306***	0.0391***	0.0308***
	(5.80)	(5.12)	(7.07)	(4.45)
LEV	-0.2347***	-0.2285***	-0.2154***	-0.2175***
	(-9.10)	(-9.11)	(-8.52)	(-8.94)
GROWTH	-0.0678**	-0.0508*	-0.0505*	-0.0295
	(-2.24)	(-1.77)	(-1.77)	(-1.01)
C	-0.5084***	-0.3069***	-0.5230***	-0.3793***
	(-4.53)	(-2.91)	(-5.88)	(-3.48)
Durbin Test	23.9892	62.9039	44.6560	4.7254
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.1942)
Wu-Hausman	12.0210	31.6909	22.3049	2.4661
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.1850)
R^2	10.51	9.67	9.06	7.83

This table reports the regression estimates for equations [10], [11], [12] and [13] using IV methodology, during the period 1999-2014. Time dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)].)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC^2 is the square value of NTC. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. AR^2 is the square value of AR. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. INV^2 is the square value of INV. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. AP^2 is the square value of AP. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. The Durbin-Wu-Hausman test is as described before. P-value of Durbin and Wu-Hausman test is in parentheses. R square is expressed in percentage.

Additionally, Table 7 provides the results of the equations [11], [12] and [13], that tests the Hypotheses 6, 7 and 8, respectively. Although not as expected, we find a positive relationship between ROA and the squared terms of the variables AR, INV and AP, indicating the presence of a minimum level instead of a maximum level, as it is seen with the NTC variable. Thus, we reject Hypotheses 6,7 and 8.

This relation indicates that, for a determined number of days-sales of accounts receivable, inventories and accounts payable, the profitability is going to achieve a minimum level. There are a few recent studies that analyse the non-linear relationship between profitability and the components of the NTC that provide the same evidence (Pais & Gama, 2015; Lyngstadaas & Berg, 2016)[26]. Other studies suggested the existence of a negative relationship between profitability and these variables (Baños-Caballero, García-Teruel & Martínez-Solano, 2014), but they reach the same conclusion, i.e. a decrease in profitability with an increase on AR, INV and AP.

We can also observe from Table 7 that almost all the independent variables are statistically significant at the 1 percent level. However, in the Durbin-Wu-Hausman test the null hypothesis for the equation [13] is not rejected, which means that the AP and AP^2 variables need to be treated as exogenous. For the remaining variables, the null hypothesis is rejected, indicating that these variables are considered endogenous and, therefore, the IV methodology provides a more robust estimator than the FE model.

To conclude, we compute the level for each equation where the profitability is at their minimum, according to the model that provides the best estimator. Thus, we calculate the minimum level for AR and INV according to the results obtained in the IV model (Table 7) and for the AP, we used the results from the FE model (Appendix D, Table D.1)[27]. Finally, by deriving the equations [11], [12] and [13] in relation to AR, INV and AP, respectively, we obtained the following results: AR = 285 days-sales; INV = 126 days-sales and AP = 297 days-sales[28]. These findings indicate that the minimum level of

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[26] However, in the study of Pais and Gama (2015) the AR variable loses their significance and in the study of Lyngstadaas and Berg (2016) the variable INV2 also loses their statistical significance.

[27] We also re-estimated equations [10] to [13] in order to include firm, time and industry dummy variables. The results are presented in Table E.1 of Appendix E and are very similar with the results presented in Table D.1 of Appendix D.

[28] The minimum point is obtained through the equation ($-\beta_1/2\beta_2$). If we replace by the coefficients provided in Table 7 we obtain the following values: AR = [-1.76E-03/ (2*3.09E-06)] = 285 days-sales and INV = [-3.17E-03/ (2*1.26E-05)] = 126 days-sales. From the Table D.1, in Appendix D, we obtain: AP = [-1.06E-03/ (2*1.79E-06)] = 297 days-sales.

profitability occurs for large values of these independent variables, suggesting an overall decrease in ROA as these variables increase[29].

5.2 Financial Constraints Effects

According to Baños-Caballero, García-Teruel and Martínez-Solano (2014), the financial capacity of firms may influence their optimal level of working capital. Indeed, and as mentioned before, the asymmetric information between the capital markets and firms can lead to credit rationing, since the lacking of information difficult the access of firms to the external financing and raises their costs. Therefore, since a higher level of working capital needs to be financed, it is expected that firms more likely to be constrained will have a lower optimal working capital level than others less likely to be constrained.

In order to test this possibility, we add to equation [10] a dummy variable that differentiates between firms with financial constraints and those unconstrained, according to the measures mentioned in section 2. This dummy variable (DFC) assumes the value 1 for firms more financially constrained and 0 otherwise. The estimates of the coefficients from equation [14] are obtained using the IV methodology. We consider again the NTC and NTC^2 variables as endogenous variables and the instruments are the same as applied before.

$$ROA_{it} = \beta_0 + \beta_1 NTC_{it} + \beta_2 (NTC_{it} * DFC) + \beta_3 NTC^2_{it} + \beta_4 (NTC^2_{it} * DFC) + \beta_4 SIZE_{it} + \beta_5 LEV_{it} + \beta_6 GROWTH_{it} + \mu_i + \varepsilon_{it} \quad [14]$$

All dependent, independent and control variables are as described before. The only difference is the inclusion of the DFC dummy variable that for each financial takes the value of 1 when the firm is under financial restrictions and 0 otherwise[30]. This dummy variable interacts with each independent variable in the equation.

[29] Equations [10] to [13] were estimated using IV methodology and including firm, time and industry dummy variables. The results are reported in Table F.1 of Appendix F and are similar to these ones.

[30] In order to estimate the DFC dummy variable, we first calculate the average of each financial variable used to measure the financial constraints. Then, the dummy variables are defined as follows. Dividends: 1 for firms below the average and 0 otherwise. Cash Flow: 1 for firms below the average and 0 otherwise. Size: 1 for firms below the average and 0 otherwise. Cost of External Financing: 1 for firms above the average and 0 otherwise. Interest Coverage: 1 for firms below the average and 0 otherwise.

Table 8 reports the regression results for firms constrained and unconstrained, classified according to the dividends paid, cash flows, size, cost of external financing and interest coverage, in order to test Hypothesis 9. As can be seen, all variables are statistically significant, especially the coefficients with the product of the dummy variables, that are statistically significant at the 5 percent level for all measures. These results indicate that when we introduce the financial constraints in the non-linear relationship between ROA and NTC it remains significant. In other words, through the positive coefficient of NTC*DFC and the negative coefficient of NTC^2*DFC, we can conclude that firms with financial constraints also have a concave relationship between their profitability and the NTC. This confirms the existence of an optimal level of working capital since the relationship between ROA and NTC is positively related until a certain point and beyond that point it starts to relate negatively. Moreover, this relation continues to hold in firms less financially constrained, that also present the existence of an optimal level of investment in working capital through the positive NTC coefficient and the negative NTC^2 coefficient.

As mentioned before, all the financial criteria used to classify the firms are statistically significant, which indicates that firms with financial constraints usually have a lower payout ratio and generate lower cash flows. Furthermore, they face financial distress and are also smaller. Additionally, those firms also have a higher cost of external financing, which confirms the existence of agency conflicts and information asymmetry problems.

According to the results of the Durbin-Wu-Hausman test, we reject the null hypothesis for the exogeneity of the independent variables in all the classifications of the financial constraints. Once again, the IV methodology presents a more consistent estimator than the FE model. However, we also estimate equation [14] using the FE model and the results, reported in Table G.1 in Appendix G, remain unchanged, showing again evidence of a concave relationship between ROA and NTC. Therefore, we can conclude that this relationship is robust and consistent. We also carried an F test, in order to analyse the statistical significance of the coefficients of the new variables added, i.e. NTC*DFC and NTC^2*DFC. From this test we can conclude that all the coefficients are significant and robust[31].

Table 8 – Results from regression analysis testing for the effects of financial constraints on the relationship between ROA and NTC using IV methodology

	Dividends	Cash Flow	Size	Cost External Financing	Interest Coverage
Observations	7,286	7,286	7,286	7,286	7,286
NTC	1.85E-03***	1.34E-03***	2.55E-03***	1.71E-03***	2.64E-03***
	(5.13)	(3.00)	(3.55)	(3.92)	(3.58)
NTC*DFC	9.39E-04***	1.67E-04**	1.25E-03***	3.18E-04**	1.35E-03***
	(3.89)	(0.64)	(2.45)	(1.17)	(2.55)
NTC^2	-4.98E-06***	-4.85E-06***	-8.16E-06***	-5.22E-06 ***	-8.34E-06***
	(-3.66)	(-3.28)	(-3.18)	(-3.37)	(-3.20)
NTC^2*DFC	-3.64E-06***	-2.41E-06**	-6.09E-06***	-3.07E-06***	-6.30E-06***
	(-3.08)	(-2.07)	(-2.82)	(-2.44)	(-2.85)
SIZE	0.0366***	0.0342***	0.0374***	0.0347***	0.0374***
	(9.64)	(7.81)	(8.24)	(8.36)	(8.24)
LEV	-0.2296***	-0.2337***	-0.2429***	-0.2472***	-0.2453***
	(-15.77)	(-14.09)	(-13.76)	(-15.93)	(-13.68)
GROWTH	-0.0728***	-0.0224	-0.0894***	-0.0478**	-0.0921***
	(-3.56)	(-1.05)	(-3.68)	(-2.21)	(-3.75)
C	-0.4569***	-0.4344***	-0.4524***	-0.4144***	-0.4517***
	(-6.06)	(-5.59)	(-5.48)	(-5.40)	(-5.47)
Durbin Test	20.5424	61.5576	19.2378	43.3031	18.8106
(*P*-value)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)
Wu-Hausman	10.2649	30.9345	9.6113	21.7063	9.3973
(*P*-value)	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)
R^2	14.36	26.27	17.63	19.81	17.57

This table reports the regression estimates for equations [14] using IV methodology, during the period 1999-2014. Time dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. DFC is a dummy variable that equals 1 for firms more likely to be financially constrained and 0 otherwise. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC*DFC represents the interaction between the DFC dummy variable and the NTC variable. NTC^2 is the square value of NTC. NTC^2*DFC represents the interaction between the DFC dummy variable and the NTC^2 variable. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through $[(Sales_t – Sales_{t-1})/Sales_{t-1}]$. C is the intercept term. Robust t Statistics are in parentheses. The Durbin-Wu-Hausman test are as described before. P-value of Durbin and Wu-Hausman test is in parentheses. R square is expressed in percentage.

[31] Equation [14] as also estimated including firm, time and industry dummies. The results, reported in Table H.1 of Appendix H, are very similar with the ones presented on Table G.1 of Appendix G.

In order to test Hypothesis 9 and understand the effects of firms' financial constraints on the working capital level, we re-calculate the optimal level of these firms. According to Baños-Caballero, García-Teruel and Martínez-Solano (2014), and as mentioned before, the expression ($-\beta_1/2\beta_2$) measures the optimal working capital investment of firms less likely to be financially constrained. On the other hand, if we derive equation [14] in relation to the financial constraints variables, the optimal level for firms more financially constrained is measured by [$-\beta_2(NTC_{it}*DFC) / 2\beta_4(NTC^2_{it}*DFC)$].

Therefore, using the values provided in Table 8 we compute the optimal level of working capital. Table 9 presents the results for the optimal level of investment in working capital for firms both financially constrained and unconstrained, for each financial measure.

Table 9 – Optimal level of working capital for firms less financially constrained and more financially constrained

	Dividends	Cash Flow	Size	Cost External Financing	Interest Coverage
Firms less financially constrained	185.71	137.97	156.28	164.16	158.26
Firms more financially constrained	128.91	34.63	102.37	51.84	106.75

This table reports the optimal level of working capital for firms less financially constrained and for firms more financially constrained, according to the different financial measures. The results are in days-sales and are obtained through the following formulas. Firms less financially constrained: ($-\beta_1/2\beta_2$). Firms more financially constrained: [$-\beta_2(NTC_{it}*DFC) / 2\beta_4(NTC^2_{it}*DFC)$].

As can be seen in Table 9, the optimal level of working capital is always lower for firms considered more financially constrained, independently of the financial variable used to measure the financial constraints, meaning that we cannot reject Hypothesis 9.

The highest optimal working capital level is observed when dividends are used to measure financial constraints, with an optimal NTC level of around 186 days-sales and 129 days-sales for firms less financially constrained and more financially constrained, respectively. The lowest optimal working capital level occurs when the variable Cash

Flow classification is used, with an optimal NTC level of 138 days-sales and 35 days-sales for firms unconstrained and constrained, respectively[32].

To summarize, when financial conditions are taken into account we verify that the optimal level of working capital is lower for firms more likely to be constrained. In fact, those firms usually face higher financing costs and credit rationing, which leads to a lower capacity to finance a high working capital level.

These findings show that the optimal working capital investment is sensitive to firms' financial restrictions. Moreover, they confirm the importance of the availability of internal funds of financing and the financial conditions in the capital markets for the working capital level.

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[32] Equation [14] was re-estimated again using IV methodology and including time, firm and industry variables. The results are presented in Table I.1 of Appendix I and provide the same conclusions.

6. Conclusions

The working capital, defined by the management of the current assets and the current liabilities, is used to finance a business' daily operations due to the time lapse between buying raw materials for production and collecting payments from the sale of the final product. As previous studies have shown, most of the firms hold a high amount of cash invested in working capital and, for this reason, it is expected that the management of these assets will significantly affect firms' profitability. In fact, the impact of the WCM on profitability is going to depend on the working capital policy adopted by firms. This policy should be focused and planned in order to achieve the optimal level of working capital, where corporate profitability is at its maximum. However, this optimal level may vary in order to reflect business conditions, such as the type of industry, size of the firm, financial constraints faced, among others. Therefore, the WCM aim is to manage the costs and benefits of investing in working capital in a balanced way.

Considering these facts, the purpose of this investigation is to analyse the relationship between WCM and profitability using a sample of German firms over the period of 1999 to 2014. Our findings provide evidence of a non-linear relationship between these variables, which are in line with recent studies (Wang, 2002; Deloof, 2003; Silva, 2011; Chiou, Cheng & Wu, 2006; Baños Caballero, García-Teruel & Martínez-Solano, 2012; Baños Caballero, García-Teruel & Martínez-Solano, 2014). Nevertheless, and as far we are aware of, this study is the first to provide evidence of the impact of WCM on the profitability of German listed firms.

According to our results assuming a linear relationship, firms can increase their profitability through a reduction in the average number of days of accounts receivable, as well as in the average number of days of inventories. Additionally, managers should also reduce the average number of days of accounts payable, indicating that prompt payment conditions can lead to a better operational performance of the firms. Finally, the indicator of the working capital management presents a negative relationship with profitability, which means that a lower level of investment in working capital leads to an increase in firms' profitability.

When we analyse the existence of a non-linear relationship between the WCM and profitability, there is a positive relationship between the variables ROA and NTC for low levels of investment in the working capital and a negative relationship for high levels of investment in the working capital. This indicates that German firms do have an optimal working capital level that maximizes profitability. Outside this optimal, the low level of investment in working capital can lead to a decrease in profitability mainly due to the low supplier credit granted to customers, that consequently decreases the sales. On the other hand, the high level of investment in working capital increases the interest expenses, as well as the credit risk and the probability of bankruptcy. Therefore, firms should stand at the optimal level and avoid deviations that can decrease the firms' performance. Additionally, although our results also show evidence of a non-linear relationship between the NTC components and profitability, this relation is not concave. The signs of the coefficients indicate the existence of a minimum level of profitability when the average number of days of accounts receivable, inventories and accounts payable are at large values, suggesting an overall decrease in profitability as these accounts increase.

Regarding the impact of the firms' financial constraints in the optimal level of working capital, our findings indicate that firms more likely to be financially constrained have a lower optimal level. This fact can be justified by the low availability of internal funds and the restricted conditions to access to capital markets faced by these firms.

A limitation of our study is the small size of the sample. Another limitation concerns the use of an accounting ratio to measure firms' performance. An alternative would be the use of a financial performance measure like the Tobin's Q Ratio, which is a measure of the market value of a company. Further research could consider a wider sample, with the inclusion of more countries.

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Appendix A

Table A. 1 – Industry description by ICB Code

Industry Code	Industry	Sector
1	Oil & Gas	Oil & Gas Producers
		Oil Equipment, Services & Distribution
		Alternative Energy
1000	Basic Materials	Chemicals
		Forestry & Paper
		Industrial Metals & Mining
		Mining
2000	Industrials	Construction & Materials
		Aerospace & Defence
		General Industrials
		Electronic & Electrical Equipment
		Industrial Engineering
		Industrial Transportation
		Support Services
3000	Consumer Goods	Automobiles & Parts
		Beverages
		Food Producers
		Household Goods & Home Construction
		Leisure Goods
		Personal Goods
		Tobacco
4000	Health Care	Health Care Equipment & Services
		Pharmaceuticals & Biotechnology
5000	Consumer Services	Food & Drug Retailers
		General Retailers
		Media
		Travel & Leisure
6000	Telecommunications	Fixed Line Telecommunications
		Mobile Telecommunications
7000	Utilities	Electricity
		Gas, Water & Multi utilities
9000	Technology	Software & Computer Services
		Technology Hardware & Equipment

This table summarizes the industry per sectors, according with their ICB code.

Appendix B

Table B. 1 – Results from regression analysis considering firm, time and industry dummy variables

	[6]	**[7]**	**[8]**	**[9]**
Observations	7,928	7,928	7,928	7,928
NTC	-0.0000			
	(-0.90)			
AR		-0.0001		
		(-1.47)		
INV			-0.0005***	
			(-5.57)	
AP				-0.0008***
				(-5.77)
SIZE	0.0337***	0.0329***	0.0322***	0.0293***
	(7.30)	(7.23)	(7.21)	(6.74)
LEV	-0.2062***	-0.2071***	-0.2019***	-0.2020***
	(-8.87)	(-8.90)	(-8.63)	(-8.77)
GROWTH	-0.0569**	-0.0562**	-0.0576**	-0.0404
	(-2.17)	(-2.15)	(-2.19)	(-1.53)
C	-0.2701***	-0.2511***	-0.2568***	-0.2119***
	(-3.75)	(-3.49)	(-4.16)	(-3.35)
F Test	0.82	2.17	31.01	33.34
(*P*-value)	(0.3665)	(0.1406)	(0.0000)	(0.0000)
R^2	45.52	45.54	45.89	46.29

This table reports the regression estimates for equations [6] to [9] including firm, time and industry dummy variables, during the period 1999-2014. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. F test is estimated as described before. P-value of F test is in parentheses. Coefficients of the dummies are not reported. R square is expressed in percentage.

Appendix C

Table C. 1 – Results from regression analysis using IV methodology and considering firm, time and industry dummy variables

	[6]	**[7]**	**[8]**	**[9]**
Observations	7,288	7,288	7,288	7,288
NTC	-0.0002*			
	(-1.86)			
AR		-0.0004***		
		(-2.86)		
INV			-0.0008***	
			(-4.06)	
AP				-0.0010***
				(-2.68)
SIZE	0.0308***	0.0266***	0.0326***	0.0274***
	(5.37)	(4.55)	(6.44)	(5.06)
LEV	-0.2223***	-0.2269***	-0.2155***	-0.2161***
	(-8.95)	(-9.13)	(-8.58)	(-8.91)
GROWTH	-0.0613**	-0.0555**	-0.0586**	-0.0313
	(-2.10)	(-1.96)	(-2.07)	(-1.07)
C	-0.4168***	-0.3309***	-0.4505***	-0.3429***
	(-4.20)	(-3.22)	(-5.34)	(-3.57)
Durbin Test	6.3914	15.6891	2.7784	0.5091
(*P*-value)	(0.0110)	(0.0000)	(0.0955)	(0.4755)
Wu-Hausman	5.8274	14.3228	2.5320	0.4638
(*P*-value)	(0.0100)	(0.0002)	(0.1116)	(0.4959)
R^2	45.65	45.40	46.28	46.87

This table reports the regression estimates for equations [6] to [9] using IV methodology, during the period 1999-2014. Firm, time and industry dummy variables dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. The Durbin-Wu-Hausman test is an exogeneity test, under the null hypothesis that regressors are exogenous. The null hypothesis must be rejected at the 5 percent significance level. P-value of Durbin and Wu-Hausman test is in parentheses. R square is expressed in percentage.

Appendix D

Table D. 1– Results from regression analysis testing for a non-linear relationship between ROA and the NTC, AR, INV and AP variables

	[10]	[11]	[12]	[13]
Observations	7,928	7,928	7,928	7,928
NTC	8.81E-06			
	(0.08)			
NTC^2	-1.38E-07			
	(-0.60)			
AR		-2.56E-04*		
		(-1.63)		
AR^2		3.75E-07*		
		(1.16)		
INV			-1.24E-03***	
			(-3.72)	
INV^2			3.33E-06**	
			(2.09)	
AP				-1.06E-03***
				(-3.49)
AP^2				1.79E-06*
				(0.91)
SIZE	0.0293***	0.0293***	0.0298***	0.0280***
	(5.60)	(5.60)	(5.92)	(5.59)
LEV	-0.2188***	-0.2201***	-0.2130***	-0.2148***
	(-6.91)	(-7.01)	(-6.66)	(-6.68)
GROWTH	-0.0592	-0.0587	-0.0620*	-0.0361
	(-1.60)	(-1.58)	(-1.67)	(-0.95)
C	-0.2736***	-0.2585***	-0.2373***	-0.2310***
	(-4.32)	(-4.05)	(-3.98)	(-3.86)
Hausman Test	37.04	21.85	81.22	39.83
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
F Test	37.59	18.52	44.37	62.00
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	9.96	10.30	7.85	13.63

This table reports the regression estimates for equations [10], [11], [12] and [13] using FE methodology, during the period 1999-2014. Time dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC^2 is the square value of NTC. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. AR^2 is the square value of AR. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. INV^2 is the square value of INV. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. AP^2 is the square value of AP. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. Hausman test is as described before. P-value of Hausman test is in parentheses. F test is as described before. P-value of F test is in parentheses. R square is expressed in percentage.

Appendix E

Table E. 1 – Results from a non-linear relationship between ROA and WCM considering firm, time and industry dummy variables

	[10]	[11]	[12]	[13]
Observations	7,928	7,928	7,928	7,928
NTC	1.29E-05			
	(0.13)			
NTC2	-1.18E-07			
	(-0.63)			
AR		-0.0003***		
		(-2.64)		
AR2		5.46E-07**		
		(2.16)		
INV			-0.0012***	
			(-4.32)	
INV2			3.18E-06***	
			(2.61)	
AP				-0.0012***
				(-4.48)
AP2				2.73E-06*
				(1.64)
SIZE	0.0333***	0.0334***	0.0341***	0.0305***
	(7.27)	(7.33)	(7.46)	(6.98)
LEV	-0.2058***	-0.2068***	-0.2008***	-0.2015***
	(-8.86)	(-8.88)	(-8.57)	(-8.75)
GROWTH	-0.0561**	-0.0558**	-0.0572**	-0.0386
	(-2.14)	(-2.13)	(-2.18)	(-1.45)
C	-0.2974***	-0.2611***	-0.2859***	-0.2225***
	(-4.70)	(-3.69)	(-4.31)	(-3.53)
F Test	0.02	6.96	18.66	20.11
(*P*-value)	(0.8957)	(0.0000)	(0.0000)	(0.0000)
R^2	45.52	45.62	45.99	46.35

This table reports the regression estimates for equations [10] to [13] including firm, time and industry dummy variables, during the period 1999-2014. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC^2 is the square value of NTC. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. AR^2 is the square value of AR. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. INV^2 is the square value of INV. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. AP^2 is the square value of AP. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through $[(Sales_t - Sales_{t-1})/Sales_{t-1}]$. C is the intercept term. Robust t Statistics are in parentheses. F test is estimated as described before. P-value of F test is in parentheses. Coefficients of the dummies are not reported. R square is expressed in percentage.

Appendix F

Table F. 1 – Results from regression analysis testing for a non-linear relationship using IV methodology and considering firm, time and industry dummy variables

	[10]	[11]	[12]	[13]
Observations	7,288	7,288	7,288	7,288
NTC	0.0002***			
	(2.54)			
NTC^2	-8.39E-07***			
	(-3.85)			
AR		-0.0007***		
		(-5.59)		
AR^2		6.03E-07***		
		(1.83)		
INV			-0.0007***	
			(-4.34)	
INV^2			5.35E-06***	
			(4.44)	
AP				-0.0162***
				(-4.16)
AP^2				1.06E-06
				(0.36)
SIZE	0.0221***	0.0216***	0.0216***	0.0209***
	(19.53)	(19.75)	(18.79)	(16.13)
LEV	-0.1214***	-01455***	-0.1232***	-0.1083***
	(-8.63)	(-10.06)	(-8.57)	(-8.13)
GROWTH	-0.0469**	-0.0373**	-0.0371**	-0.0211
	(-3.64)	(-2.99)	(-2.79)	(-1.72)
C	-0.2174***	-0.0.1522***	-02182***	-0.1461***
	(-12.90)	(-10.00)	(-14.05)	(-10.67)
Durbin Test	48.3968	46.0995	22.3804	0.8602
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.6504)
Wu-Hausman	22.1842	21.1245	10.2220	0.3917
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.6759)
R^2	42.64	44.05	45.62	46.91

This table reports the regression estimates for equations [10], [11], [12] and [13] using IV methodology, during the period 1999-2014. Firm, time and industry dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)].)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC^2 is the square value of NTC. Number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. AR^2 is the square value of AR. Number of days-sales of inventories: INV=[(Inventories/Sales)*365]. INV^2 is the square value of INV. Number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. AP^2 is the square value of AP. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. The Durbin-Wu-Hausman test is as described before. P-value of Durbin and Wu-Hausman test is in parentheses. R square is expressed in percentage.

Appendix G

Table G. 1 – Results from regression analysis testing for the effects of the financial constraints on the relationship between ROA and NTC

	Dividends	**Cash Flow**	**Size**	**Cost External Financing**	**Interest Coverage**
Observations	7,924	7,924	7,924	7,924	7,924
NTC	1.99E-04**	1.16E-03***	8.15E-04***	6.70E-04***	7.82E-04***
	(2.43)	(8.60)	(5.94)	(5.47)	(5.73)
NTC*DFC	3.23E-04***	1.48E-03***	8.99E-04***	9.46E-04***	8.69E-04***
	(3.49)	(20.46)	(10.82)	(13.21)	(10.36)
NTC^2	-3.23E-07*	-1.99E-06***	-1.07E-06***	-1.17E-06***	-1.01E-06***
	(-1.35)	(-7.13)	(-3.62)	(-4.91)	(-3.44)
NTC^2*DFC	-2.52E-07***	-2.49E-06***	-1.05E-06***	-1.49E-06***	-9.91E-07***
	(-1.11)	(-10.32)	(-4.32)	(-6.69)	(-4.08)
SIZE	0.0323***	0.0242***	0.0297***	0.0278***	0.0298***
	(10.69)	(4.52)	(5.33)	(4.91)	(5.33)
LEV	-0.2059***	-0.1818***	-0.1779***	-0.2151***	-0.1783***
	(-15.50)	(-6.21)	(-5.81)	(-6.97)	(-5.81)
GROWTH	-0.0543***	-0.0035	-0.0285	-0.0338	-0.0290
	(-2.97)	(-0.10)	(-0.82)	(-0.96)	(-0.84)
C	-0.2917***	-0.2465***	-0.2736***	-0.2548***	-0.2722***
	(-7.98)	(-3.95)	(-4.20)	(-3.86)	(-4.16)
F_1	11.67	418.42	117.03	174.50	107.39
(*P*-value)	(0.0005)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
F_2	6.79	106.53	18.65	44.72	16.61
(*P*-value)	(0.0711)	(0.0000)	(0.0000)	(0.0000)	(0.0001)
R^2	20.44	36.35	24.72	27.91	24.52

This table reports the regression estimates for equations [14] using FE methodology, during the period 1999-2014. Time dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. DFC is a dummy variable that equals 1 for firms more likely to be financially constrained and 0 otherwise. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC*DFC represents the interaction between the DFC dummy variable and the NTC variable. NTC^2 is the square value of NTC. NTC^2*DFC represents the interaction between the DFC dummy variable and the NTC^2 variable. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [$(Sales_t - Sales_{t-1})/Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. F_1 is a F-test to analyse the statistical significance of the coefficients, under the null hypothesis that the coefficient estimate of the variable NTC*DFC is zero. P-value of F_1 test is in parentheses. F_2 is a F-test to analyse the statistical significance of the coefficients, under the null hypothesis that the coefficient estimate of the variable NTC^2 *DFC is zero. P-value of F_2 test is in parentheses. The null hypothesis for both tests must be rejected at the 5 percent level. R square is expressed in percentage.

Appendix H

Table H. 1 – Results from the effects of the financial constraints on the relationship between ROA and NTC considering firm, time and industry dummy variables

	Dividends	**Cash Flow**	**Size**	**Cost External Financing**	**Interest Coverage**
Observations	7,924	7,924	7,924	7,924	7,924
NTC	2.00E-04*	1.15E-03***	8.15E-04***	6.70E-04***	7.82E-04***
	(1.85)	(10.56)	(7.20)	(6.57)	(6.92)
NTC*DFC	2.23E-04***	1.48E-03***	9.00E-04***	9.46E-04***	8.69E-04***
	(3.87)	(25.87)	(13.69)	(16.69)	(13.02)
NTC^2	-3.23E-07**	-1.99E-06***	-1.07E-06***	-1.17E-06***	-1.01E-06***
	(-0.95)	(-8.18)	(-4.05)	(-5.57)	(-3.83)
NTC^2*DFC	-2.52E-07***	-2.49E-06***	-1.05E-06***	-1.49E-06***	-9.91E-07***
	(-0.82)	(-11.49)	(-4.53)	(-7.90)	(-4.25)
SIZE	0.0323***	0.0242***	0.0297***	0.0278***	0.0298***
	(7.01)	(5.47)	(6.52)	(6.13)	(6.54)
LEV	-0.2060***	-0.1818***	-0.1779***	-0.2151***	-0.1783***
	(-8.88)	(-8.21)	(-7.70)	(-9.42)	(-7.70)
GROWTH	-0.0544**	-0.0035	-0.0285	-0.0338	-0.0290
	(-2.07)	(-0.14)	(-1.09)	(-1.30)	(-1.11)
C	-0.3697***	-0.2637***	-0.3364***	-0.3094***	-0.3390***
	(-5.12)	(-3.82)	(-4.72)	(-4.37)	(-4.75)
F_1	7.57	338.37	93.86	147.78	84.85
(*P*-value)	(0.0005)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
F_2	3.43	67.83	10.90	34.41	9.63
(*P*-value)	(0.0641)	(0.0000)	(0.0000)	(0.0000)	(0.0001)
R^2	45.68	51.87	47.62	48.12	47.47

This table reports the regression estimates for equations [14] including firm, time and industry dummy variables, during the period 1999-2014. Time dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. DFC is a dummy variable that equals 1 for firms more likely to be financially constrained and 0 otherwise. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC*DFC represents the interaction between the DFC dummy variable and the NTC variable. NTC^2 is the square value of NTC. NTC^2*DFC represents the interaction between the DFC dummy variable and the NTC^2 variable. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through $[(Sales_t - Sales_{t-1})/Sales_{t-1}]$. C is the intercept term. Robust t Statistics are in parentheses. F_1 is a F-test to analyse the statistical significance of the coefficients, under the null hypothesis that the coefficient estimate of the variable NTC*DFC is zero. P-value of F_1 test is in parentheses. F_2 is a F-test to analyse the statistical significance of the coefficients, under the null hypothesis that the coefficient estimate of the variable NTC^2 *DFC is zero. P-value of F_2 test is in parentheses. The null hypothesis for both tests must be rejected at the 5 percent level. R square is expressed in percentage.

Appendix I

Table I. 1 – Results from regression analysis testing for the effects of the financial constraints on the relationship between ROA and NTC using IV methodology and considering firm, time and industry dummy variables

	Dividends	Cash Flow	Size	Cost External Financing	Interest Coverage
Observations	7,286	7,286	7,286	7,286	7,286
NTC	9.16E-04***	9.95E-04***	1.50E-03***	9.84E-04***	1.15E-03***
	(4.37)	(7.61)	(6.76)	(6.23)	(6.76)
NTC*DFC	6.27E-04***	1.49E-03**	1.07E-03***	1.10E-03**	1.10E-03***
	(4.51)	(17.51)	(7.69)	(12.19)	(7.58)
NTC^2	-2.00E-06***	-1.13E-06***	-2.28E-06***	-1.35E-06 ***	-2.43E-06***
	(-2.42)	(-2.72)	(-3.35)	(-3.06)	(-3.49)
NTC^2*DFC	-1.52E-06**	-1.88E-06**	-1.80E-06***	-1.62E-06***	-1.94E-06***
	(-1.90)	(-4.73)	(-2.75)	(-3.84)	(-2.89)
SIZE	0.2048***	0.0169***	0.2154***	0.0172***	0.0216***
	(21.69)	(19.81)	(24.91)	(18.97)	(25.04)
LEV	-0.1082***	-0.1058***	-0.0693***	-0.1243***	-0.0659***
	(-10.41)	(-11.07)	(-6.42)	(-12.53)	(-6.01)
GROWTH	-0.0497***	-0.2038	-0.0374***	-0.0392**	-0.0389***
	(-4.16)	(-1.84)	(-3.19)	(-3.41)	(-3.32)
C	-0.2094***	-0.4344***	-0.2338***	-0.1708***	-0.2348***
	(-14.33)	(-5.59)	(-16.25)	(-12.09)	(-16.30)
Durbin Test	49.8871	50.7504	48.3525	60.8435	48.6847
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Wu-Hausman	22.8646	23.2600	22.1600	27.9300	22.3100
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	41.44	41.26	33.79	39.07	33.41

This table reports the regression estimates for equations [14] using IV methodology, during the period 1999-2014. Firm, time and industry dummies are included in the estimation but not reported. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The variables used in this analysis are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. DFC is a dummy variable that equals 1 for firms more likely to be financially constrained and 0 otherwise. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC*DFC represents the interaction between the DFC dummy variable and the NTC variable. NTC^2 is the square value of NTC. NTC^2*DFC represents the interaction between the DFC dummy variable and the NTC^2 variable. SIZE is measured by the logarithm of sales. Leverage: LEV=(Total Debt/Total Assets). GROWTH is calculated through [$(Sales_t - Sales_{t-1})/Sales_{t-1}$]. C is the intercept term. Robust t Statistics are in parentheses. The Durbin-Wu-Hausman test are as described before. P-value of Durbin and Wu-Hausman test is in parentheses. R square is expressed in percentage.